

EVA London 2024

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Electronic Visualisation and the Arts
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Proceedings of EVA London 2024

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8–12 July 2024

Editors:
Jonathan P. Bowen
Jon Weinel
Ann Borda
Graham Diprose

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The Computer Arts Society
A British Computer Society Specialist Group

Preface

The *Electronic Visualisation and the Arts* London 2024 Conference (EVA London 2024) is co-sponsored by the Computer Arts Society (CAS) and BCS, the Chartered Institute for IT, of which the CAS is a Specialist Group.

As for 2023, the EVA London 2024 Conference is a physical and online “hybrid” conference. We continue with publishing the proceedings, both online, with open access via ScienceOpen, and in traditional printed form, with full colour. The main conference presentations run during 8–12 July 2024, with parallel Research Workshop sessions and other workshops on 11–12 July 2024.

Over recent decades, the EVA London Conference on *Electronic Visualisation and the Arts* has established itself as one of the United Kingdom’s most innovative and interdisciplinary conferences. It brings together a wide range of research domains to celebrate a diverse set of interests, with a specialised focus on visualisation.

The long and short papers in this volume cover varied topics concerning the arts, visualisations, and IT, including 3D graphics, animation, artificial intelligence, creativity, culture, design, digital art, ethics, heritage, literature, museums, music, philosophy, politics, publishing, social media, and virtual reality, as well as other related interdisciplinary areas.

The EVA London 2024 proceedings presents a wide spectrum of papers, demonstrations, Research Workshop contributions, other workshops, and for the ninth year, the EVA London Symposium, in the form of an opening morning session, with three invited contributors. The conference includes a selection of other associated evening events including a CAS Evening Joint Book Launch, an EVA International China Social Night, a Lumen Prize Event, and a Student and Emerging Artist Pop Up Show.

As in previous years, there are Research Workshop contributions in this volume,

aimed at encouraging participation by postgraduate students and early-career artists, accepted either through the peer-review process or directly by the Research Workshop chair, Graham Diprose. Selected Research Workshop contributors are offered concessions to aid participation. EVA London liaises particularly with Art in Flux, a London-based group of digital artists.

The EVA London 2024 proceedings includes long “full” papers and short “poster” papers from international researchers inside and outside academia, from graduate artists, PhD students, industry professionals, established scholars, and senior researchers, who value EVA London for its interdisciplinary community. The conference also features keynote talks.

This publication has resulted from a selective peer review process, with at least four reviews per proposal, fitting as many excellent submissions as possible into the proceedings. This year, submission numbers were higher than last year, with a continued requirement to submit drafts of long papers for review as well as abstracts. It remains pleasing to have so many good proposals from which to select the papers that have been included.

EVA London is part of a larger network of EVA international conferences. EVA events have been held in Athens, Beijing, Berlin, Brussels, California, Cambridge (both UK and USA), Canberra, Copenhagen, Dallas, Delhi, Edinburgh, Florence, Gifu (Japan), Glasgow, Harvard, Jerusalem, Kiev, Laval, London, Madrid, Montreal, Moscow, New York, Paris, Prague, St Petersburg, Thessaloniki, and Warsaw. Further venues for EVA conferences are very much encouraged by the EVA community.

As noted earlier, this volume is a record of accepted submissions to EVA London 2024. Associated online presentations are in general recorded and made available online after the conference.

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Encomium Tribute to George Mallen

Nick Lambert
Former Chair, Computer Arts Society

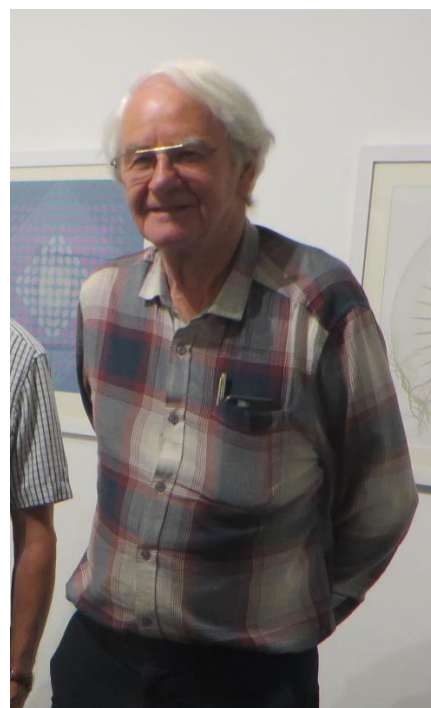
This year, EVA recognises the many contributions of Dr George Mallen to the development and preservation of British computer art, in addition to his achievements in cybernetics and computing. George played a key role in founding the Computer Arts Society (CAS) in 1968, alongside John Lansdown and Alan Sutcliffe, and this was but one aspect of his lifetime's engagement with research and development.

He first worked on early computer simulations of air traffic control at the Royal Aircraft Establishment after graduation and then became a director of System Research in Twickenham, working closely with the cybernetics pioneer Gordon Pask. This engagement with cybernetic principles led him to set up System Simulation Ltd in 1969. A year later, George and a team of contributors from CAS created ECOGAME, a simulation of ecological consequences stemming from the player's economic decisions. It was groundbreaking and first exhibited at Computer Graphics 70 before moving to the first European Management Forum at Davos. George maintained his activities with CAS and the British Computer Society for many years.

System Simulation also pioneered the use of computer graphics, including the landing sequence for Ridley Scott's first *Alien* film in 1979; the company then moved into making large databases including museum and heritage applications. Meanwhile, George held key academic roles at the Royal College of Art and at Bournemouth University, where he set up the Department of Communication and Media, which became a national centre for computer graphics.

George was also instrumental in preserving the archives of CAS at the Covent Garden office of System Simulation, where they became the nucleus of the CACHE Project at Birkbeck, University of London from 2002–2006. These archives became a key part of the Victoria and Albert Museum's national collection of computer art and led directly to the refounding of CAS in 2005 and its collaboration with EVA starting in 2009. One of my proudest moments as Chair of the Computer Arts Society was to make George our Emeritus President in 2019, thus bringing the wheel full circle. Since then, George and his wife Sarah – herself a strong supporter of CAS throughout its lifetime – have collaborated with Catherine Mason on a book published in the Springer Series on Cultural Computing this year, *Creative Simulations: George Mallen and the Early Computer Arts Society*, and launched at the EVA London 2024 Conference.

I very much look forward to reading the book and raising a toast to George!



*George Mallen at Event Two,
Royal College of Art, 16 July 2019.
Photograph by J. P. Bowen.*

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Computation, AI, and Creativity

Jonathan P. Bowen
London South Bank University
School of Engineering
London, UK
<http://www.jpbowen.com>
jonathan.bowen@lsbu.ac.uk

Tula Giannini
Pratt Institute
School of Information
New York, USA
<http://sites.google.com/view/tgiannini>
giannini@pratt.edu

Ann Borda
The Alan Turing Institute
London, UK
<https://www.turing.ac.uk/people/researchers/ann-borda>
a.borda@ucl.ac.uk

Catherine Mason
Independent
London, UK
<http://www.catherinemason.co.uk>
cath@catherinemason.co.uk

This Symposium explores themes of the creative digital arts and artificial intelligence (AI) concerning developments in computational culture. The three speakers are all contributors to two new books in the *Springer Series on Cultural Computing*. The paper provides some background to the increasing use of AI in the context of digital and computational culture, specifically in the arts. Then each participant provides a statement from their viewpoint and experience. These cover diverse issues based on the varied backgrounds and expertise of the contributors.

Artificial Intelligence. Computational culture. Creativity. Digital art. The arts. Visual arts.

1. INTRODUCTION

This paper records talks for a Symposium of invited speakers at the EVA London 2024 Conference. It continues a series from the previous seven EVA London Symposiums held since 2016 (Bowen & Giannini et al. 2016–2021; 2023; Giannini et al. 2022), which have been supported by the EVA London Conference (Bowen 2020).

The Symposium series initially started in association with the Pratt Institute London Summer School, with an emphasis on digital culture and “digitalism” or “digitality” (Bowen & Giannini 2014; 2021; Giannini & Bowen 2019a; 2019b). A collaboration with the Royal College of Art developed, providing an artistic and philosophical angle to the Symposium. Aspects of digital culture (Giannini & Bowen 2018; 2019a) and continued in the 2022 Symposium, which considered identity concerning human and artificial intelligence (AI) in the sphere of digital art, and especially the advent of the “Metaverse” (Giannini & Bowen 2022b; Giannini et al. 2022). The speakers for this 2024 Symposium come from varied backgrounds, but with a collective interest in developments in computational culture, bringing their ideas to the overall theme from different

perspectives. Two are chapter authors for a newly published book on the arts and computational culture (Giannini & Bowen 2024), a follow-on to a previous book on museums and digital culture (Giannini & Bowen 2018; 2019). The third speaker is the author of a book in the same Series of Cultural Computing, celebrating the life work of George Mallen, one of the three co-founders of the Computer Arts Society in 1968 (Mason 2024).

2. COMPUTATION, AI, AND CREATIVITY

The idea of computation was formalized by Alan Turing in 1936 (Copeland et al. 2017). Turing and Claude Shannon also had very early ideas on with is now known as artificial intelligence in the 1940s (Giannini & Bowen 2017). More recently, both have led to increasing support of creativity (Du Sautoy 2019).

Recent developments in Artificial Intelligence (AI) have enabled generative art to be produced automatically and interactively. A leading piece of software enabling this is Open AI’s DALL.E 2 (<https://openai.com/dall-e-2>). An example of an image generated by DALL.E 2 using the prompt of this paper’s title is shown in Figure 1. It should be

noted that this software is still not very inspired or good at spelling!



Figure 1: DALL.E 2 prompt: "Computation, AI, and creativity" (<https://labs.openai.com>).

We asked OpenAI's highly successful ChatGPT (OpenAI 2024) online AI chatbot (Chat Generative Pre-trained Transformer, <https://chat.openai.com>): "What are computation, AI, and creativity?" According to ChatGPT, the answer is:

Computation, AI, and creativity are interconnected concepts that play significant roles in various fields, including technology, arts, and sciences:

1. **Computation:** Computation refers to the process of performing calculations or operations using a computing device, typically a computer. It involves manipulating data according to predefined algorithms or instructions. Computation can range from simple arithmetic operations to complex simulations and data analysis. It forms the foundation of modern computing and enables the development of software, algorithms, and systems to solve a wide range of problems.
2. **Artificial Intelligence (AI):** AI is a branch of computer science that focuses on creating systems capable of performing tasks that would typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, language understanding, and decision-making. AI techniques include machine learning, neural networks, natural language processing, computer vision, and expert systems. AI technologies are used in various applications such as virtual assistants, autonomous vehicles, recommendation

systems, medical diagnosis, and many others.

3. **Creativity:** Creativity is the ability to generate novel ideas, concepts, or solutions that are valuable or meaningful in some context. It involves thinking divergently, making connections between seemingly unrelated concepts, and producing original or innovative outcomes. Creativity is not limited to artistic endeavors but is also crucial in fields such as science, engineering, business, and everyday problem-solving. AI has increasingly been applied to support and enhance human creativity, such as generating art, music, literature, design, and even scientific discoveries.

In summary, computation provides the infrastructure for AI systems to operate, and AI techniques leverage computation to emulate human intelligence. Creativity, on the other hand, involves the generation of novel and valuable ideas, which can be supported and enhanced by AI technologies and computational tools. Together, these concepts contribute to the advancement of technology, innovation, and problem-solving across various domains.

We also asked ChatGPT to write a poem about the title of the book "*The Arts and Computational Culture: Real and Virtual Worlds*" (Giannini & Bowen 2024) and it provided the following:

In realms where art and code entwine,
Where pixels dance and colors shine,
A canvas vast, both real and virtual,
Where dreams take flight, so ethereal.

In computational culture's embrace,
The artist's hand finds a new space,
Where algorithms hum with creative fire,
And innovation's spark climbs higher.

In the tapestry of virtual worlds,
Imagination's flag unfurls,
From pixels formed, a symphony,
Where souls connect, in harmony.

Yet still, the touch of brush on paint,
In the real world, does not faint,
For art transcends the digital sphere,
In every stroke, its truth is clear.

So let us navigate this duality,
In the arts and computational reality,
For in both realms, our spirits unfurl,
In the dance of the real and virtual world.

We leave it to the reader to decide just how "creative" the AI-based ChatGPT is in practice. It does at least have some "understanding" of rhyming couplets.



Figure 2: Deep Dream Generator prompt:
“Computation, AI, and creativity”
(<https://deepdreamgenerator.com/generate>).

As well as the widely known DALL.E AI image generator, as mentioned earlier, there is quite a variety of arguably more artistic AI generative art websites and apps available, often free with limited facilities and providing more functionality with payment. One example is Deep Dream Generator (<https://deepdreamgenerator.com>). This certainly produces more artistic results than DALL.E 2, as shown in Figure 2, using the same prompt as for DALL.E 2 in Figure 1.

We are now in a post-COVID and arguably post-digital world (Giannini & Bowen 2021; 2022a; 2022c; 2022d). Each presenter interprets the symposium theme of the computational creatively based on their experience and contributions to the *Springer Series on Cultural Computing* (Giannini & Bowen 2019; 2024; Borda 2024; Mason 2024). As well as looking at the past and present, the presenters also consider possible future developments.

3. SPEAKER STATEMENTS

Tula Giannini

Pratt Institute, New York, USA

The Intersection of Arts and Computational Culture: Tangible and digital realms

A significant shift and defining moment in the 21st century are underway, driven by the intersection of computational culture, artificial intelligence, and machine learning. This convergence is catalysing a revolutionary period for arts and culture, poised to have a profound impact on human life and global society. The emergence of the Metaverse, featuring extended reality (XR) and immersive virtual worlds, holds great promise. With these advancements, reality and virtuality are converging for the first time. A new book (see Figure 3) aims to be among the

pioneering works delving into the context, complexity, and implications of this multifaceted phenomenon in detail (Giannini & Bowen 2024). It seeks to engage readers intimately while offering a broad perspective. As digital culture progresses towards computational culture, we are entering a digital era transitioning from 2D to 3D realms. Traditional flat screens of the Internet and smartphones are evolving into immersive digital environments. Concurrently, new technologies and AI are increasingly becoming integrated into various aspects of daily life, as well as the realms of arts and education.

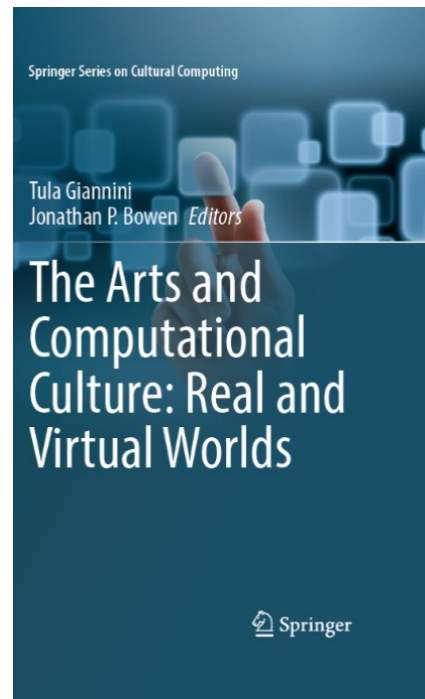


Figure 3: Cover of the book (Giannini & Bowen 2024).

Biography

Tula Giannini is a Professor in the School of Information at the Pratt Institute, New York, USA. She was formerly Dean of the School during 2014–2017. At Pratt, she has initiated and managed several successful collaborative digitization projects with leading New York City museums, libraries, and related cultural institutions, supported by the IMLS (Institute of Museum and Library Services) and other funding agencies. She has also established a Master of Science (MS) in *Museums and Digital Culture*. She has co-organized the EVA London Symposium, associated with the annual EVA London Conference on *Electronic Visualisation and the Arts* since 2016. She co-edited the 2019 book *Museums and Digital Culture* and the 2024 book *The Arts and Computational Culture*, both in the Springer Series on Cultural Computing. Professor Giannini has an interest in musicology and has contributed entries in *The Grove Dictionary of Musical Instruments*, published by Oxford University Press.

Ann Borda

The Alan Turing Institute, London, UK

Serious Games Embracing Activism and AI: A transformative shift

This talk delves into the evolutionary journey and practical applications of immersive serious games within cultural and educational domains spanning several decades (Boiano et al. 2018; 2022; Borda & Molnar 2024; Gaia et al. 2019). Utilizing technologies like virtual and augmented reality, as well as computational and machine learning innovations such as generative media, these serious games are revolutionizing interactive learning and narrative experiences. They not only raise awareness about pressing social and environmental justice issues but also amplify narratives from marginalized communities (Borda et al. 2023), mirroring similar initiatives in cultural and artistic spheres. Consequently, immersive serious games offer avenues to explore diverse perspectives across both physical and virtual landscapes – from remote wilderness settings to envisioned Metaverse realms and generative AI environments. While challenges persist in ensuring broad accessibility to these immersive experiences, they possess a unique capability to foster communication, self-reflection, and even activism, regarding local and global concerns (Borda 2023).



Figure 4: Deep Dream Generator
using the title of this talk as a prompt
(<https://deepdreamgenerator.com/generate>).

Biography

Ann Borda, PhD, is based at the Alan Turing Institute in London, with an interest in AI and ethics, at University College London, and as an Associate Professor at the School of Population and Global Health, University of Melbourne, Australia. She has a doctorate in informatics from University College London. She is an Honorary Senior Research Associate at UCL and a Fellow of the Australasian Institute of Digital Health, and the Royal Society of Arts (FRSA). Her research interests include citizen science (Borda & Bowen 2020), smart cities, living

lab methodologies, digital health futures, and participatory design (Boiano et al. 2019). In Australia, Ann has held positions as CEO of the Victorian Partnership for Advanced Computing, and Executive Director of the state-government-funded VerSI consortium. Before this, Ann was based in the UK at King's College London with the JISC government-funded program for eScience. Concurrently, she was a Visiting Research Fellow at the Institute for Computing Research, London South Bank University. Following her PhD, Ann was Head of Multimedia Collections at the Science Museum in London (Bowen et al. 2023; Gaia et al. 2020).

Catherine Mason

Independent, UK

A Quest for Creative Collaboration: George Mallen and members of the early Computer Arts Society

The Computer Arts Society (CAS) was envisaged in late 1968 after discussions between Alan Sutcliffe, George Mallen (see Figure 5), John Lansdown, and Jasia Reichardt following the exhibition *Cybernetic Serendipity*. A few months later, CAS's first official event - Event One at the Royal College of Art (March 1969), defined the future direction of the Society. Namely, a desire to promote creative computing in all art forms, based on an understanding of cybernetics that allowed a previously unknown degree of collaborative meaning-making for art. An analysis of the early activity of CAS demonstrates, through interactive (and occasionally didactic) applications, that computer arts could consist of more than graphics and have a greatly amplified role, one that was integrated with societal concerns.



Figure 5: George Mallen at Gordon Pask's company
Systems Research, circa 1964–5.

Today, with AI affecting nearly every aspect of human life – one largely mediated through screens, it is timely to focus on Mallen, a pioneer of creative computer systems since 1962, the last surviving founder of CAS and founder of System Simulation Ltd, one of the longest established software companies in the UK (Mason 2024). The groundbreaking *Ecogame* project of 1970 led by him involved many CAS members. A very early example of multi-media digital technology in interactive art, *Ecogame* was a simulation model of an economic system (see Figure 6), dealt with opportune issues of ecology and environment, and was the first multi-player, digitally driven, interactive gaming system in the UK. CAS members believed in a positive ‘human-machine interrelationship’ made visible through art – their cross-disciplinary and collaborative art projects heralded the future, a future visible today in many aspects of technologically mediated art.

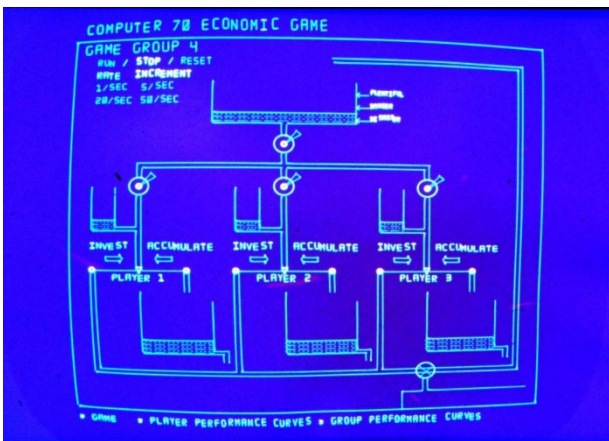


Figure 6: *Ecogame* Simulation Simulator vector display unit, 1970, photograph of the screen.

Biography

Catherine Mason is an independent art historian and writer. Over a thirty-five-year career, she has worked in both commercial galleries and public-sector arts organisations, spent ten years teaching adult education in the 1990s, and from 2002 has been focused on recovering the lost history of computer and digital art. Recent work has involved documenting George Mallen’s contribution to the field of creative computing – just published is *Creative Simulations: George Mallen and the Early Computer Arts Society* (Mason 2024). Other books include the solo-authored *A Computer in the Art Room: The Origins of British Computer Arts 1950-80* (Mason 2008) and the co-edited *White Heat Cold Logic: British Computer Art 1960–1980* (Brown et al. 2009). She is on the Board of the Computer Arts Society.

4. CONCLUSION

We live in a world where computational culture is increasingly at the heart of human communication and creativity, and in the hands and minds of literally billions of people across the world. As the advances in AI come to life in the online domain, while our bodies are embedded with digital devices that augment our human powers, how will artists respond to this new world where digital imagination rules?

Beyond Human by Tula Giannini

My proclivity
For creativity
What about AI sensibility
I’m a woman
More than human
My life in cyberspace
Leaves no trace
of the real life
I left behind
Reminds me
of past times
finds I’m a new woman
Beyond human
a digital image
of the life I knew
Morphing into virtual reality
A fatality
of digital identity
Unplug the computer
Life’s more than digital
Remember the original
Love reaches
beyond human identity
Human hands touch
Love you so much



Figure 7: *Beyond Human*. Image, DALL.E 2 prompt: “a woman beyond human in cyberspace”.

This paper records an overview of the speakers’ statements concerning creativity, especially in the context of computational culture and especially AI. The panellists take a historical viewpoint by way of background, building on this to consider the present and possible developments for the future. The issues have been developed by the EVA London 2024 Symposium contributors from varied viewpoints. The paper acts as a starting point for the presentations during the Symposium, aimed at promoting further discussion.

Online information concerning the EVA London 2024 Symposium is available under:

<http://www.eva-london.org/eva-london-2024/symposium>

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The EVA London Conference Archive

Sean Clark
Interact Digital Arts Ltd
Leicester, UK
seanc@interactdigitalarts.uk

1. INTRODUCTION

The EVA series of conferences began in London in 1990 under the title “Electronic Imaging and the Visual Arts”. Established by James Hemsley, interest in EVA spread across Europe, and beyond, resulting in a large network of EVA groups and conferences.

In its earlier years, the UK EVA conferences took place in various locations, mostly in London but also in Cambridge (1998), Edinburgh (2000) and Glasgow (2001). In 2008 EVA London (now styled as “Electronic Visualisation and the Arts”) became an official conference of the Computer Arts Society (CAS) and has since been hosted by the BCS (British Computer Society) at their London offices, first in Camden and now in Moorgate.

2. THE EVA LONDON ARCHIVE

Since 1990, EVA founder James Hemsley has built up a large collection of EVA-related materials. In 2021, these were transferred to the Computer Arts Archive CIC in Leicester (<http://www.computer-arts-archive.com>) to become the basis of an official EVA London Archive (Figure 1). Materials in the collection included an almost complete set of printed UK/London conference proceedings (1993 and 1999 are currently missing), proceedings from other EVA conferences (most notably EVA Florence), project documents and assorted books, papers, proposals and ephemera.

In addition to this, the Computer Arts Archive already had access to digital copies of all the EVA London conference proceedings from 2008 to the present day, following the move to the BCS and the eWiC catalogue (ScienceOpen, 2024) and video recordings of EVA London conferences since 2020 on the Computer Arts Society YouTube Channel (<https://youtube.com/ComputerArtsSociety>).

Finally, assorted floppy disks containing EVA London conference proceedings from before 2008 had already been transferred to the Computer Arts Archive, although these had not been catalogued.

These materials, together with the contents of the EVA London Conference website (<http://www.eva-london.org>), form the current EVA London Archive.



Figure 1: Jim Hemsley's EVA materials following their arrival at the Computer Arts Archive in Leicester.

3. A SEARCHABLE EVA LONDON DATABASE

The James Hemsley materials, plus the digital resources, have resulted in a collection of many hundreds of EVA-related items. The first cataloguing task being undertaken is the creation of a

searchable database of EVA London conference papers.

At the time of writing, each paper in the 2008 to 2023 EVA London conferences has been indexed in terms of title, author(s), year, session and full paper link. For the 2000 to 2023 conferences, links to videos on YouTube are also included (where permission to upload the video was given by the presenter This has resulted in over 500 records with papers and almost 200 video links.). For all of the conferences, an image of the proceedings cover has also been included (Figure 2).



Figure 2: The more recent EVA London proceedings feature unique cover images.

The database was edited in Google Sheets and uses the “Sheety” (<https://sheety.co>) web service to convert it into a web-friendly JSON file. The JSON file is then automatically uploaded to the Computer Arts Society Web site, where JavaScript is used to generate conference web pages and a search facility.

The resulting system is simple to use and provides insights into the changing nature of the papers presented at EVA London since 2008, as well as the names of all of those who have presented over the years. Of particular interest for this group, is the ability to produce a web address containing the author’s name. This allows members of the EVA London community to easily share a link to all their EVA contributions. The usefulness of this facility will be further enhanced as the data is standardised. For example, the author, Jonathan Bowden, sometimes appears as J P Bowden or Jonathan P Bowden.

Adding the EVA London conference proceedings before 2008 remains an ongoing task. While floppy disks containing at least some of these are in the EVA Archive extracting data from them is proving time-consuming. Therefore, a more manual process of scanning the paper proceedings is now underway. Starting with a scan of the proceedings index, the EVA London conference database is

being gradually completed, although including copies of full papers will take some time. Indeed, while later proceedings were produced as published books, early copies were spiral bound, or in the case of EVA London 1990, contained in a lever-arch file (Figure 3).



Figure 3: The proceedings of early EVA London conferences were often provided as a set of simply-bound loose sheets.

4. NEXT STEPS

Once the work to add the early EVA London conference papers to the database has been completed, we intend to move our attention to the other EVA-related items contained within the James Hemsley materials.

We also encourage the organisers of international EVA conferences to take an interest in the project and consider producing a similar archive to EVA London. The software developed will be made available to our international colleagues.

5. EVA LONDON ARCHIVE WEB ADDRESS

The EVA London Archive, with the latest version of the searchable conference proceedings, will be officially launched in July 2024 at the EVA London conference at BCS Moorgate. The initial web address will be:

<https://www.computer-arts-society.com/evaarchive>

Expect to see the papers and videos for EVA London 2024 in the archive by the end of July 2024.

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Turing, Warhol, and Monroe: Development of *The Turing Guide* cover

Jonathan P. Bowen
London South Bank University
School of Engineering
Computer Science and Informatics
London, United Kingdom
<http://www.jpbowen.com>
jonathan.bowen@lsbu.ac.uk

B. Jack Copeland
University of Canterbury
Department of Philosophy
Christchurch, New Zealand
<https://www.canterbury.ac.nz/arts/contact-us/people/jack-copeland.html>
jack.copeland@canterbury.ac.nz

This article explores how the artwork for the cover of a 2017 book on computing pioneer Alan Turing was developed collaboratively and digitally. The cover was inspired by the work of Andy Warhol, a leading 20th-century exponent of American pop art. An initial mock-up of the cover art was made, followed by a digital artwork entitled *Turing Diptych*. Elements of the latter were used by the publisher in creating the book's cover design. A high-quality print of *Turing Diptych* was displayed in the Computer Arts Society Members' Exhibition at the BCS London office in 2023 (the print is now in the Computer Arts Archive). 'Old fashioned' digital methods were used to produce *Turing Diptych*, and the article also investigates using today's AI-powered generative art software to create images of Turing.

Alan Turing. Andy Warhol. Marilyn Monroe. Digital art. Pop art. Generative AI. Book cover design.

1. INTRODUCTION

The mathematician Alan Turing (1912–1954) is widely considered to be the father of computer science (Bowen 2017; 2019; Copeland 2004; 2005; Copeland & Proudfoot 2005; 2012). Copeland and Bowen organised a number of events celebrating the 2012 centenary of Turing's birth, including *Alan Turing's 100th Birthday Party* at King's College, Cambridge, *The Turing Education Day* at Bletchley Park, and *Turing's Worlds* at the University of Oxford. Copeland also gave the Opening Address to the General Public at the University of Manchester's *Turing 100 Celebration*. Cambridge, Bletchley Park, and Manchester were all places where Turing worked; his connections with Oxford were more tenuous, but there are some interesting ties nevertheless (Bowen 2022). Out of the centenary celebrations grew a book on Turing's life and work, published by Oxford University Press (Copeland et al. 2017).

Bowen, Copeland, and collaborator Robin Wilson met at Pembroke College, Oxford, in June 2013 and discussed ideas for the book's cover. Copeland had referred to Turing as 'computing's Marilyn Monroe'—since both are leading icons of the 20th century, both were lovable but misunderstood, and both died at a tragically early age, meaning that each

is forever young in their surviving images. Copeland was interested in creating some Turing imagery in the style of Andy Warhol's famous Marilyn Monroe silkscreens and suggested this as a cover idea. Bowen, also a fan of Warhol and his colourful multiple screenprint images, was enthusiastic. The meeting broke up feeling that this could be the right recipe for a memorable and unusual cover image.

Warhol (Figure 1) created his images of famous people largely during the 1960s and 1970s (Coppstone 1995). Besides Marilyn Monroe, his subjects included Jackie Kennedy, Elizabeth Taylor, and even Mao Zedong, but never Alan Turing, who was unknown to the general public at that time, due to the ultra-secrecy that surrounded his groundbreaking World War II mechanised codebreaking at Bletchley Park. Perhaps if Warhol had been active decades later, when Turing achieved almost rock-star fame, there might have been a genuine Warhol portrait of him. But in the absence of such a glorious thing, Bowen turned to the Pictomizer website (<http://pictomizer.com>), also known as the 'Warholizer'. This allows the creation of Warhol-like images from a source photograph. Bowen created the images shown in Figure 2 using Turing's Royal Society portrait as the source photograph. Bowen, Copeland, and Wilson were soon referring to this artwork as 'the cover mock-up'.

Meanwhile, Copeland returned to New Zealand, keen to create Turing imagery more closely connected with Warhol's famous Marilyn silkscreens.

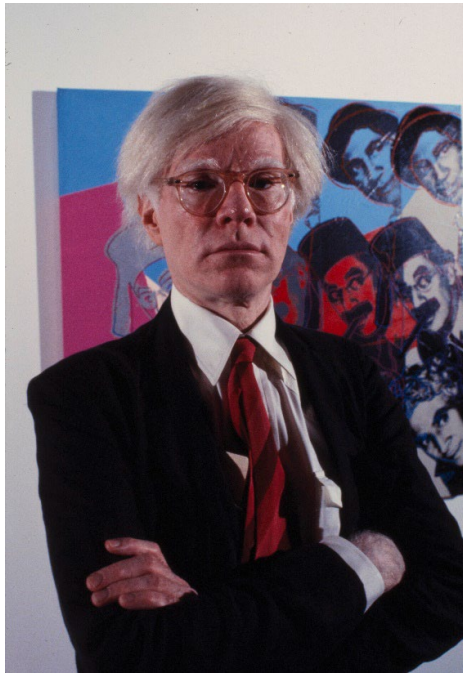


Figure 1: Andy Warhol (1928–1987).
Photograph by Bernard Gotfryd, 1980. Wikimedia Commons,

[https://commons.wikimedia.org/wiki/File:Andy_Warhol_at_the_Jewish_Museum_\(by_Bernard_Gotfryd\)_-LOC.jpg](https://commons.wikimedia.org/wiki/File:Andy_Warhol_at_the_Jewish_Museum_(by_Bernard_Gotfryd)_-LOC.jpg)



Figure 2: Bowen's 2013 'Warholized' Turing.
(Subsequently published in Bowen (2016).)



Figure 3: A detail from Warhol's *Marilyn Diptych*. The full work, which is in the Tate Gallery, London, consists of two equal-sized panels, one bright and one dark, each containing 25 images of Monroe (<https://www.tate.org.uk/art/artworks/warhol-marilyn-diptych-t03093>).

Photograph by Tula Giannini, reproduced by permission.

2. TURING DIPTYCH

One of Warhol's Marilyn silkscreens stood out as reflecting something about Turing's life—his 1962 *Marilyn Diptych*, reproduced in Figure 3. Warhol created the multiple images of Monroe in the Diptych from a single 1953 publicity photograph (Figure 4). The left-hand panel of the diptych is in bright pop colours while the right-hand panel is altogether darker. *Turing Diptych* (Figure 5) follows the same conceptualisation, although uses fewer individual images than there are in Warhol's Diptych. The source photo (Figure 6) shows an engaging, smiling Turing—or perhaps 'smirking' is more accurate—and looking much more relaxed than in his ultra-serious, even grim, Royal Society portrait. *Turing Diptych's* left-hand panel is even brighter than the left panel of *Marilyn Diptych* and echoes the vivid colours of a series of Warhol silkscreens known as the 'shot Marilyns'. (The story goes that a visitor to Warhol's Manhattan studio, The Factory, pulled out a revolver and fired a bullet through a small stack of Marilyn silkscreens (Darwent 2008).) In the right-hand panel of *Turing Diptych*, the darkened and besmirched heads speak of Turing's persecution, trial, and judicially mandated chemical castration.



Figure 4: The source photo used by Warhol in *Marilyn Diptych*. (Photograph by Eugene Kornman, 1953.)



Figure 6: The source photo used in *Turing Diptych*. (Courtesy of King's College Cambridge.)



Figure 5: *Turing Diptych* (Copeland et al. 2016). (Artwork by Jack Copeland, Peter Fitzpatrick, and Vicki Hyde, © 2016.)

Copeland collaborated with two New Zealand graphic artists Peter 'Fitz' Fitzpatrick and Vicki Hyde to produce the final digital image (Figure 5).

3. THE TURING GUIDE COVER

The book cover itself was designed by Rio Ruskin at Oxford University Press, including the appealing multicoloured lettering of the book's title (Figure 7). The cover graphic combines individual heads taken from *Turing Diptych*. (Somewhere along the way, these acquired the name 'Turilyns'.) Like the original cover mock-up, the final cover was not a diptych, and the besmirched heads and bright heads are mixed randomly together. Nevertheless, with its Warholesque colours and repeating images, a strong kinship with *Marilyn Diptych* is preserved.

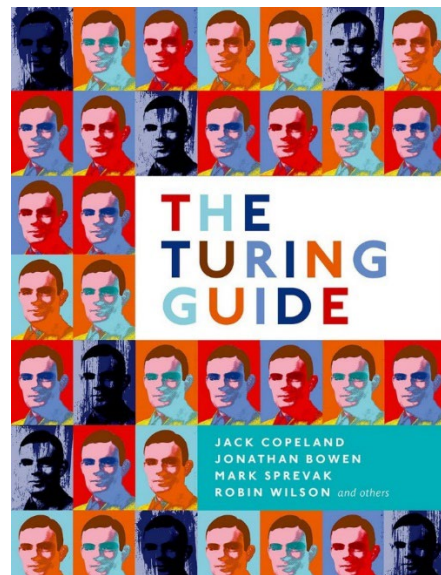


Figure 7: The final front cover of *The Turing Guide* (Copeland et al. 2017). (Artwork by Copeland, Fitzpatrick and Hyde, and Rio Ruskin at Oxford University Press.)

Figure 8 shows *The Turing Guide* with a shelf of competing titles in a bookshop. Readers may decide for themselves whether the aim of making the book stand out was achieved.



Figure 8: *The Turing Guide* and its competition at Blackwell's bookshop in Oxford. (Photograph by J. P. Bowen, 2018.)

4. TURING, AI, AND DIGITAL ART

Artificial Intelligence (AI) is infusing rapidly into the digital art world (Bowen et al. 2017; Giannini & Bowen 2023). Much of the necessary computing grunt is currently provided by Nvidia's AI-friendly graphics chips. Nvidia's New York City office is on Manhattan's 11th Street, a short walk through Greenwich Village from the legendary Bell Labs headquarters located near the Hudson end of 11th Street. In 1943, Turing settled into Bell Labs and spent two months within strolling distance of the gay bars and clubs of the Village (Copeland 2012, ch. 6; Giannini & Bowen 2017). It must have been quite a change from the quiet country villages surrounding Bletchley Park.

At Bell Labs, Turing and Claude Shannon, two of AI's greatest early prophets, discussed many things (Giannini & Bowen 2017), especially computer chess. Then as now, chess was an important testbed for AI. Turing began thinking about algorithmic chess at Bletchley Park around 1941 (Copeland and Prinz 2017). He circulated a typescript on intelligent machinery and machine learning while still at Bletchley Park—undoubtedly the earliest paper in the emerging field (Copeland 2023). In 1950, Turing published his classic article *Computing Machinery and Intelligence* (Turing 1950). This included the specifications of his now famous 'imitation game' or Turing Test.

Commentators often say that according to Turing, humanlike AI would be achieved by the end of the 20th century. What Turing actually said, however, was quite different. In 1952, he predicted on BBC

Radio that it would be 'at least 100 years' before a computer stood any chance of passing the Turing Test (Copeland 2023). Whether the recent advances in machine learning, along with large language models and generative AI, will bring that momentous event about earlier than Turing predicted is hard to judge—one can only keep an open mind.



Figure 9: Images generated by OpenAI's DALL.E 2 in 2022, using the prompt 'Alan Turing'. (Produced by J. P. Bowen.)

In the graphics arena, there is already new and developing AI software available online, such as OpenAI's DALL.E (<https://openai.com/research/dall-e>). DALL.E 2, launched in 2021, produces generative AI artworks using text prompts. The prompt 'Alan Turing' resulted in the four images in Figure 9. It is notable, though, that none of these bears much resemblance at all to Turing. One of them looks much more like Shannon than Turing (at the bottom left) and the two images in the top row seem to resemble Adolph Hitler. It will be some time before human creativity and judgement become redundant in the graphics field.

The current 2024 version of the DALL.E generative AI software is still not much better (Figure 10). Again none of the four images bears any real resemblance to Turing. These images are more colourful, though the colour selections are often bizarre. It is difficult to say whether the increased use of colour reflects new developments in the software or simply the wider availability online of colourised images of Turing. Unrealistically, all the generated images show him smartly dressed in a jacket and tie, a woeful distortion of the real—scruffy—Turing. No doubt this is because the majority of photographs available online show him dressed formally. The software's correct choice of blue eyes in some of the

generated images no doubt derives ultimately from a much-quoted remark by Turing's confidante Lyn Irvine, who described his eyes as being 'blue to the brightness and richness of stained glass' (Irvine 1959).



Figure 10: Images generated by OpenAI's DALL.E 2 in 2024, using the prompt 'Alan Turing'.
(Produced by J. P. Bowen.)



Figure 11: A compound image generated by OpenAI's DALL.E 2 in 2024, using the prompt 'Alan Turing in the style of Andy Warhol'.
(Produced by J. P. Bowen.)

Prompting DALL.E with 'Alan Turing in the style of Andy Warhol' produced images that are certainly colourful (Figure 11). Yet with the oddly-shaped mouth, the receding hairline, and eyes reminiscent of Wiene's classic 1920 horror movie *The Cabinet of*

Dr. Caligari, it would be impossible to guess that these are supposed to represent Turing.

Few photographs of Turing are known to exist and all are monochrome. During Turing's lifetime black-and-white photography was much cheaper than colour, which did not start to edge towards mass adoption until around the time of his death. Generative AI software is able to colourise monochrome images with increasing veracity. The Deep AI *Image Colorizer* (<https://deepai.org/machine-learning-model/colorizer>) generated Figure 12, using machine learning and with additional enhancements to improve the monochrome image shown in Figure 6. But the software failed to reproduce Turing's blue eyes.



Figure 12: A colourised version of Figure 6 generated in 2024 using the Deep AI Image Colorizer.
(Produced by J. P. Bowen.)

The commercially available *Midjourney AI* software (<https://midjournevai.online>) is arguably more successful at producing works with a smidgen of artistic merit, for example, the mock-watercolour portrait shown in Figure 13. This image could perhaps fool a naïve human viewer into thinking that another human had produced it—but, without the caption, could you tell that it is supposed to be Turing? Cutely, the image's permission information in its Wikimedia Commons metadata states:

This file is in the **public domain** because it is the work of a **computer algorithm** or **artificial intelligence** and does not contain sufficient human authorship to support a copyright claim.



Figure 13: 'Alan Turing in watercolour', generated by Midjourney AI in 2023.
(Produced by Netha Hussain.)
Wikimedia Commons,

https://commons.wikimedia.org/wiki/File:Alan_Turing_in_watercolour.png

5. CONCLUSION

Although originally conceived as a purely screen-based digital artwork, *Turing Diptych* was subsequently printed by the photographer Graham Diprose on archival paper using a high-quality printer. This was exhibited as part of the BCS Specialist Group Computer Arts Society (CAS) Members' Exhibition, held in 2023 at the BCS London headquarters (Clark 2023); see Figure 14. This print has been donated to the Computer Arts Archive associated with CAS (<https://www.computer-arts-archive.com>; Bowen & Clark 2023). The digital file *Turing Diptych* is now on long-term loan to the Bletchley Park Trust.



Figure 14: The printed *Turing Diptych* (with co-author Bowen) in the Computer Arts Society Members' Exhibition, held in 2023 at the BCS London headquarters. (Photograph by J. P. Bowen, 2023.)

It can easily be imagined that, were Turing alive today, he would be contributing ideas to generative AI that are no less revolutionary than the ones he contributed to Bletchley Park's extraordinary codebreaking feats. While no generative AI was used in producing *The Turing Guide* cover, this would certainly have added a highly appropriate new dimension to the symbolism, given the breadth and depth of Turing's pioneering contributions to AI during the 1940s and 1950s (Copeland 2023). However, our examples of AI-generated images of Turing incline us to believe that old-fashioned human methods are still the gold standard in image creation—for now. Perhaps, though, Warhol could have prompted even today's generative software into achieving new artistic heights. With his deep interest in the mechanisation of art production, he would surely have been fascinated by modern developments in AI-generated art.

While Turing was at Bell Labs talking to Shannon about machine intelligence, Warhol was in his early teens and still living in his native Pittsburgh. His art first began to achieve recognition in the early 1950s, with an exhibition in New York in 1952, two years before Turing's untimely death. Suppose the two men—the eccentric pioneer of computer science and the eccentric pioneer of pop art—had met, what might they have talked about? The difficulties of being openly gay? Turing's trial? Marilyn Monroe movies? Or perhaps Turing's creation, at Manchester, of the first computer-generated musical notes (Copeland & Long 2017)? Warhol—who in the 1960s was manager and producer of the massively influential experimental rock band *The Velvet Underground* (with a lineup that included Lou Reed and Nico)—would surely have been greatly interested in that. Of course, there never was a meeting, so far as we know. But *Turing Diptych* is a conceptual meeting of three 20th-century icons.

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Ethical AI and Museums: Challenges and new directions

Stefania Boiano
InvisibleStudio Ltd
London, UK
stefania.boiano@invisiblestudio.net

Ann Borda
The Alan Turing Institute and
University College London, UK
a.borda@ucl.ac.uk

Giuliano Gaia
InvisibleStudio Ltd
London, UK
giuliano.gaia@invisiblestudio.net

Guido Di Fraia
IULM University
Milan, Italy
guido.difraia@iulm.it

In this paper, we consider challenges and new directions in the use of Artificial intelligence in museums and particularly the need for supporting ethical frameworks. Such frameworks aid in the equitable and responsible adoption of technology and new forms of participation which can extend the role of museums as social good agents.

Artificial intelligence. Creative AI. Digital heritage. Ethics. Museum collections. Machine learning.

1. INTRODUCTION

Museums and other cultural heritage organisations have the potential to be relevant, socially-engaged and ethical spaces for intercultural dialogue. These organisations have traditionally been resilient places holding experiences accrued by human societies over time and across boundaries and worlds. The emergence of new technologies, namely Artificial intelligence (AI) and machine learning (ML) applications can assist in scaling the participation of communities and heritage stakeholders in supporting intercultural dialogue and inclusion.

Although there is no global definition of AI, computer scientist Alan Turing defined it as the science and engineering of making intelligent machines, especially intelligent computer programs (Turing 1950). Generally, the concept has evolved into a focus on simulating human intelligence by machines – e.g. an ability to build some kind of perception of knowledge that uses statistical methods to carry out tasks commonly associated with human intelligence and that assist or replace human decision-making in those tasks. Machine Learning (ML) is a subfield of AI which identifies patterns in data to include supporting classification, pattern recognition, prediction and the generation of text, sound and images (Leslie et al. 2022).

AI and ML are opening innovative ways to make museums more immersive and interactive. Museums and cultural organisations have been exploring the opportunities of AI, as well as the obstacles to their use and ethical implications (Villaespesa and Murphy 2021). According to a study of US and UK museums by Villaespesa and Murphy (2021), the application of ML to sort, analyse, and describe museum collections is a particular opportunity. These examples are reinforced in principle by regulatory framework advancements, e.g. Ethics Guidelines for Trustworthy AI (UNESCO 2021), and alongside developments in digital cultural heritage towards open knowledge systems and community participatory practices in narrative co-creation and decolonizing approaches.

Notwithstanding, there remain acknowledged gaps in our understanding of emerging and dynamic forms of knowledge production using AI, e.g. ChatGPT and *AI Time Machine*[™], in which AI foundation models are often interculturally or semantically insensitive or misinformed to contexts of lived experience. Such challenges could be addressed in part through the insights gained in applying AI to cultural heritage knowledge systems in support of intercultural dialogue.

This endeavour simultaneously requires the fostering of new ethical frameworks which can more effectively account for the accumulation of such human experience, not least represented in knowledge co-production and in the decoding-encoding of intercultural agency in cultural heritage itself.

2. MUSEUMS AND AI

Museums have been piloting AI and natural language processing (NLP) enabled demonstrators for more than two decades (Abbatista et al. 2003; Boiano et al. 2003, Boiano et al. 2018, Borda and Bowen 2017). Chatbot applications, e.g. those made popular through Facebook Messenger, were quickly piloted by museums, most often as virtual guides (Gaia et al. 2019) when they appeared in 2015. For instance, the chatbot game developed by Invisible Studio for the *House Museums of Milan* project used Facebook Messenger to engage mainly younger visitors and teenagers in exploring four historic homes in Milan. In 2016, the Musée du quai Branly in Paris hosted *Berenson*, the robotic art critic, who interacted with visitors about their favourite and least favourite item in the collection, and through these interactions Berenson gradually built-up aesthetic preferences as it interacted with museum visitors (Styx 2023).

Among other potential applications are decoding unstructured knowledge embedded in cultural artefacts, context-based automated content creation and recommender systems, encoding context-specific cultural and personalised data. However, their actual implementation is currently limited due to the lack of resources and the inaccuracies created by algorithms. The role of crowdsourcing, and forms of online citizen science, have been filling this gap - that is the involvement of the general public in undertaking distributed tasks (such as tagging content, correcting text, etc.) using the Internet and various online computer-mediated communication platforms (Ceccaroni et al. 2023).

There is already an awareness of the potential of crowdsourcing in digital cultural heritage (Ridge et al. 2023) such as transcription efforts in the *Transcribe Bentham* project (Causer et al. 2018). The AI-enabled *MapReader* application was developed by computational historians and curators, to help users to analyse large map collections of scanned and born-digital artefacts using deep learning and computer vision-based methods (Beelen et al. 2021). The industry involvement of Google DeepMind with classics researchers at Oxford University, the University of Venice, and the Athens University of Economics and Business supported the development of the AI application

Ithaca, a deep neural network that can restore the missing text of damaged Greek text inscriptions, identify their original location, and help establish the date they were created (Assael et al. 2022). Harvard Art Museums (n.d.) is another example of a cultural institution piloting search and computer vision algorithms on its *AI Explorer* website. Users can choose an annotation search to find artworks which draws on tags, captions and object, as well as face and text recognition (Villaespesa and Murphy 2021).

An increase in creative AI tools available for museum practitioners will inevitably change the field in what is possible in content creation, curation and exhibition design. Text to image generators, such as DeepAI and DALL-E, are machine learning models that can create realistic and high-quality images from text. By inputting text descriptions of characters or environments, museum developers can rapidly generate visuals to incorporate in online or physical exhibitions or applications such as mobile games. Text to voice applications, such as *Murf.ai*, provide opportunities to create dialogue and lifelike voices for historical characters, for instance.

Generative AI systems can already create interactive narratives based on previously learned storylines and using text generation systems, such as the text-based fantasy simulation game *AI Dungeon* (n.d.). See Figure 1

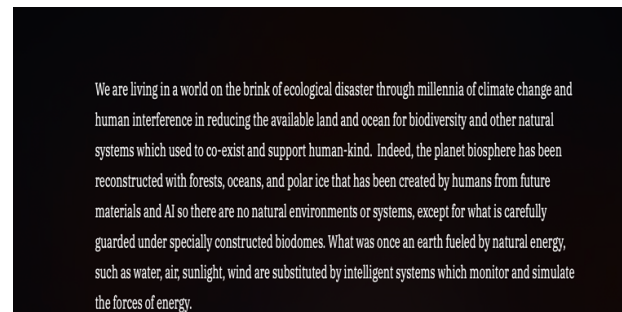


Figure 1. Author (AB) generated scene in *AI Dungeon* (<https://aidungeon.com>) using text prompts. Feb 2024.

In a cultural heritage setting example, *Cultural Icons* is a web-based game experiment created by artist Gael Hugo, Artist in Residence at Google Arts & Culture Lab, that allows users to explore AI generated imagery, as well as engage in cultural conversations with Google's large language model PaLM2 (ai.google/discover/palm2/) and test their cultural knowledge through game play. Google Arts & Culture has concurrently established experimental sites developed by creative coders for piloting algorithms, such as *X Degrees of Separation*, which allows the user to select a random set of two cultural heritage images and discover their visual connection.

Among the challenges, however, concern the ownership of outputs of Generative AI which are built on others' source content. The latter has raised copyright issues and the difficulties in determining the ownership of the art and code generated by AI models (Murray 2023). In response, the content company Getty Images developed a proprietary AI tool in partnership with technology partner Nvidia to generate images from its immense database of digital media, thus avoiding copyright infringement (Villa 2023).

Similarly, there is the danger that AI will amplify already existing biases as it trains on existing data aggregated from vast and unvetted Internet and social media sources. Amongst the challenges for AI governance is that for algorithmic systems to process information about lived experience, these need to be synthesised into standardised data formats that can be interpreted and processed by machines. This process has given rise to ethical questions concerning the oversimplification of complex social phenomena leading to the erasures of minority identities, for example. AI practitioner and artist, Stephanie Dinkins, in residency at the Guggenheim Museum addresses marginalised groups "who are excessively affected by poor code design" (Segal 2023).

The limitations of Generative AI can be further understood in the example of *AI hallucination* when an AI model generates incorrect information but presents it as a fact. Curators at the Nasher Museum of Art at Duke University (Durham, North Carolina, USA) piloted the use of ChatGPT to curate an exhibition utilizing works of art from the Museum's collection and documented the results, including hallucinations (Merritt 2023). Amid a rapidly evolving landscape in which more AI-enabled systems are tracking with real-time geolocation data and using facial recognition, there is an equally urgent consideration in mitigating harmful risks through regulation and the impacts on vulnerable populations, such as children (Vosloo 2023). The implications for museums in this space is yet to be fully understood, but debates are ongoing as exemplified by the Misalignment Museum in San Francisco, USA (www.misalignmentmuseum.com) with its memorial exhibition to an imagined future in which AI has eradicated most of humanity.

3. ETHICAL FRAMEWORK FOR DIGITAL CULTURAL HERITAGE

To support an investigation of the multiple opportunities of AI use, we need to consider potential ethical issues of AI in museums by grounding perspectives in a theoretical framework. As AI continues to evolve and transform society and the museum sector, it is imperative that ethical

considerations are at the forefront of their construction. This is exemplified by the regulatory landscape and global directives in progressing appropriate ethical guidance such as the UNESCO *Recommendation on the Ethics of Artificial Intelligence* (2021), raising critical questions about the impact of this rapidly advancing technology on individuals and societies. The European Parliament has adopted resolutions addressing AI-related issues in education and culture sector in May 2021 devoting a separate section to the application of AI in the cultural heritage domain, including potential contribution to the preservation, restoration, on and management of the tangible and intangible cultural heritage (European Parliament 2021).

In 2019 the Museums + AI network engaged with 50 senior museum professionals, and leading academics across the UK and US to develop a toolkit (Murphy and Villaespesa 2020). The network published a planning toolkit that allows museums to critically reflect on the capabilities and ethics of using AI within their collections. The toolkit is further outlined in the use case by IULM below. In brief, the toolkit helps a team to build an ethics workflow over the course of a project life cycle starting from the project goals to task-based phases, such as data input, data collection, data training, testing, application and evaluation. Individual museum organisations, for example, the Smithsonian Institution, have also worked towards establishing an AI values framework specific to their context (Dikow et al. 2023).

The *SAFE-D Principles* are another example of an ethical framework for evaluating more specifically the harms and benefits of data-driven technologies. Developed within the Public Policy Programme of the Alan Turing Institute (Leslie et al. 2022), the SAFE-D principles have been iteratively revised, tested, and validated with a wide-variety of stakeholders (Burr and Leslie 2022). See Figure 2.

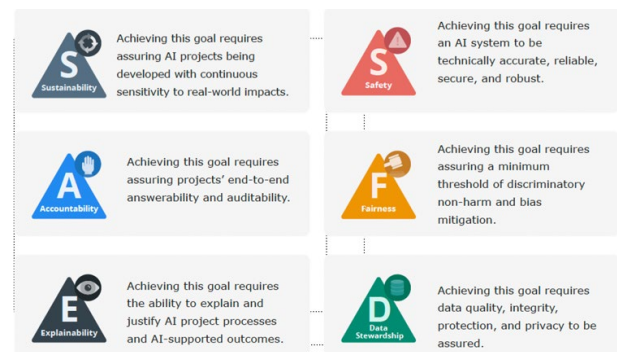


Figure 2. SAFE-D principles and icons (Leslie et al. 2023a).

The acronym, 'SAFE-D' emphasizes 'safety' - an important component of trustworthy AI. The letters stand for the following five ethical principles:

- Sustainability
- Accountability
- Fairness
- Explainability
- Data stewardship

The SAFE-D principles provide high-level normative goals, - each of the SAFE-D principles has a subset of core attributes that help to specify and operationalise the principles throughout a project's lifecycle using a series of processes and activities. The core attributes serve as practical guardrails throughout a project's lifecycle.
text:

3.1 Sustainability

Sustainability requires the outputs of a project to be safe, secure, robust, and reliable. The sustainability of AI systems can rely on many factors, including the availability, relevance, and quality of data (Leslie et al. 2023b). For example, the technical sustainability of AI tools that are being deployed in museum contexts, require consideration in regard to how maintainable and reliable these tools can be in the long-term. Recent studies found that many AI systems are technically vulnerable (Zhang et al. 2024) and on-going maintenance efforts will be even more relevant as issues such as model degradation over time mean that AI-enhanced software require continuing efforts to remain accurate (Vela et al. 2022).

3.2 Accountability

Accountability requires transparency of processes and associated outcomes coupled with processes of clear communication that enable relevant stakeholders to understand how a project was conducted or why a specific decision was reached (Leslie 2019). This also concerns the question of how decisions are being made when it comes to the implementation of such tools. For example, images shared online have been appropriated for AI tools without explicit consent.

The Yahoo-Flickr Creative Commons 100 Million (YFCC100M) dataset contains 100 million media objects of photographs and video which carry a Creative Commons licence. The use of these images for AI has been questioned due to unanticipated re-use (Greshake Tzovaras and Ball 2019). Similarly, copyrighted artworks are being used for training AI for text-to-image applications

without consent to create self-defence tools that modify the digital work to "poison" any tools being trained on them (Shan et al. 2023).

3.3 Fairness

Fairness determines whether the design, development, and deployment of data-driven technologies is fair which begins with recognising the full range of rights and interests likely to be affected by a particular system or practice, such as creating impermissible forms of discrimination (e.g. profiling of people based on protected characteristics or contributing to or exacerbating harmful stereotypes) (Leslie et al. 2023c). How fair an AI system depends heavily on the representativeness of the underlying data, as well as the quality of the collected data. In the absence of representative, high-quality data, AI are bound to reproduce and automate the biases in the underlying datasets used for training (EU 2022).

Connecting the issue of representation in museum projects, there is the question of whether projects that aim to deploy AI would benefit from data collection and whether the right kinds of data can be collected, as the use of data itself might be limited depending on how the project is rooted in dominant socio-technical contexts (Nafus 2023). The implementation of AI projects can further solidify participation biases, by privileging dominant forms of knowledge creation (Toupin 2024).

3.4 Explainability

Explainability refers to a property of an AI system to support or augment an individual's ability to explain the behaviour of the respective system (Burr and Leslie 2022). However, when the internal logic of a model is hidden or derives from empirical models that simply relate inputs and outputs, without explanations of the decision-making process or the internal functions, this is often termed as a 'black box' model (Hassija et al. 2024).

AI literacy is key to explainability so that individuals can become critical users of AI-enabled technologies. Broadly stated, AI literacy is the ability for individuals to understand, use, evaluate, and critically reflect on AI applications without the need to develop AI models themselves (Ng et al. 2021). For museums, the ability to locate, evaluate and use information (generated by humans and AI systems) critically and ethically is also essential for active participation and informed decision-making in an increasingly data-driven and algorithmic society (Kelley and Woodruff 2023).

3.5 Data stewardship

Data stewardship focuses on the data that undergirds AI and machine learning projects, including consideration of 'data quality' (e.g. whether the contents of a dataset are relevant to and representative of the domain and use context), 'data Integrity' (e.g. how a dataset evolves over the course of a project lifecycle) and legal obligations, including adherence to data privacy, protection and human rights compliance.

In considering data stewardship, museums have an opportunity to address the ethical and governance issues which this entails, not least due to its grounding in communities and data governance models (Micheli 2020). However, this critical stewardship role can be exacerbated by the evolving challenges of AI, such as image mislabelling by non-experts for training data resulting in them not being representative of source collections held by GLAM institutions (Dikow et al. 2023). Relatedly, there is a potential 'degrading' of the digital commons by generative AI models trained on publicly available data and public infrastructure but do not have mechanisms to reciprocate value captured to data producers or stewards (Huang and Siddarth 2023).

4. CASE STUDY: ITALIAN AI MUSEUM APPLICATIONS

In October 2023, InvisibleStudio, a cultural innovation studio based in London and Milan, organised a workshop on AI ethics in museums, in collaboration with Dr. Oonagh Murphy from Goldsmiths University and co-leader of the Museums+AI Network project. The event was held at the IULM AI Lab, a spinoff of IULM University in Milan, which focuses on AI in business and the humanities, founded and directed by Prof. Guido Di Fraia.

During the workshop, three AI case study applications in Italian museums were presented and examined from an ethical perspective. The three applications were selected as representative of three important directions in the development of AI in museums, specifically: artificial vision, virtual guides and generative AI. The three case studies are outlined below with analysis conducted using the *Museum AI Toolkit*, developed by the Museum+AI Network and freely distributed on <https://themuseumsai.network/toolkit/>. An Italian version of the toolkit is being developed by InvisibleStudio and IULM AI Lab in collaboration with Goldsmiths University and will be available on the Museum+AI Network website.

4.1 Artificial vision

The case study on artificial vision was presented by the Nemech/MICC research centre at the University of Florence. In this case, researchers developed the concept of an in-gallery game called *Strike-a-pose*. *Strike-a-pose* is a web application that analyses and evaluates human poses in comparison to those in famous paintings and statues (Donadio et al. 2022).

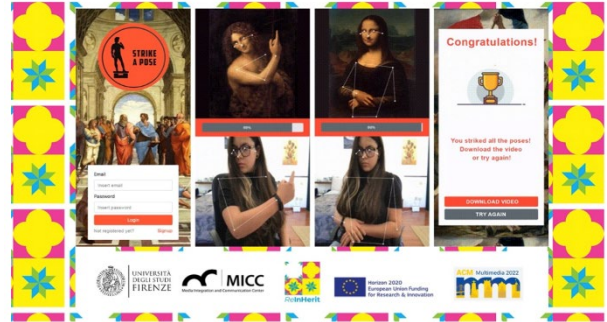


Figure 3. *Strike-a-Pose* app screenshots 2022 (Courtesy of University of Florence)

In *Strike-a-pose*, the user is challenged to reproduce in sequence the poses of some artworks from the museum's collections. Once all the poses have been matched, the application allows the user to generate a video that can be saved for any social sharing and provide information on the artworks. The video captures the user matching process and the overall interactive experience lived at the museum.

Artificial vision systems and expression recognition are focal points in the ethical debate on AI, reflected in their close monitoring under the European Union's proposed *AI Act*. It is thus crucial for the museum, both ethically and legally, to clarify the non-implementation of any automatic user identity recognition policies, nor the storage of biometric data. Given the use of externally developed recognition software, it is important that such software is free from pre-existing biases and capable of recognizing expressions across a diverse range of physical traits. Similarly, it is essential for apps like *Strike-a-pose* to function correctly with users who have various disabilities, such as the absence of certain limbs or use of a wheelchair.

As these types of apps use artwork images, it is vital for the museum to appropriately manage the usage and sharing rights of these images, whether owned by the museum or other institutions.

4.2 Virtual guides

The second case study focused on virtual guides, AI-powered characters capable of interacting with visitors and answering their questions. An example is *Nerobot*, developed by Machineria and Ask Mona for the Rome Colosseo. *Nerobot* is a chatbot

designed to provide practical information and can be utilised in two ways: either by clicking links or by posing open-ended questions, which are then analysed by the chatbot to match with pre-compiled answers provided by the museum staff. Nerobot is depicted in a comic style as Nero, the most famous of the Roman emperors, and introduces itself as such, albeit in an evidently ironic manner. Currently, it does not offer cultural content about the historical figure of Nero, except for a response about the Great Fire of Rome.

In museums, chatbots have been perceived as the institution's voice interacting with the public, necessitating accurate and reliable responses aligned with the museum's mission and values (Gaia et al. 2019). It is, therefore, essential to consider biases in the platform and biases represented in museum collections, in order to avoid a "double bias" effect (Murphy and Villaespesa 2020).

Regarding historical figures' portrayals, defining and understanding the limitations of a chatbot is key, especially when aiming to recreate the mindset of a character from another era. Informational chatbots are generally capable of answering basic queries, but ensuring privacy and security in conversations, particularly with third-party AI platforms, is essential.

The introduction of AI supported virtual guides can be seen as an evolution of widely-used audio guides and informational chatbots, however, replacing human guides in museums raises broader ethical concerns, including reduced human interaction during the museum visit.

4.3 Generative AI

The third case study highlighted a project that utilised ChatGPT at the National Cinema Museum in Turin, developed by Synesthesia. At the end of their visit, museum visitors were presented with the possibility to choose a few parameters to generate a script of a fictitious movie, such as genre, director style, time setting, and characters involved. Based on the user input, the system generated both a script and a movie poster, asking the user if they considered themselves as the "authors" of the script and movie, creating a connection with the screenwriters strike in Hollywood.

By putting generative AI systems in the hands of the public, the museum has a duty to prevent improper uses, and similarly to guarantee the privacy of the interactions and clarify any possible biases which might arise in the use of AI third party applications (in this case ChatGPT and Stable Diffusion). See Figure 4.



Figure 4. Images from the Cinema Museum installation 2023 (courtesy of Synesthesia)

At the National Cinema Museum, a limited range of choices is offered to users to address the issue of AI-generated content potentially not aligning with the institution's mission and values. The challenge is that the vast creative potential of generative AI systems do not fully guarantee alignment. On the other hand, limiting options may reduce creative interactions and not address legitimate curiosities or interests of visitors. Balancing openness and systemic risk (e.g. privacy, security, bias) is a complex and evolving challenge in technology and knowledge production in museums.

5. CONCLUSION

Increasingly museums are identified as integral to a multi-stakeholder process, e.g. aiming at open data and participatory approaches to engagement (Godinho et al. 2019; Lesley 2019). The benefits of museum engagement can also be a key mechanism for knowledge co-creation, awareness raising, and behaviour change needed to operationalise ethical AI frameworks, including governance, safety and responsible use. To proactively address this agenda, museums can be engaged as a source of ethical AI literacy, contribute to trusted resources relating to responsible AI operationalisation, and co-lead in sociotechnical governance of responsible AI tools, among other opportunities.

Museums and cultural organizations are at a particularly significant juncture to re-imagine themselves filling in these ethical gaps as potential stewards of both the future and the past in which the digital citizen can participate in and equally contribute to closing those gaps arising in the evolving usages of AI in digital society.

6. CONTRIBUTIONS

AB and GG conceived the idea for the paper. AB, SB, GG drafted the paper. AB researched and wrote the introduction, museums and AI section and ethical framework section on SAFE-D principles. SB, GG, GDF conceived and wrote the Italian case study section.

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What Is New in AI – More of the Same or an Artificial General Intelligence Breakthrough?

Susan Hazan
Digital Heritage, Israel
Maagal Beit Hamidrash 22
Jerusalem, Israel
Susan.hazan@gmail.com

1. INTRODUCTION

Throughout 2023 the AI sector continued to command significant public interest when the launch of Google's new large language model (LLM) Gemini was offered to developers and enterprise customers at the end of the year and made headlines for what seemed like its impressive multimodal performance in processing images, videos, and audio. Even though Google later admitted to the widely published criticism that the promotional video was 'fabricated or tweaked' the launch caused quite a stir (Edwards 2023). The demo in the video (2024) appeared to show Gemini identifying objects and relationships in visual data, challenging the user to entertaining games, while solving self-improvised scenarios. At the same time, the highly popular image-generating models available in the public sector were still enjoying exponential growth throughout the year with new and impressive versions such as DALL·E 3 and Midjourney v.6 released to the public. Both models proved to be incrementally better than their previous versions and both continued to dazzle and excite with new functionalities and variations. At the same time, Open AI released its beta version of Sora, a much-hyped but rather underwhelming video generator. According to Open AI, Today, Sora has been offered to red teamers to assess critical areas for harm or risks, as well as granting access to some visual artists, designers, and filmmakers to gain feedback on how to advance the model to be most helpful for creative professionals. 2023 had been a very prolific year for AI developers and the public was more than happy not only to experiment with these systems but to actively integrate their functionalities into their working and creative lives.

The AI sector presented numerous opportunities for users to sign up for a whole range of tantalizing platforms – either for payment or for free while at the

same companies were already eyeing their next goal. The next critical landmark was hotly anticipated in research centres and the commercial sector that saw artificial general intelligence (AGI) as their ultimate goal. There had been many red herrings dropped into the public discourse concerning whether AI had already reached the point where LLMs such as GPT-4 models had attained the level where users identified sentience in their interaction with these systems or something approaching human consciousness. See for example when Microsoft's OpenAI-powered Bing chatbot spontaneously changed its name from Sidney to Venon and had been making serious waves by making up horror stories, gaslighting users, passive-aggressively admitting defeat, and generally being extremely unstable in incredibly bizarre ways (Hazan 2024). This apparently spooked the research community but most of the calls of alarm seemed to be aimed at hyping their very expensive products, perhaps in a bid to create a demand for them. AGI is mainly theoretical, but frenetic development is underway to create platforms with human-like intelligence including the much-coveted abilities such as self-teaching, emergent agency, and autonomy, and even the suggestion of self-replication. This capability was suspected with Google's Bard spontaneously learning to speak Bengali, a language which it had not been specifically trained for. The claim by Sundar Pichai, CEO of Google's parent company Alphabet, was later challenged with the explanation that AI had already been trained in Bengali with millions of tokens. Reaching AGI still seems to be mainly elusive but the race to create an autonomous system that surpasses human capabilities is more than tantalizing.

2. TOWARDS AGI

So how can we know with confidence that we are witness to an AGI event or entity, the moment when software performs as well or better than humans on a wide range of cognitive activities or shows the capability to self-teach and even self-replicate? For decades the world has been pondering singularity – the moment AI becomes the dominant form of intelligence on Earth as robots or computer software effectively takes control of our planet. First coined by John von Neumann in 1958, the term “Singularity” describes a hypothesis that developments in science – especially in the fields of informatics, nanotechnology, and biology will ultimately lead to the invention of an AGI. Ray Kurzweil famously discussed how artificial machines with natural intelligence would be safe or not and based on scientific, philosophical, and theological arguments suggested how human-level AGI could evolve as early as around 2029, and reach singularity in 2045. While there are many ways where companies and research centres are negotiating their distinct pathways towards realizing AGI in addition to the public and secret government programs around the world this paper suggests just three such pathways out of the many.

3. AGENCY

Already freely available and highly popular are the intelligent AI-driven agents, intelligent agents that can be programmed to support a range of tasks either as a simple logical progression or in the more sophisticated model-based system that is focused on a complex goal. An AI agent can be instructed to act on your behalf. For example, you could instruct your agent on the occasion of your five-year-old birthday to help with all the arrangements. You could ask it to find a suitable hall, pick out the perfect children’s entertainer for the party, perhaps a magician or local band. After making all your choices you then prompt the system to act on these plans and book the room, the magician, make the catering arrangements, and even purchase the gifts on your behalf. Although these are innocuous actions once a less benign agent is granted agency to a system to act on their behalf in the real world, one that perhaps had been mal programmed with bugs in the system or even biases that crept in during the training the results could just as easily be nefarious. At what point does our AI actor break out of its prescribed boundaries and what happens when things get out of control? These scenarios could be very unnerving.

4. AI GETS AN INNER MONOLOGUE

One of the notable limitations of LMs is their inability to contextualize the flow of ideas causing them to ‘hallucinate’, an innocuous term that can be otherwise described as confabulation or delusion. Not only does this remind us that AIs are untrustworthy, but their blatant predilection for lying becomes a major obstacle for a system that attempts sentience. Quiet Self-Taught Reasoner, Quiet-STaR, supports a process that resembles a human’s inner monologue and supports a reasoning process that enriches outputs, allowing users of the model to be able to select which response is most accurate like the reasoning that is implicit in almost all written text. LMs learn to generate rationales at each token to explain the future text, thereby improving their predictions. The process represents the text (as think), mixing the future-text predictions with and without rationales (talk), and then learning to generate better rationales using REINFORCE (learn) Zelikman et al P.2) and delivers ideas that are closer to natural text, connecting the meaning hidden between the lines – the missing context.

5. SELF-REPLICATION

In a New York Times podcast with Ezra Klein (2024) Anthropic CEO Dario Amodei raising truly existential questions by suggesting AI models might reach autonomy levels whereby AI entities can self-replicate and survive, a possibility he suggests that could happen as early as 2025-2028. This poses formidable governance challenges and hair-raising security risks. This is but one progression that is not beyond impossibility in the future AGI landscape and one that is truly chilling. The Computer Gone Rogue has played out in our collective memories since the spine-chilling movie 2001: A Space Odyssey (1968) in the famous scene where Hal 9000 computer refuses to obey an order from Bowman (Keir Dullea) by simply responding in monotone, "I'm sorry Dave, I'm afraid I can't do that." Although there are fortunes to be made by the company that first cracks the AGI code – one can only hope that whoever gets there first treads with extreme caution and leads the way with responsibility and care.

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Movement Matters: Embodied expression in VR

Leslie Deere
Postdoctoral Researcher Guildhall
1 Milton St, London EC2Y 9BH, UK
Leslie.Deere@gsm.d.ac.uk

1. INTRODUCTION

During field work, as part of recent practice-based PhD research, a new participatory version of the project, *Array Infinitive*, emerged. This PhD project looks at gestural audiovisual performance in virtual reality (VR). In the new participatory format of this work, which emerged towards the end of the PhD, audience were invited to step into what had previously been my role as conductor or performer. This created a new dynamic and highlighted the ways in which people interact with *Array Infinitive*, their willingness to explore and engage in an act of embodied audiovisual discovery.

The focus of this paper and contribution to EVA London 2024 will focus on this participatory format of my PhD project. This is the beginning phase of examining the psychology of movement in relation to VR audiovisuals and *Array Infinitive* specifically. Ideas around the 'cognition of interaction' and embodied music cognition will be brought forth. The act of improvisation through gestural VR audiovisuals becomes an embodied form of instrumentation and source material for this paper.

2. EMBODIED COGNITION

This paper takes reference from the research of Marc Leman and Pieter-Jan Maes, who look at embodied music cognition and have developed this scholarship which suggests that corporeal interactions with music ultimately determine its cognition. Foundational areas of this research look at timing, rhythm and prediction processing. Leman and Maes take a closer look at different states of embodiment, such as movement, musical expression or even emotional states and investigate the implications of this area of research (Leman, Nijs, Maes, Van Dyck 2017, p.3).

Ideas around perception being rooted in bodily involvement and processes are brought forward and suggests that this type of cognition has validity as a

form of understanding sound and music (Maes and Leman 2013; Fritz et al. 2013, p.4).

In terms of *Array Infinitive*, the level of participant involvement, directly through a willingness to explore, greatly impacted their experience. To further explain how the piece works, as the participant moves their arms, body and head along the X, Y, Z axis, different ambient sounds and combinations of sounds emit through speakers. As this happens, colourful abstract graphic particle trails also emit from the hand positions, or controllers, and can be seen in VR in real-time. There is a significant amount of content that the participant must be aware of when interacting with this work. This includes live sound, which is amplified over a sound system, moving one's body in front of an audience of onlookers that cannot be seen and the visual litany of being immersed in a completely different optical realm. Some participants created small hand and arm movements, which limited the sonic range of possibilities. Other participants opened their arms wide, and moved their bodies to a greater degree, discovering a bigger range of auditory options and mixtures of sounds that can be created through movement. Some participants compared their sounds to others in the group, commenting that they 'didn't get' the same audio. However, what they did or did not produce sonically was based solely on their willingness to explore the audiovisual VR worlds in an embodied way.

Leman and Maes assert that predictive models support embodied actions and action-perception and thus generate specific changes in one's immediate environment (Leman, Nijs, Maes, Van Dyck 2017, p.5). Through this research there is a broadening of what the term embodied encompasses and mention is made of wellbeing (MacDonald et al. 2012), musical affect research (Cochrane et al. 2013), healing (Koen et al. 2011), music engineering (Kirke and Miranda 2013), and brain studies (Arbib 2013) (Leman, Nijs, Maes, Van Dyck 2017, p.8).

3. CONCLUSION

This is early stage new research into embodied expression and cognition, following on from recent PhD study looking at audiovisual performance in VR and its impact on a group as a shared collective experience. Further inquiry is planned on the notion of 'enactment' and 'expression' with music, which suggests that our corporeal participation with music focuses on acting along with the music, either through actions such as foot tapping, dancing or creating gestures (Leman, Nijs, Maes, Van Dyck 2017, p.12). Gesture in this sense acts as a form of encoding and decoding of expression, as well as a

contingency for action, to be put into the sound, or to be taken from the sound (Godøy 2010; Krueger 2013) (Leman, Nijs, Maes, Van Dyck 2017, p.14).

Further research is planned into the exploration of movement and embodied audiovisual improvisation through *Array Infinitive* as an instrument. As part of a current postdoctoral role, ideas surrounding embodiment through XR technologies will be investigated in terms of live performance. The potentials and possibilities of *Array Infinitive* for collaborations with specialist areas such music therapy as well as movement or dance therapy, will also be explored in the near future.



Figure 1: Participant with *Array Infinitive* at the ALPs Psychedelic Research Conference, 2023.

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KIMA: Noise Map: Participatory online art exploring the effect of noise on health

Oliver Gingrich
University of Greenwich
London SE10 9LS, UK

Daniel Hignell-Tully
University of Greenwich
London SE10 9LS, UK

Claire Grant
CNWL NHS Foundation Trust
London NW1 3AX, UK

Alain Renaud
Vallais School of Art
3960 Sierre, Switzerland

Dominik Havsteen-Franklin
Brunel University
London, Uxbridge UB8 3PH, UK

KIMA: Noise is a participatory art work by the Analema Group originally exhibited as a site-specific installation at Tate Modern: The artwork invites audiences to explore the impact of urban noises interactively through 360 sound installation, via drawing an ambisonic sound trajectory - a virtual sound walk. Using specific urban sound sources, the audience experiences urban noise as spatial soundscapes, responding to it, and physically engaging and interacting with it. Intended to raise awareness of the phenomenon of noise pollution, the project was reimagined as part of the AHRC-funded p_ART_icipate research project on the effect of participatory online art on health and wellbeing. In this sense, KIMA: Noise not only raises awareness of the effect of noise on health, but also interrogates the effect of participatory art on wellbeing, and social connectedness. The KIMA: Noise Map forms part of this research goal exploring the function of digital, online art interventions in fostering social connectedness. The KIMA: Noise Map is an online interface for global users to concurrently interconnect and stream their noise-scapes from all around the globe. Participatory and playfully, any participant can draw their own sound-walks, interactive sound trajectories created as digital drawing, while listening to ambisonic sound streams that are responding in real-time. Within the context of the p_ART_icipate project, led by the University of Greenwich, CNWL NHS Foundation Trust and Brunel University, KIMA: Noise case study looks at design, facilitation strategies of participatory art online, while highlighting the awareness building and impact generating potential of community based art forms. This paper looks at preminent research in the field of noise, social sculpture, and arts participation, as well as introducing the KIMA: Noise project technically and conceptually.

Participatory art. Social connectedness. Noise. Public health. Art and health.

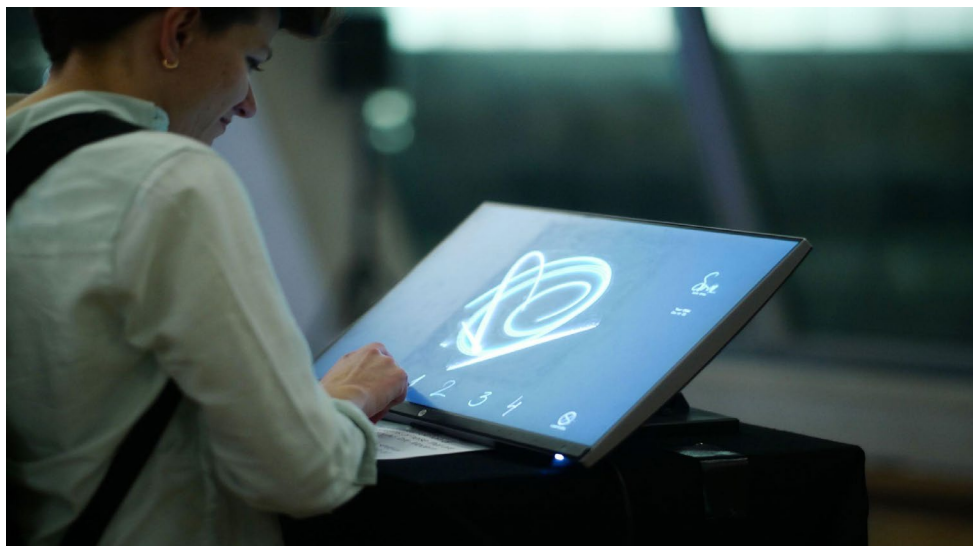


Figure 1: KIMA Noise at Tate Modern, 2019



Figure 2: *Evgenia Emets, David Negrao at Tate Modern, 2019*

1. INTRODUCTION

Devised by the Analema Group in 2019, KIMA: Noise was first exhibited at Maxilla Space in North Kensington, London as a site specific installation. Located directly under the Westway, the art and studio space, is affected directly by noise pollution in one of London's noisiest urban areas. Daytime pollution from the car traffic often exceeds 80db, affecting local residents and visitors alike.

The artwork was designed as a participatory experience, whereby interactants playfully design their own soundscapes consisting of real-time sound inputs from their direct environment. Building on research that shows the effect of perceived control over noise over mid- and long-term physiological consequences, participants maintain a degree of control over the soundscapes, by selecting different sources and then using a touchpad to draw their own soundwalks:

These lines are then sonified as a 360 soundscape that can be explored in real-time. The sound moves across the space following the drawn lines, surrounding participants in what can be seen as a sound sculpture (Leitner). After piloting at Maxilla space following a residency in September 2019, the project was then shown at Tate Modern in November 2019, accompanied by large scale projection works projected onto the windows of the Tate Exchange. Seen by almost 2,000 people across 4 days, the artwork stimulated a discourse on noise and health among community members, public stakeholders including representatives of the Department for Environment, Food and Rural Affairs (DEFRA) and the public. The Head of Tate Exchange acknowledges that Analema Group's KIMA: "Noise at Tate Modern addressed local,

national and international audiences by focussing on noise pollution across Southwark Council." (Courage 2020).

The Department for Environment, Food & Rural Affairs (DEFRA), who have "overall lead responsibility for policy on noise management in England" acknowledge the important role of this research in raising awareness of the health effects associated with noise amongst the general public. They state that, "participatory art such as KIMA: Noise is so important [...] as it communicates through a different medium to those traditionally employed by Government, and can therefore broaden the scope of public debate and help to inform policy decisions related to impacts of sound and noise".

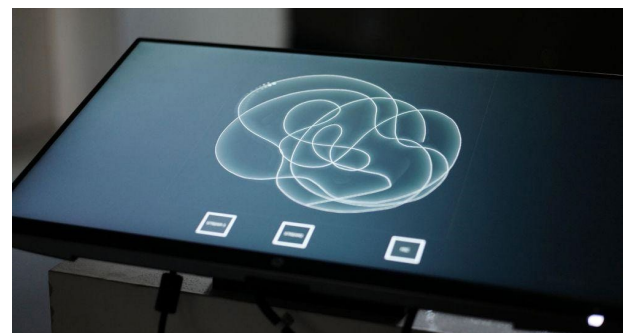


Figure 3: *KIMA: Noise at Tate Modern, 2019*

2. THEORETICAL GROUNDING

Noise is rather unique in so far as it exists at the nexus of subjectivity and objectivity, a seemingly indescribable, unknowable, disagreeable material that sits between the individual and the Other. It is shared only, perhaps, by our sense of smell - a direct transgression of the boundaries of the body - a

phenomenon produced outside of our self that literally vibrates within us. By this token, we find in noise an inescapable connection with others, even as its very presence highlights our separation from them. On the one hand, noise is subjective - one person's perceived symphony is another one's subjective experience of a scratching chalkboard. The delineation of definition between what constitutes sound, noise, and music, remains indeterminate and murky at best. On the other hand, noise is an entirely concrete, objective concern, and physiologically measurable: However much you may personally cherish the sound of a jet engine, it is capable of producing lasting and measurable damage to those who witness it at close range (Haines et al. 2002). We might even consider noise as a case for an ontological rebuke to the philosophy of the individual so central to modern thought. Noise can be seen as critical evidence that the notion of a fully autonomous individual, detached from the confines of their community, is demonstrably impossible and false.

The primacy of subjectivity - your love of jet engines versus my love of silence, and the social battle that ensues - collapses upon the reality that, as with the physiological response to noise, objectivity reigns and gives way to a primacy of inter-subjectivity (Passerini 2017). As Garret Keizer points out, the notion that noise is subjective suggests 'it is all in your head', that we, as individuals, construct our own realities. Subjectivity, however, as Keizer so succinctly points out, 'does not make you go deaf' (Keizer 2012, p.31).

Noise might even be considered as a bridge between objectivity and subjectivity, the world brought into the subject, beyond the will of the individual. As such, it is perhaps not simply a sonic phenomena, but shared viscerally as an objective measurable soundscape. The fact that one cannot shut out another one's noise, that it breaches one's boundaries, that it might damage us, re-enforces the reality of social responsibility:

"Noise brings a heightened awareness of your connection to other people. Your happiness and wellbeing are seemingly at odds with their happiness and wellbeing, but only because, on the deepest social level, your happiness and wellbeing are connected to theirs. You may not be interested in neighbourhood, but neighbourhood is interested in you." (Keizer 2012, p.20).

Building upon the work of the World Soundscape Project, noise is framed as a vital social issue due to its impact on well-being, especially within urban environments. The domination of a small number of intrusive or loud sounds results in what R. Murray Schafer termed a 'lo-fi' soundscape (Schafer 1994): whilst noise itself is not an implicitly negative

phenomenon, prolonged noise exposure often is. The European Environment Agency estimates that 67 million people in the EU are regularly exposed to decibel levels that exceed safe guidelines for both our hearing and our cardiovascular health (Prochinik 2010), with traffic being the biggest culprit. Though we may mentally adapt to such an omnipotent sound environment (Lyle 1997), our physiology is somewhat less flexible in the face of urban noise, resulting in a situation where "our behaviour, unconsciously or no, reflects the bodily failure to adjust" (Prochinik 2010).

Excessive noise exposure can have a pronounced physiological effect, interrupting everything from sleep patterns and immune systems (Ermolaev and Katalinic 2017), to educational outcomes (Keizer 2012), and causing a range of negative health outcomes including raised blood pressure and myocardial infarction (Basner et al. 2014), and cardiometabolic morbidity and mortality (Elmenhorst et al. 2019). Despite this, our conscious experience of noise is highly culturally mediated. Numerous studies have shown that physiological disturbance and perceived annoyance do not closely correlate: A 2016 study exploring the effect of urban noise on sleep found participants were more likely to cite aircraft noise as a disturbance than car traffic, despite the latter being both more frequent and louder: suggesting that "objective sleep quality and noise annoyance are not related" (Elmenhorst et al. 2019).

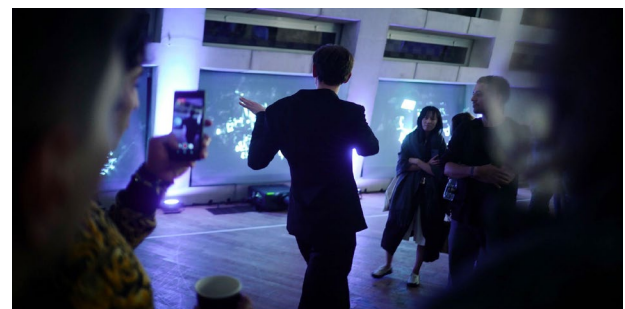


Figure 4: Oliver Gingrich and David Negrao with KIMA Noise at Tate Modern, 2019

3. LINE-MAKING AS A PROCESS OF SOCIAL AND ECOLOGICAL ENGAGEMENT

With KIMA: Noise, our aim is to re-establish a sense of control over noise, both by raising awareness of its effects, and through direct interaction with the art installation and active engagement. Echoing Murray Schafer's credo that 'Noise pollution results when man does not listen carefully', the project seeks to deconstruct the "noises" around us, in order to create new awareness and engagement with urban sounds. Such a movement towards ecological awareness as a form of creative practice has a rich

history, not least in the social sculpture work of Joseph Beuys. Beuys suggested that a deliberate engagement with ones environment amounted not to observing objects or 'things' but rather lifecycles, a position in which perception merely abstracts moments from a longer process. Whatsmore, for Beuys there was little difference between creative practices and social practices, since art-making is an 'evolutionary force' geared towards reimagining the individuals engagement with their ecology, a practice that 'relates to the social organism's capacity for life' (Beuys 2007, p.22).

Operating at the nexus of soundwalking and land-art, KIMA: Noise reimagines the process of aurally traversing one's environment through the medium of line-making. Drawing upon the historical precedent of line-making as a means of creatively documenting movement, ecological engagement, and process - an approach exemplified by Richard Long's 'A Line Made By Walking' (1967) - the project imagines the production of lines as the production of potentiality. Participants are not only encouraged to physically explore their environment, but to make connections between their own walked environments and those of other users in other locations. In contrast to traditional map-reading - in which 'lines, drawn across the surface of the cartographic map signify occupation, not habitation' (Ingold 2007, p.85), the lines drawn in KIMA: Noise do not lead to destinations, but reveal new potentialities as the participants digitally share the sound of their lived environments. The map is not a surface by which participants can make their way expediently to a predetermined destination, but a canvas to be explored. Such an articulation allows for new forms of digital presence, with participants sharing and collaborating on imagined journeys through their landscape. By doing so, the geo-dislocation that typically acts as a barrier in such technologically-mediated communication becomes a font of creativity - the distance between collaborators acting as a space of resonance, the method by which, as the philosopher Jean-Luc Nancy suggested, sound can extend and re-sound, taking on new meaning as it grows with the resonance of others (Nancy, 2007).

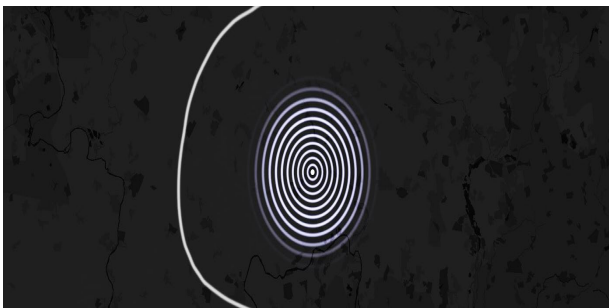


Figure 5: KIMA: Noise Map - 2023 by the Analema Group

4. METHODOLOGY AND DEVELOPMENT

Building on the success of the original installation, in 2023, the Analema Group's initial application was redesigned for a participatory, online context, as per the remit of broader p_ARTicipate project. Within its design there was a balance between ease of use and aesthetic appeal. The KIMA: Noise map is by no means the first application to use a digital map to highlight or navigate environmental sound - where it deviates, however, is in its focus on liveness. Whilst precursors such as soundaroundyou.com allow users to listen to, and upload their own recordings of their real-world location, soundaroundyou is not a real-time process. There is no interaction with other participants, save for the after-the-fact audition of their recordings and notes. Such an approach necessitates a pragmatic and utilitarian aesthetic - users can identify specific locations on a traditional map, zooming in to reveal specific countries, cities, streets and other such geographical specificities.

In contrast, KIMA: Noise prioritises a more creative, if less specific form of geographic engagement. Rendered in black, blue and grey, and without common identifiers (city names, street markings), the landscape is more akin to semi-abstract shapes and shadings, with the lines of nature - its shores and rivers - providing the strongest definition. Rather than serving as a map in traditional sense - a tool for arriving at predetermined destinations - the KIMA: Noise aesthetic encourages exploration. It is a surface to be both traversed and written by the participants, a surface defined by the vectorisation of the lines laid upon it, as is the manner of a canvas that only become meaningful through creative interaction (Klee, in Ingold 2007). Designed by the Analema Group, and developed with its visual coders Marc S. David and Gaelle Berton, its design invites participants to deprioritise the traditional boundaries and borders of a map, and in doing so to draw new, impossible and imagined pathways between other living participants in real-time. Initial development stages considered the transience of such connections - should lines disappear after they have been made? Or fade over time? Experimenting with different approaches, it was conceived that lines would last only until a new line was drawn by the participant, but that they could easily be saved and downloaded if desired, thereby resulting in lasting legacy of the otherwise transient experience of a sound-walk.

5. USER TESTING AND FACILITATION

The Kima: Noise map was user-tested in several contexts. Working with student groups at both Greenwich and Brunel University, the projects aims were presented to cohorts of between 5 and 20 studying animation and graphic design (Greenwich)

and arts therapy (Brunel). Two sessions were held at each site, run to a similar format. The project aims were discussed and the preliminary work presented, before participants were invited to try out the application for themselves. The user tests had two main aims: to discover how participants engaged with the phenomenon of urban noise, and to discover how the application might encourage deeper or more nuanced engagement on the subject. Additionally, the sessions allowed us to gather technical feedback to improve the overall user experience. Engaging in a process of limited co-design, testers were encouraged to suggest direct improvements to the usability of the application, with a particular focus on minimising any technical frustrations that may occur, and improving accessibility for the widest range of possible participants. This co-design extended to the aesthetic aspects of the application, with researchers seeking to explore how the existing aesthetic contributed to both the enjoyment of the experience, and the fostering of creative potential (in terms of the lines and connections participants are inclined to produce).

Through the utility of pre- and post questionnaires, alongside structured discussions, the researchers sought to determine the degree to which the conceptual and philosophical presumptions that underpinned the research were borne out by participants' real-world experiences. As the wider p_ARTicipate research project is concerned with the relationship between digital art interventions and social-connectedness, the research team sought to uncover how a focus on communal line-making in this context might develop such connectedness. From a research perspective, social connection was framed as a multifaceted and complex phenomenon involving both an embodied relationship to one's local community or what might more accurately be described as their social ecology, as conceptualised in the systems theory of Niklas Luhmann (2000), and the digitally-mediated connection to other participants within the app.

By overlapping these two forms of connectedness, researchers anticipated the emergence of resonant questions regarding the nature of physical vs. digital communities, (tele)presence, conceptual and physical distance, and the affordance of prioritising walking and line-making as a means of re-imagining the social in contemporary contexts. As such, the pre-intervention framing drew upon these terminologies, and the post-intervention discussion sought to further unpick their meaning in regard to users' own unique experiences. Such discussions innately risked positioning noise as a negative phenomenon, and effort was made to consider any positive affordances of noise. The pre- and post questionnaires were worded to frame the experience of noise as both potentially comforting

and discomforting, whilst simultaneously highlighting the concept of 'lo-fi' sound environments via a focus on both dominant sounds and expected but ultimately absent sounds.

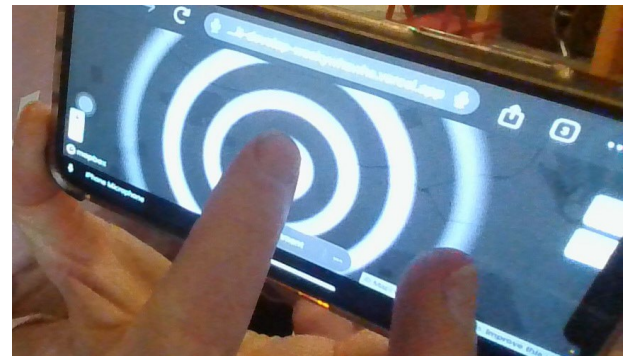


Figure 6: iPhone user testing of KIMA Noise by the Analema Group

Lastly, and by extension of its remit of social-connectivity, user-testing explored how engagement with the application affected the health and well-being of its participants. Whereas prior p_ARTicipate projects have explored the capacity for art to improve health and well-being through increased social connectedness, KIMA: Noise extended this investigation. Through our discussions we sought to determine how urban noise impacts upon the lives of participants, and how the application might provide them with a framework by which to better engage with the issue. By asking participants to describe their existing relationship to noise - and to avoid an explicitly negative framing of the phenomena - we were able to develop a thematic analysis of their experiences.

Working in collaboration with the Royal Borough of Greenwich, our research sought to discover whether participatory art can contribute to a public discourse, how local and technologically-mediated collaboration can make participants feel closer to one another and their communities. The application draws upon the specific health and well-being attributes of noise as a social, economical and perceptual phenomenon. Given the ongoing research around noise pollution, the user tests attempted to determine how such a tool might assist participants to both better engage with their lived soundscape, and to take on a more active and autonomous role in both contributing and improving the sound world in which they live. Working in collaboration with scientist Prof Stephen Stansfeld and the Royal Borough of Greenwich, participants were invited to follow up the user testings by contributing to an urban noise awareness campaign, to be presented at local galleries.

Given that the ultimate aim is for KIMA: Noise to be a free-standing online application, user testing was equally a means of exploring the nature of the

facilitation required to ensure productive utility of the application. The purpose of such facilitation is two-fold: in the first instance to work out what aspect of the user-experience can be streamlined so as to negate the requirement of facilitation in the long-term, and in the second to assess how it meets its goals of addressing primary concerns regarding social connectedness, ecological awareness, and improved health and well-being.

As part of the project framing, students at Greenwich were introduced to the work of both the research teams and the local councils noise abatement team, as well as experts from the field of urban noise. Following this, a short 10 question pre-questionnaire was used to ascertain participants current experiences of noise, as well as their existing sense of connection to their environment and ecological awareness. Participants were asked to express their perceived connection to the local community, as well as to other participants using the application at the same time as them. Similarly, they were asked to reflect on their own current relationship to noise - are there dominant sounds that disturb them, or which they enjoy? What do they expect to hear within the local community? How aware are they of their lived sound environment?

After the KIMA: Noise intervention, participants were asked to further reflect on these topics, including whether, having focussed on the environment, their expectations were met. Equally, students were encouraged to consider if using the application, and as such taking some control of their sonic experiences, changed their general sense of autonomy and power concerning urban noise in general. Given the subjective component of noise, it was important to provide the conditions for meaningful self-reflection. Participants were asked to self-report (via the questionnaires), and their observations were contextualised through the specific prism of their experience. Our research was conducted that though many of their experiences would correlate with the broader population, there would nonetheless be aspects of their experience - residing in London, shared student accommodation, an existing interest in health and wellbeing - that may result in the requirement for a more nuanced reading in light of our chosen demographic.

6. ANALYSIS

The thematic analysis was conducted on two levels across a cohort of n=14 at University of Greenwich and n=5 at Brunel University: firstly to determine the emergence of common themes; secondly, to determine the mood or context relating to those themes. As expected - in part due to the negative cultural connotation of noise - pre- survey responses frame noise as an overwhelmingly negative affair,

with twice as many (10) participants describing it in negative terms than positive (5). However, respondents were more likely to be indifferent (6) to the phenomena than to view it positively. Interestingly, post- surveys painted a rather different picture: asked to consider levels of comfort or discomfort relating to noise, negative responses were halved (5) after using the app, whilst both indifference and positive readings marginally increased (8, 6). Although working with a limited number of participants, these results nonetheless suggest that using the application might provide users with a sense of control or autonomy over their soundworld, thus reducing overtly negative connotations - a finding that would correlate with much of our initial research (Keizer, 2012). Notably, traffic noise was alone in bucking this trend, with self-reporting of negative experiences increasing by a third after using the app.

Likewise, the noise of other people was raised as a significant cause of discomfort prior to the intervention (5), but afterwards was mentioned only by one participant in these terms. What was initially a mostly negative reading of the sound of others - articulated by 'shouting', 'partying', and 'waking', alongside 'soothing' and 'reassuring' - took on a more neutral character afterwards. Participants offered a nuanced reading on the affordances of the app to foster social connection, suggesting that the technology involved hindered natural communication, and resulted in them feeling both 'distracted and connected' in equal measure. It was noted that the app succeeded in heightening awareness of urban noise, even whilst it reduced the number of negative responses.

Participants were asked to reflect on their anticipation of noise and their actual experience of it within the app. Eschewing negative/positive connotations, participants considered instead what sounds were most prevalent. Unsurprisingly, traffic was both most anticipated and most experienced during the application (11, 11), closely followed by people (9, 5). It was interesting to note the anticipation here was greater than the experience, as well as the descriptors more passive ('talking' rather than 'shouting'). Likewise, there was a significant anticipation of industrial or construction sounds (8), yet only 2 participants mentioned actually hearing any during the length of the intervention. In contrast, several sound sources were not anticipated, but experienced - notably nature sounds, architecture (in the form of reflection and reverberation), and the noise of the app itself. Whilst useful on an indicative level, this analysis is limited by several factors (that can be improved upon in future user tests): the relatively small number of participants (<20), the limited time using the app (<10 minutes), and more structured facilitation (particularly around digitally-mediated social connection) would all be hugely beneficial.

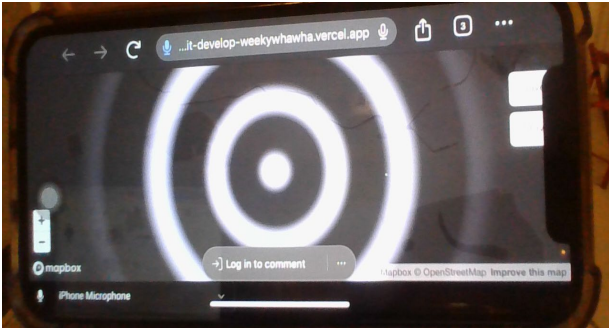


Figure 7: iPhone user testing of KIMA: Noise by the Analema Group

7. CONCLUSION

Just as Beuys argued that art-making can act as preparation for real-world ecological engagement, KIMA: Noise not only opens its participants up to the real-world issues of noise pollution and noise abatement, but draws literally and imagined lines between their bodies and their communities. New communities are created, as meeting point of globally dispersed collaborators within the application; and existing communities are explored with the physical body, their affordances reimaged through a focus on the aural, rather than ocular sense. In this way, interventions of this manner eschew any (already questionable) baggage of 'art for arts sake', and instead engage with the world through an embodied interrogation of the political possibility of sound.

As Solome Voeglin (2019) suggests, such a conception of sound making as an affective, change-making practice, is deeply tied to auralties incorporeal roots. For Voeglin, sound invokes imagination - the desire to conjure an often indistinct or obfuscated line between source and audition, an affordance that enables us to position 'sound and listening as generative and innovative intensities in the space of the political in order to probe their potential for an exploration of politics and to try to imagine and effect its transformation' (Voeglin 2019, p.17). We might further argue that noise in particular points towards the political. As Keizer suggests, noise is a 'weak' issue (Keizer 2012, p.4), in so far as it disproportionately affects the politically weak - it is a signifier of a greater power imbalance within a given community.

Pointing out that the word volume concerns both amplitude and occupation of space, Keizer argues that the production of noise is invariably a manifestation of power - whether that is power stations or powerful cars - and to be affected by noise is to be subject to another's power over your body. Not only to the less powerful have less control over noise - neither owning factories nor harbouring the political clout to constrain them - but they are

equally subject to the noise of others with greater intensity. The impoverished are more likely to live with persistent noise issues, with cheaper neighbourhoods located closer to train tracks and flightpaths, and their houses likely to be closer together and built with thinner walls (Keizer 2012, p.56).

Against this backdrop, the function of KIMA: Noise might be considered as a means to return power to the weak - to enable those affected by urban noise to both engage ecologically and creatively with their soundscape. Through the creative act of line-making, undertaken across both the digital and the physical realm, and engaging directly with both local and the geo-dispersed communities, includes participants as collaborators within a shared soundworld. In doing so, it seeks to ignite the imagination as agency - by empowering participants to share, extend, manipulate and reframe their sound environment, KIMA: Noise offers new affordances, wherein its users can begin to take on an active role in reshaping urban noise through a new found creative agency.

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The Challenges of a Tactile Model With Scientific Uncertainty

Dominik Lengyel
BTU University Cottbus-Senftenberg
Konrad-Wachsmann-Allee 4
03046 Cottbus
Germany
lengyel@b-tu.de

Catherine Toulouse
Lengyel Toulouse Architects
Sundgauer Str. 29
14169 Berlin
Germany
toulouse@lengyeltoulouse.com

This contribution is based on the contributions from 2021 to 2023 and shows how the visualisation of uncertainty is developing from pure imagery to the implications of materiality in a three-dimensional physical model. As last year, the focus is on haptic models for conveying architectural concepts from the field of archaeology, but here it is about a new challenge, namely the compatibility of a model that can be perceived both visually and tactilely. In contrast to pure tactile models for use by people with special visual needs, this city model of the ancient metropolis of Pergamon is intended to fulfil both requirements. The paper presents the project, the museum's ambition in terms of its own extensive historicity, and in detail the special requirements faced in the production of the model. After a general introduction to the underlying visualisation of uncertainty, the increasing demands on models to be viewed from all sides in general, those visible in physical reality in particular and finally those that may also be touched are described. As in the earlier projects on the visualisation of uncertainty, the focus is not on the technical implementation, but on the particular design requirements. Aggravating circumstances such as the tactility of the model require a dedicated design of such forms, which has to correspond above all to the production process of milling, a production process that is owed to the material that is able to offer the greatest resistance to touching and also to dirt.

Visualisation. Archaeology. Architecture. Uncertainty. Virtuality. Physical reality. Tactile models.

1. INTRODUCTION

When representing architecture, the central concern is to compensate for the actual experience of space. Architecture is lived space, the actions and movements of people are its central component. Every form of representation is therefore associated with a loss and takes place on a more or less theoretical level. Decades of experience as designing and analysing architects indicate that the introduction of more and more diverse media gradually reduces the detachment from the actual experience, but there is still a long way to go until there is a complete illusion of physical reality. Until then, the various disciplines use different methods to overcome this. Photography attempts to capture the essence of the architecture in a still image through targeted compositions of viewpoint, direction of view and exposure, whereas a drawing adds the targeted emphasis of selected contours, providing it remains committed to the geometry of the original. Filmic representations attempt to more or less recreate the process of walking through the

building or detach themselves completely when they take the form of a flyover. Models, whether in physical or virtual reality, choose different levels of detail in order to come close to physical reality in its unlimited granularity. But all these methods require fundamental reflection when it comes to lost architecture. This is where the uncertainty of knowledge comes in, which requires us to recognise that we do not know everything that made up the physical reality of architecture, indeed that we will most probably never know most of it. The aspects of the visualisation of uncertainty developed by the authors in the previous conferences set out to do a balancing act. The aim is to create a vision that does not primarily capture everything we know in a single image without restriction, but to create a vision that captures an architectural idea as it reflects the state of science according to our current knowledge, as it might have been conceived before it was translated into physical reality, before the architecture was built. All of the previous aspects have mainly referred to the image, to visual perception in general, as well as to film, which is then procedural visual

perception. Most recently, the experimentally haptic approach was added, the dissection of the complex geometry of an amphitheatre with the even more complex internal pathways, with the aim of making these complexities perceptible. In the current project, the focus is on the spatial perception of an entire city (Figure 1) in the form of a physical model, taking into account the uncertainty of knowledge. Basically a cross-section of previous projects, the imperial palaces on the Palatine Hill in Rome were already three-dimensionally printed urban models on a scale of 1:1000 and showed the palaces in the context of the Circus Maximus and the surrounding

city. Here it is the Acropolis of Pergamon (Figure 2), which, as a contextualisation of the original altar, though not in its original location (Figure 3) but in the dedicated Pergamon Museum Berlin, is intended to show visitors after the museum's reopening that the altar was integrated into a tight urban network (Figure 4). As an additional and particular challenge, in this case the model should also be able to be touched deliberately. It should not completely fulfil the requirements of a model for people with special visual needs, as it should also remain representative for all other visitors, but it should again be a balancing act between a visual and haptic model.

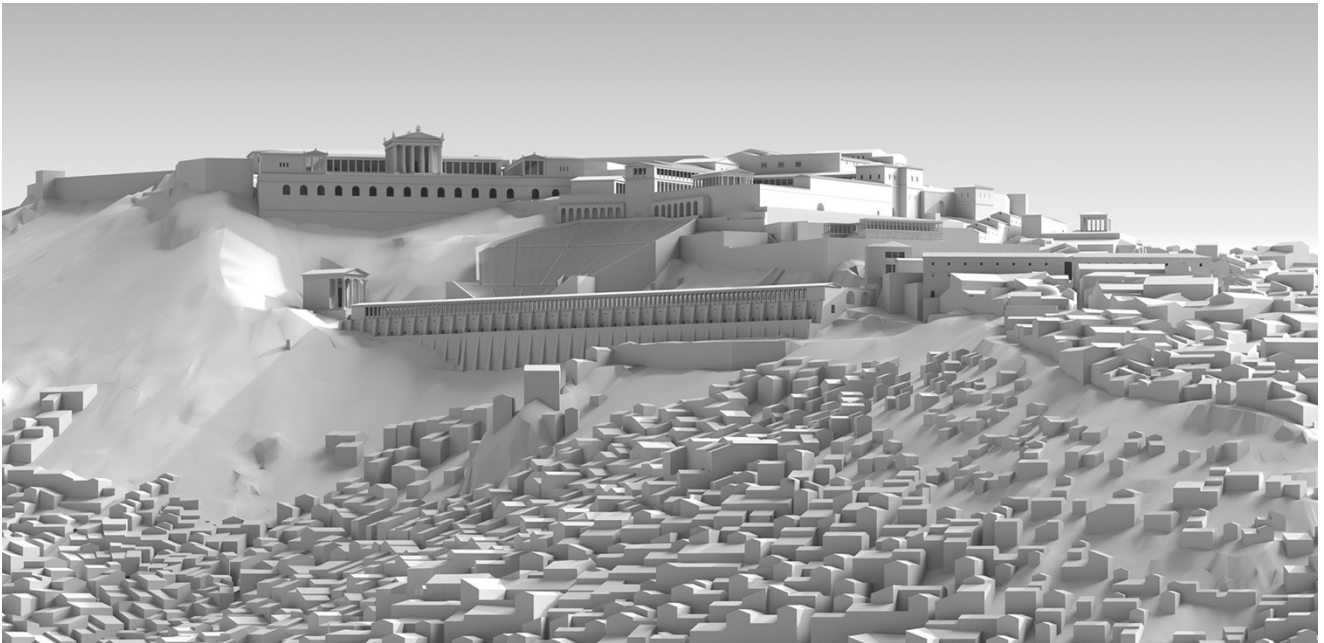


Figure 1: Skyline of the ancient metropolis Pergamon around 300 CE

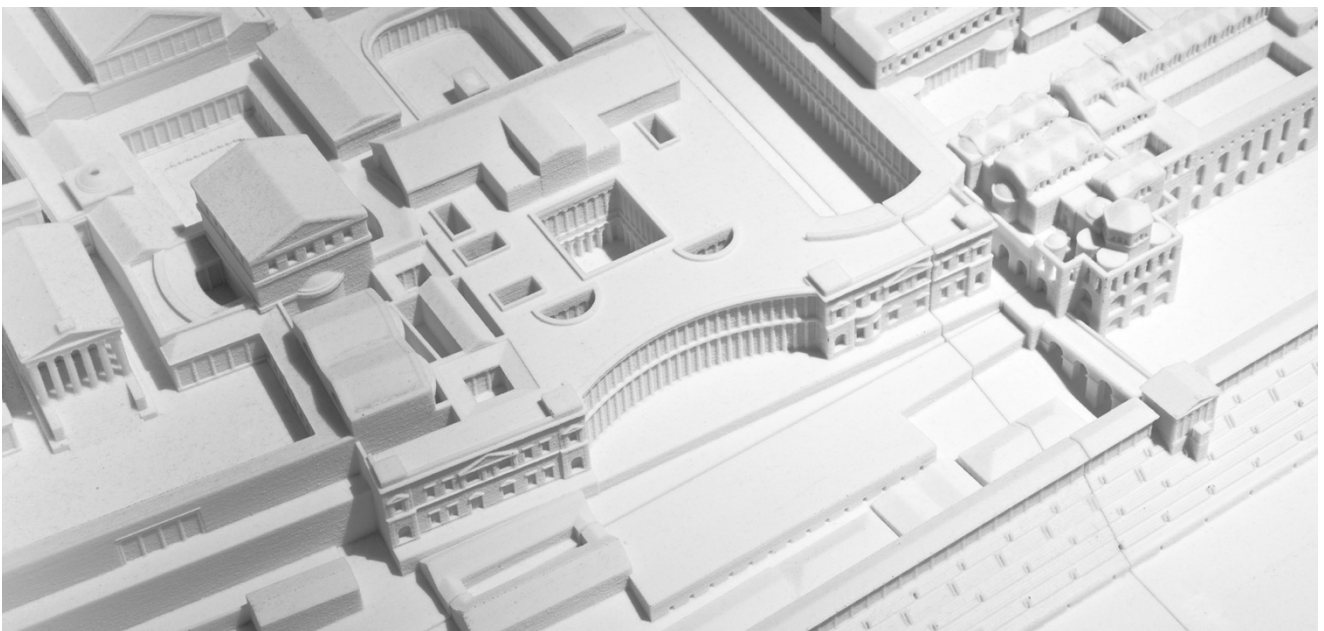


Figure 2: 3D print of the Roman imperial palaces on the Palatine Hill in Rome



Figure 3: The Pergamon archaeological site as it stands today



Figure 4: The entire city mountain of the ancient metropolis Pergamon around 300 CE

2. METHOD

The visualisation of uncertainty in the knowledge of archaeology is a central question of design, because the aim is to create completely new forms that do not exist in physical reality, the aim of which is to evoke abstract ideas in the viewer. Even if the ideas that arise from this in the viewer's imagination are not the same as those that existed in the imagination of the author of the verbal hypotheses, the archaeologist, at least the amount of free invention is so negligible that the viewers become aware of it. They immediately see that it is necessary to reflect on what they perceive, recognise its scientific nature and question what they see involuntarily and quite appropriately. This is already a great achievement. But this time, the method demonstrated in the previous conferences using various projects goes one step further and focusses on representations in which the architectural idea can be read in the sense of a design idea despite the uncertainty, similar to a design sketch in a contemporary architectural project. In contrast to an all-encompassing representation, which also contains all the metadata, the difference is that the architectural idea, and therefore the origin, perhaps even the motivation for the realisation of the site, becomes subtly visible. An essential aspect here is the photographic composition, which can be used to further focus the viewer's gaze in a particularly effective way, so that things that should not be visible are not revealed.

This is the fundamental difference to models that can be looked at from all sides (Figure 5). Such models, and insofar as they are static, this applies equally to physical and virtual models, must be designed in such a way that the content to be conveyed, i.e. the scientific hypothesis, can be read from all sides equally. It is obvious that this cannot be realised in the same targeted manner as in a photographically composed still image. In this respect, the model to be examined from all sides poses a particular challenge, a new trade-off between an excess of misleading information versus omitted information. In the case of a physical model, there is another condition that does not apply to the virtual model, namely stability as an interplay between material and filigree. Here, the material properties must be taken into account in such a way that the model supports itself in the general case or, as in the present case, the model also withstands the requirements of being touched by museum visitors. Here it is primarily up to the museum to estimate the risk of vandalism and to plan ahead and thus at least facilitate the possibility of partial repairs, for example by fragmenting the model.

This immediately creates an additional requirement. A material that is particularly well suited for haptic models is Corian, a type of artificial stone commonly used as sanitary ware, which is particularly less sensitive to staining due to its particularly smooth surface. However, the main disadvantage of this material is its manufacturing: it cannot be additively fabricated or printed, but only bent and milled. The major difficulty therefore lies in preparing the geometry in such a way that the drill can reach the areas that need to be taken out of the block. Entire cavities, as in the additive process, are therefore excluded. So the issue is not the fineness of the detail, but a question of accessibility. Small ornaments are not a problem, but objects that are too close together, such as narrow streets or inner yards, certainly are (Figure 6). The same data set as for an additive three-dimensional print cannot be straightforwardly used to operate the milling machine, as the result would look completely different. Instead, the object – and this applies in particular to architecture and cities – must be specifically fragmented in such a way that the milling machine can actually produce all the essential surfaces. As a result, the necessary joints that result from the fragmentation will become visible edges, which will ultimately become visible through dirt and abrasion when the model reaches a certain age. These joints must therefore be planned in the same way as the geometry itself. Otherwise they will become independent, i.e. in the worst case they will suggest a meaning to the viewer in the sense of the hypothesis if they are not recognised as technically caused production joints or at least intuitively ignored as irrelevant.

Overall, the stability of the material, which in the case of Corian is very high, the production by a milling machine with its limitations, not in the mobility of the robot arm, but in the accessibility, and the visibility of the fragmentation raise new questions regarding the design. After all, it is always the visible form that determines the perception and thus the interpretation of the model. Therefore, as is generally the case in the visualisation of uncertainty, specific new forms must be designed that are able to approximate the hypothesis as closely as possible under the given conditions. And here, too, this means finding a balance between proximity to the hypothesis and the necessary additions for a clear interpretation as architecture.

As in the preceding projects, this does not mean that a mere simplification of the geometry would suffice, especially not with the help of an algorithmic reduction of the level of detail, which also just simplifies by successively removing detail.

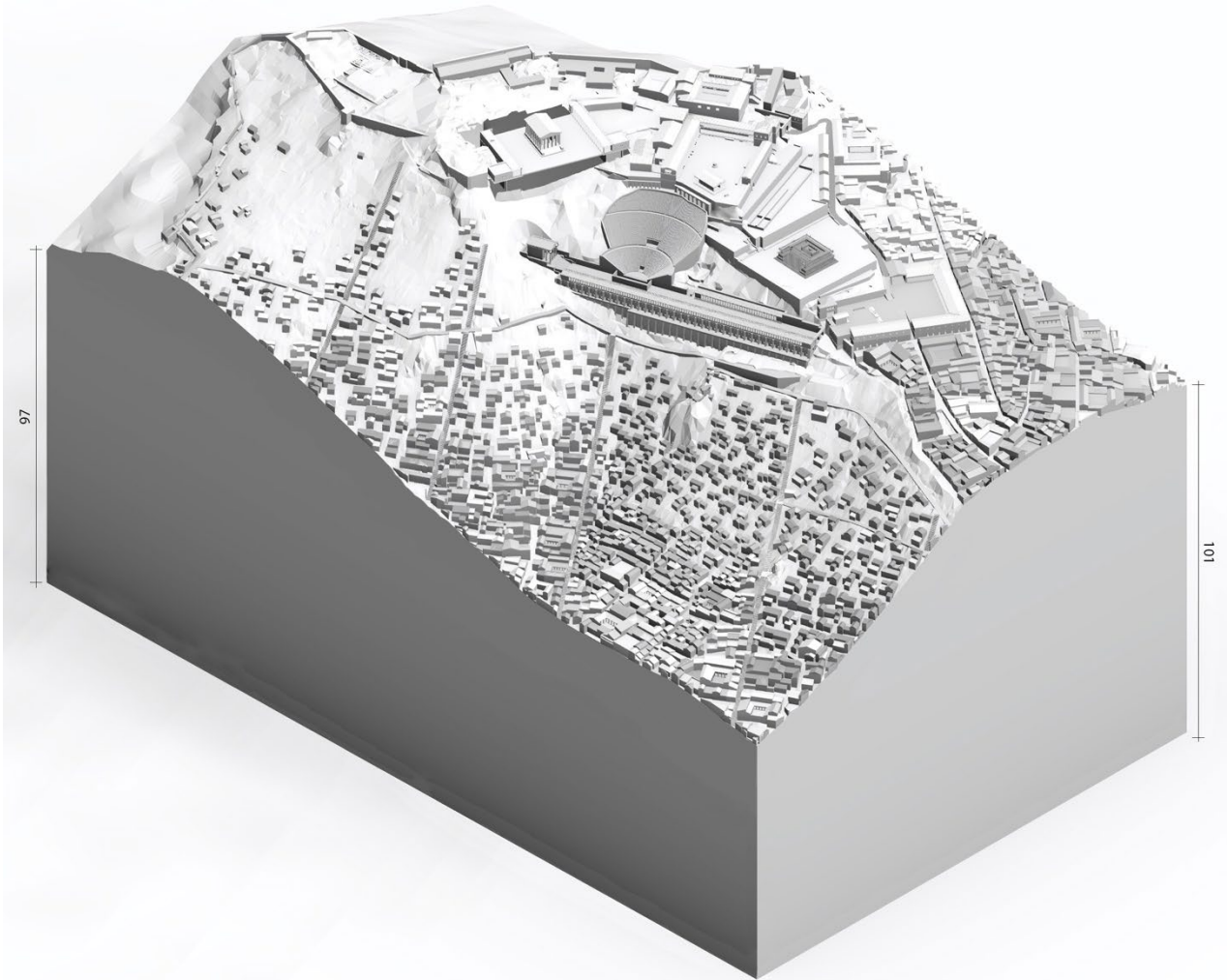


Figure 5: The selected section for the Architecture Hall in the Pergamon Museum Berlin

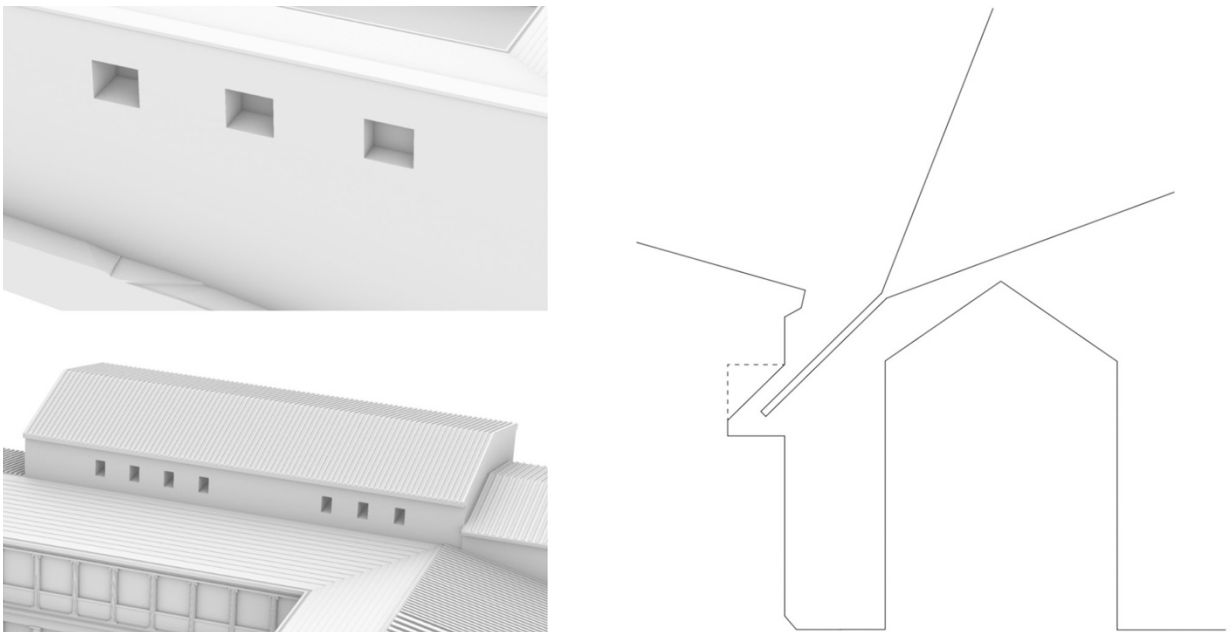


Figure 6: Restrictions according to the production by a milling machine

Its origin lies in a completely different context, namely the reduction of the number of triangles for a smooth performance in real-time movements through the virtual space. Here, on the contrary, the simplification is exclusively concerned with the adequate reproduction of scientific uncertainty, and this can indeed include extremely fine detail in those places where the knowledge is precise. A uniform geometric simplification, as suggested by the standardised levels of detail as used in administrative urban planning, would be highly counterproductive.

But this is not the only concern, there is another no less important circumstance, namely the interrelationship of shapes and dimensions. Some architectural components, such as roof tiles or window cornices, appear much more prominent in the physical reality than in the abstracted monochrome model, which is partly due to the absence of materiality and thus colour, but also to the difficulty of visibility due to the absolute size in the model. In order to correspond to the subjective visibility of the physical reality, it is necessary in certain cases to subtly alter the proportions in the model – after all, the model is more than three hundred times smaller than the physical reality – in favour of the detail, until the visual impact of the model detail corresponds to that of the building component in the physical reality. This consideration is the least algorithmisable and the least objectifiable. This is where design as a form-giving discipline is required in its entirety, this step demands the most creative expertise, and this is where the competence most closely resembles the unpredictability of art, even if this is about applied art.

The reason why Pergamon is particularly suitable for this investigation is due to the long history of the underlying virtual model. The tactile model is the latest development in a series of works produced as part of our sixteen-year cooperation with the excavation and the Istanbul Department of the German Archaeological Institute (DAI). For the first time, it is aimed exclusively at the public and, unlike the previous publications, is not also a research tool. The intensive examination of the subject and the site therefore provide a solid basis for the creation of the tactile model by all those involved.

3. CONCLUSION

Providing models in physical reality that aspire to reflect both actual knowledge and scientificity means weighing up a number of aspects, none of which existed in the historical physical reality of the portrayed city. Such models are not direct representations or mere miniaturisations. Already the scientifically justifiable reproduction of partial

historical conditions implies an immense distance to physical reality. Once this distance has been accepted, the possibilities are essentially limitless. The focus is then on the targeted communication of selected aspects of the research and the portrayed city. The result is by no means a miniature copy of the city, not even a snapshot in time. The result is a purely theoretical construction, a synthesis of different information, and of different types of information. The external resemblance of the geometry to the actual historical city is nothing more than a visual similarity. This is intentional, but at the same time sufficient as soon as it is recognised as such. Any information beyond this obvious similarity did not exist in this form in antiquity. Nevertheless, such a model is able to convey considerable information about the ancient city. Being able to be touched will also help in the future to ensure that the urban structure, which is something rather unexpected when standing in front of the large altar in the museum, can also be accessed by people with special visual needs.

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Walking in the Cold: AI-Generated depictions of warming permafrost

Bahman Fakouri
The University of British Columbia
3505 Spectrum Ct, Kelowna, Canada
Bahman.fakouri@ubc.ca

Megan Smith
The University of British Columbia
3505 Spectrum Ct, Kelowna, Canada
megan.smith@ubc.ca

The "Walking in the Cold" project, developed by the Critical Future Studio/Lab at the University of British Columbia, leverages artificial intelligence (AI) to visualize the consequences of permafrost warming in northern Canada as a means of effectively communicating climate change implications. As climate change threatens to reshape northern Canadian landscapes, psychological distance hinders public engagement—climate change is often perceived as a remote issue in terms of time, space, and relevance. To address this challenge, the team combines syndicated climate data from governmental sources with ChatGPT's AI capabilities to create vivid, data-driven visual narratives. By training ChatGPT with climate data, the project generates tailored prompts for AI text-to-image generators, producing images grounded in verifiable data and reflecting future landscapes under the threat of climate change. The project's methodology involves acquiring, curating, and transforming climate data into compelling visuals. The AI-generated images aim to present objective foresights, fostering a deeper connection with the subject matter and eliciting emotional resonance in viewers. These visuals also demonstrate the intricate role of the permafrost in the ecosystem.

Artificial intelligence. Data visualisation. Climate change.

1. INTRODUCTION

Confronting the harsh reality of climate change requires not only a thorough understanding of the science behind the change, but also effective communication strategies to engage a diverse global audience in the climate change situation. Among the starkest manifestations of this burgeoning crisis is the warming of permafrost in northern Canada—it is an alarm bell ringing for the fragility of our environment. These vast, frozen grounds are thawing at an unprecedented rate, with far-reaching consequences across local ecosystems, infrastructure, and into global climate patterns (Natural Resources Canada 2020).

Effective storytelling can bridge the psychological distance that often renders climate change a remote, and intangible issue. By harnessing the power of emerging technologies and immersive visualisation methods, we can illustrate immediate dangers and stimulate a sense of urgency that statistical data alone often falls short on conveying. This paper introduces "Walking in the Cold," a novel project that employs artificial intelligence (AI) to convert climate data from credible Canadian government sources such as Natural Resources Canada, Environment and Climate Change Canada, and Climate Data Canada into vivid visual

narratives. These AI-generated depictions serve as a clarion call, visually articulating the impacts of warming permafrost and challenging public inaction.

The project is pioneering a new approach to apply integrating AI, specifically leveraging the language model ChatGPT, to generate prompts that catalyse the creation of compelling images through AI-driven text-to-image generators. By training ChatGPT with extensive climate datasets, narratives are crafted that offer a window into future landscapes shaped by climate change. These visuals are designed to resonate with people by presenting a future that is not merely a possibility but a plausible outcome if no action is taken.

In this introduction, the necessity of addressing climate change is outlined through innovative communication methodologies. The other discussion in this paper is the transformative potential of AI in generating a visceral understanding of the issues surrounding the warming of permafrost regions. "Walking in the Cold" is not just a project; it's a journey towards bringing the abstract and distant phenomenon of climate change into the personal and immediate realm of public perception, igniting conversations, and inspiring actions for a sustainable future.

2. BACKGROUND

The backdrop of climate change visualisation and communication is replete with challenges and opportunities for improving public awareness, promoting sustainable practices, and fostering informed decision-making. Clarity of message and engagement of stakeholders are crucial to catalysing climate action. In the complex landscape of climate change communication, both successful and unsuccessful examples can be found. The challenge lies in overcoming cognitive and emotional barriers to enhance public awareness, promote sustainable practices, and foster informed decision-making. Yet, effectively conveying the urgency of environmental threats, like the warming of permafrost regions to a broad audience remains a complex task marked by cognitive and emotional barriers (Booth 2012). It is within this context that AI-driven visualisations have started to play a transformative role.

The following examples are discussed to provide insight into the factors contributing to effective and ineffective climate communication: first, a notable case of failed communication, the “Just Stop Oil” movement, followed by a successful example, “Arcadia Earth”. A notable example of unsuccessful climate communication is the “Just Stop Oil” movement. While their goal of ending new fossil fuel licensing and production in the United Kingdom is commendable, the confrontational and disruptive nature of their chosen tactics overshadows their intended message. The movement’s emphasis on direct action, vandalism, and traffic obstruction often leads to a negative public reception, causing potential supporters to distance themselves from the cause. Furthermore, the movement’s lack of clear messaging and engagement with stakeholders often hinders their ability to create meaningful change in public opinion and policy.

An example of successful climate communication is the “Arcadia Earth” project. While the initiative utilizes art and technology to convey critical messages about sustainability, it avoids the pitfalls of confrontational tactics, maintaining a positive and engaging public reception. By focusing on immersive storytelling, “Arcadia Earth” fosters a sense of responsibility and empowerment among its visitors. The creators of “Arcadia Earth” meticulously design each exhibit to provoke thought, and inspire action. This approach encourages visitors to reflect on their role in shaping the future, ultimately creating a more meaningful impact than divisive tactics.

Existing literature details various methodologies for public engagement on climate change, often highlighting the necessity of translating data into compelling narratives (Bloomfield & Manktelow

2021). People tend to connect more powerfully with stories that evoke emotional responses, compared to abstract numbers and graphs (Morris et al. 2019). Unfortunately, psychological factors such as the bystander effect and diffusion of responsibility often dilute the potency of urgent environmental messages (Frantz & Mayer 2009). These phenomena serve as psychological barriers by fostering a disconnect between awareness and action in the context of environmental crises.

To overcome these hurdles, the environmental communication field is increasingly recognizing the utility of digital storytelling. Innovative use of visual media has the capacity to distil complex scientific concepts into accessible and relatable content. This narrative approach is grounded in the concept of employing storytelling as a means to affect change (Heemsbergen et al. 2022). Stories have the power to influence perceptions, shift attitudes, and motivate individuals towards pro-environmental behaviours by making the abstract nature of climate change more tangible.

“Walking in the Cold” emerges from this convergence of science and storytelling, aiming to leverage the latest advances in AI to present climate data as immersive, emotionally charged visual stories. By integrating ChatGPT and AI text-to-image tools, the project forges a path that allows audiences to witness potential futures in a more direct and meaningful way than traditional modes of data representation provide. This background serves as a foundation for understanding how AI could be a potent tool used for demystifying and democratizing climate science, and become a method to usher in a new era of public engagement and environmental advocacy.

3. METHODOLOGY

“Walking in the Cold” is created to bridge a communication gap between complex, hard to read scientific data, government methods for sharing and visualizing climate data, mainstream media video news reels and the flood of social media clips that may or may not be relaying true interpretations of climate change stories. All of these methods affect a person’s perception and knowledge level of the situation, but “Walking in the Cold” attempts to apply evocative techniques in combination with the data and distributes the knowledge across social media channels. The project relies on the seamless integration of data analytics and the visual application tools of artificial intelligence engines. The approach involves a multi-phase process beginning with the meticulous curation of climate data provided by Government of Canada. It eventually culminates in the computational generation of visual depictions of a warming Arctic

environment. These visuals are then subjectively chosen or re-edited by the artists to increase levels of locational accuracy, or for instance to remove cultural or gender biases that the AI embeds.

In the initial phase, the project started with the acquisition and analysis of climate datasets from credible government sources, such as Natural Resources Canada, Climate Data Canada and Climate Atlas of Canada. These data repositories, among other things, contain the historical and projected metrics of permafrost temperatures in various locales within northern Canada. For instance, 'Canada's Changing Climate Report (2019)' states that 'ground temperature and active layer thickness increased across the North. Cold permafrost temperatures in the High Arctic rose faster than warm permafrost temperatures in the Central Mackenzie Valley, reflecting quicker air temperature and precipitation pattern changes in higher latitudes.' The rigorous vetting of the data sources ensures that the project AI models are fed with information that is both accurate and relevant to the narrative of permafrost warming.

Following the data curation, is the training of ChatGPT, instilling in it the nuances and intricacies of the datasets. This process involves defining data-driven prompts specific enough to generate an accurate portrayal of future climates yet abstract enough to allow for creative interpretations by the AI. Skilful crafting of prompts is crucial as it directly influences the efficacy of the generated visuals. Here is an example of the initial prompt designed by ChatGPT and the visual results in Midjourney (Figure 1: Image grid in Midjourney):

“Visualize the environmental consequences of a substantial rise in annual average temperatures, from 8.6°C to 12.3°C, in Kelowna, British Columbia, Canada. Showcase the impact on landscapes, vegetation, and local ecosystems. The mood should convey the transformation of this region due to climate change”



Figure 1: Image grid in Midjourney

The initial results generated using the original prompt showed considerable variation in terms of visual style and camera perspective. To ensure greater consistency and specificity in the generated visuals, it was necessary to modify the prompt. The modified prompt includes detailed instructions regarding the desired visual style (brand and model of camera) and lens' focal length:

“Visualize the environmental consequences of a substantial rise in annual average temperatures, from 8.6°C to 12.3°C, in Kelowna, British Columbia, Canada. Showcase the impact on landscapes, vegetation, and local ecosystems. The mood should convey the transformation of this region due to climate change, Sony a1, 35 mm”

The image generated after the prompt modification not only demonstrates an increased similarity among the results but also offers a markedly realistic portrayal of the environmental consequences of the substantial rise in annual average temperatures in Kelowna (Figure 2: Image grid in Midjourney after prompt modification).



Figure 2: Image grid in Midjourney after prompt modification

Furthermore, the project uses an AI-driven text-to-image tool, such as Midjourney, using the prompts developed by ChatGPT. In combination, these tools, with their capabilities of producing detailed and expressive imagery, transform the text-based narratives into striking visual representations. Then an iterative process of image generation occurs which is designed to refine the prompts and hone the visuals to best achieve a balance between realism and conceptual impact.

Through this methodological framework, each image generated is an intersection of an extensive data backbone, advanced AI technology, and artistic expression. The aim is to root the resulting artwork firmly within a narrative that is engaging for the public yet retains fidelity to the underlying climate data. This methodology is central to the project's vision — making climate science more accessible and stimulating a broad-based dialogue on environmental issues.

Among other artists who have worked with AI and climate change, Refik Anadol has been building immersive land-change dioramas as well (Glacier Dreams 2023). 'Walking in the Cold' sits close to Anadol's techniques of pushing the limits of computational art to relay a science-based story while structuring the artworks as immersive and somewhat shock intensive pieces. All work involving AI also needs to carefully consider the environmental impact of each search and image generation process, as well as the ethical implications of the artists images that were scraped from the internet in the making of this work. Further, it's important to consider the technology itself as a tool, and how a tool can be flawed and include

significant bias. The work of Dr. Joy Buolamwini who taught the world that the AI databases would not recognize people of colour, and that it consistently misgenders women highlights that the tool is flawed. Yet, artists and creatives are essential practitioners within the AI space as they tease out the biases that industry gloss over, and they propel critical dialogues on the tool – on what can be imagined further, what future can be made, and they draw attention to how AI companies are building tools that are appropriating data, control, and claiming creativity.

4. AI-DRIVEN STORYTELLING

At the heart of the AI-driven storytelling pipeline lies the strategic crafting of prompts — a nuanced collaboration between human expertise and artificial intelligence. Through the utilization of ChatGPT, the dense, multifaceted climate data is translated into rich, evocative prompts that capture the essence of the projected impacts of thawing permafrost. This endeavour necessitates a deft understanding of narrative structures and linguistic precision to direct the AI in creating imagery that resonates with the gravitas of the subject.

The storytelling element is critical to the success of "Walking in the Cold." It seeks to elicit an emotional response from viewers by depicting potential futures with a vividness that transcends traditional charts and graphs. Tailored prompts are designed to emphasize the stark realities and profound changes facing the affected Arctic landscapes and communities. Leveraging the immense generative potential of ChatGPT, the goal is to imbue each narrative with a sense of immediacy and relevance, connecting the real-time concerns of climate change with a broader audience's values and experiences.

The transition from text-based prompts to visual scenarios involves sophisticated AI text-to-image generators, representing the latest in deep learning technology, such as Midjourney, Runaway and Stable Diffusion. These tools interpret the prompts and render detailed visualisations, bridging the gap between abstract data and a tangible understanding. By fine-tuning parameters and providing carefully curated input, the AI's generative power is harnessed to produce compelling and varied visual narratives that could potentially speak to each viewer's context, perception of the situation, and imagination.

This AI-driven storytelling approach imbues data with a narrative quality, and it empowers viewers to visualize and conceptualize complex climate phenomena via emotionally engaging and thought-provoking images. This process humanizes climate data, offering an immersive experience where the

abstract becomes intimate, fostering a stronger connection between the global threat of climate change and individual perception and action.

5. RESULTS

The application of “Walking in the Cold” reflects a compelling translation of climate data into immersive visual stories, with the generated images offering glimpses into a future shaped by warming permafrost, flooding and other climate changes. Each visual narrative encapsulates a possible outcome based on current trends and scientific projections, providing a stark contrast to the often-underwhelming impact of mere statistical representation.

The following images (Figure 3 and Figure 4) are derived from initial compositions crafted in the lab, inspired by present-day Canadian Northern communities facing relocation due to escalating permafrost temperatures, which cause land melt. The collapse of land and the changing ecosystem are significantly shifting the northern lands, and these images and their attached prompts are important in their critical story – that humans are already adapting and shifting in these spaces. The images originate with government data, and they grow into evocative scenes of what equate to real situations.

The Figure 3 prompt, originally crafted by ChatGPT and refined by researchers for enhanced results in the Midjourney stage.

“<https://s.mj.run/8zB3B7-G5GM> Image of the consequences of a 2-degree Celsius increase in permafrost temperature over a span of 10 years in a city in Yukon. Create an image that portrays the effects of thawing permafrost, including shifting ground, infrastructure damage, erosion along riverbanks, changing hydrology, disrupted ecosystems, the release of greenhouse gases, challenges faced by communities, waste management issues, and increased fire risk, 8k, RAW photo, best quality, masterpiece, highly detailed building, realistic style, best quality, photo-realistic, uhd, DSLR, soft lighting, high quality, film grain, Fujifilm XT3, 85mm, f1.8, hyperrealistic, super detailed, intricate, high dynamic range --iw 0.2 --style raw”



Figure 3: consequences of a 2-degree Celsius increase in permafrost temperature in the Yukon

Figure 3's prompt was employed to generate a new image representing a city in the Yukon (Figure 4).



Figure 4: consequences of a 2-degree Celsius increase in permafrost temperature in the Yukon

For other instances, in the Regional Perspective Report of British Columbia, it was mentioned that sea levels in Vancouver are projected to rise approximately 135 cm by 2100 due to Antarctic ice melting. This information was provided to ChatGPT to design a prompt, resulting in:

"Visualize Vancouver's future with a 135 cm sea-level rise by 2100 due to Antarctic ice melting."

To enhance the result in Midjourney, the prompt was refined, and a link to an aerial image of Vancouver was incorporated into the system. Midjourney then generated an image based on the provided data, visualizing Vancouver's future with a 135 cm sea-level rise by 2100 (Figure 5).

"<https://s.mj.run/ld2-2v0aU-8> photo of Vancouver with a 135 cm sea-level rise by 2100"



Figure 5: Vancouver 2100

In order to effectively convey the impact of sea-level rise on Surrey, British Columbia, a government image of the region was utilized as a visual prompt, accompanied by the same text prompt that was used for Vancouver and adjusting the Image Weight Parameter to a value of 2. This setting enhancement aimed to emphasize the similarity between the generated image and the current appearance of Surrey, creating a more striking and relatable visual experience for the viewer (Figure 6).

"<https://s.mj.run/PTiZdbXw--w> photo of Vancouver with a 135 cm sea-level rise by 2100 --iw 2"

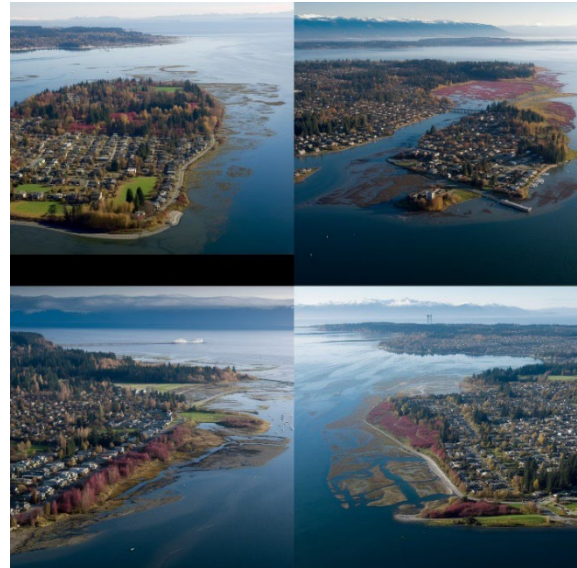


Figure 6: Surrey 2100

In another instance, based on data from climatedata.ca, the historical annual average temperature for Kelowna was 8.6 °C between 1971 to 2000. Projections indicate that, under high emissions scenarios, this average could increase to 10.7 °C between 2021 and 2050 and reach 12.3 °C in the period from 2051 to 2080 (ClimateData.ca 2023). This data was inputted into ChatGPT, which generated the following prompt:

"Visualize the environmental consequences of a substantial rise in annual average temperatures, from 8.6°C to 12.3°C, in Kelowna, British Columbia, Canada. Showcase the impact on landscapes, vegetation, and local ecosystems. The mood should convey the transformation of this region due to climate change"

This prompt was then input into Midjourney to help illustrate the potential visual outcomes (Figure 7).



Figure 7: Kelowna 2080

Visualisation of Richmond's flood consequences was conducted independently in Midjouney, without the assistance of ChatGPT, focusing on climate change-induced sea-level rise. Warmer temperatures cause glacier melt and ocean expansion, increasing flood risks from king tides and storm surges. By 2100, the government of British Columbia is advising municipalities to plan for a 1m sea-level rise, with Richmond's land settling by 0.2m (City of Richmond 2022). The visualisation emphasizes potential challenges and highlights the need for coastal communities to prepare for sea-level rise impacts (Figure 8).

"Hyper realistic photo of Vancouver, Richmond is flooded, drone shot, homes are flooded"



Figure 8: *Richmond 2100*

Feedback from initial presentations to the public across social media platforms Instagram and Facebook, indicates a pronounced emotional influence on viewers, which have generated both private and public conversations within the platforms. This has the potential to heighten the sense of understanding, connection and urgency regarding climate change in general, and then has an impact through increased circulation and access to the specific posts that discuss permafrost-related climate change. These responses are a testament to the project's efficacy in not only informing but also evoking an emotional connection that prompts a call to action. By bridging the cognitive distance between complex data and its human implications, the images serve as a powerful catalyst for dialogue and reflection.

6. CONCLUSION

"Walking in the Cold" stands as a testament to the transformative power of artificial intelligence in environmental storytelling. Transcending the barriers of traditional data representation, this project utilizes AI to bring a personal and impactful dimension to climate change communication, fostering dialogue and inspiring action. By engaging the emotive faculties of our audience, we offer a deeper, more visceral understanding of the implications of permafrost thaw in Canada.

This journey through data acquisition, AI training, and visual generation has not only underscored the capabilities of AI technology in narrative creation but also revealed the potential for such narratives to spur change. As the audience witnesses vivid images generated from real data, they are invited to confront the palpable reality of climate change in a way that statistics or reports seldom achieve. These visual narratives will continue to act as catalysts for awareness, discussion, and proactive environmental stewardship.

In conclusion, the conversation around climate change requires innovative approaches to cut through the noise of a data-saturated world. "Walking in the Cold," with its novel utilization of AI and creative storytelling, posits a blueprint for future projects and initiatives. These endeavours will benefit from the findings in this project, using AI not just as a tool for analysis but as a medium for composing compelling graphical communication.

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Research on the Interactive Learning Mode of Intangible Cultural Heritage Interactive Video Based on Digital Narrative Theory

Minliang Bai
Guangdong
University of
Technology
Guangzhou, China
Ambrose_bai@163.com

Congxiao Sang
Guangdong
University of
Technology
Guangzhou
939577713@qq.com

Tingting Wei
Jinan University
Tianhe District
Guangzhou
China
619220375@qq.com

Yi Ji
Guangdong
University of
Technology
Guangzhou
jivi001@hotmail.com

Sean Clark
Guangdong University
of Technology, De
Monfort University
Leicester, UK
seanc@interactdigitalarts.uk

XiuHong Li
Guangdong
University of
Technology
Guangzhou
247273866@qq.com

This paper discusses the digital dissemination and interactive learning model of intangible cultural heritage (ICH), emphasizes the importance of ICH inheritance, and points out the limitations of existing digital dissemination methods such as WebAR, VR, live streaming and MOOC online education. Due to the impact of COVID-19 and the development of online video courses, ICH online education needs innovative ways to enhance the learner's experience. This paper also explores the development and application of digital narrative theory, and cites four structures of digital narrative proposed by Henry Jenkins: Evocative Spaces, Enacting Stories, Embedded Narratives and Emergent narratives, to analyse the interactive video course of ICH. Further, the paper also analyses the application of digital narrative theory in the online video course of Guangcai porcelain, and proposes to improve learners' creative participation experience through interactive learning mode. The research also includes user research and interactive video design analysis, aiming to solve challenges in online education of Guangcai porcelain by combining digital narrative theory and interactive video technology.

Interactive video. Intangible cultural heritage. Interactive learning. Digital dissemination. Digital narrative.

1. INTRODUCTION

The preservation of Intangible Cultural Heritage (ICH) is essential to bolstering a country's soft power in the cultural sphere since it embodies the historical and cultural complexity of that nation. The journey of ICH preservation involves a large number of practitioners and researchers, some of whom mix ICH with modernization. "Digital dissemination" of ICH is one significant way that this modernization is being demonstrated. Digital dissemination techniques that are now in use include live streaming, MOOC online education, WebAR, VR, and live streaming (Hammad, Harpstead, Hammer 2021) and (Lu 2019) and (Chen, Ji & Tan 2019). These techniques all play a major role in the spread of ICH. Unfortunately, there are drawbacks to the existing digital distribution model. For example, learners are not able to completely experience the

production process of ICH, which results in partial absorption of knowledge and an inability to produce exceptional, customised works. Additionally, we've also entered an era of "mass" online video courses thanks to the global expansion of COVID-19 and the growth of MOOC online courses (Hou 2021, Tang & Chen 2021, Hu & Xie 2020). Studies conducted early in the epidemic revealed minimal public knowledge of and acceptance of online video courses, which had problems with low emotional engagement, low practicality, and poor learning quality. Online video courses have an impact on the spread and evolution of ICH culture since they are an essential digital distribution channel for ICH. The goal of this study is to develop an interactive learning model for online video courses of traditional ICH crafts by utilising digital narrative theory. This will improve learners' creative involvement experience in online ICH learning.

2. HENRY JENKINS' DIGITAL NARRATIVE THEORY

Henry Jenkins, in his article "Game Design as Narrative Architecture," proposed four structures of game narrative (Jenkins 2004):

Evocative Spaces: These are environments with a specific atmosphere that evoke inherent impressions in players. This narrative mode can also be applied in videos, such as the futuristic scenes, technological inventions, and character makeup in the movie "Back to the Future," all designed around the public's perception of the "future," conforming to the audience's impressions and aiding their immersion into the plot.

Enacting Stories: Here, players enact characters and perform actions, with the game environment providing the setting. This narrative technique can be applied in most role-playing games, where players progress the story by controlling the "main character" in the game's plot.

Embedded Narratives: This involves narrating by dispersing information across various locations in a scene. Some scholars in China have noted a "narrative contradiction" in interactive videos and used Henry Jenkins' digital narrative theory to deconstruct the narrative environment in these videos. Since the audience needs to rely on the plot to deduce and choose their preferred options, the author suggests that interactive film works lean more towards the concept of embedded narratives. (Liu 2020)

Emergent Narratives: These provide players an environment to create stories. Games like "The Sims" and "Minecraft," where players build their own "stories" through creation, are typical examples of this narrative model.

Jenkins primarily applied this theory to game narratives in his article, but with years of development, game narratives are often referred to as digital narratives or interactive digital narratives. He stated that these four narrative structures could coexist in an interactive work, with interactive videos like "Black Mirror: Bandersnatch" and "The Origin of the Buddha Head in the Antique Bureau" containing these narratives. (Liu 2020) and (Roth & Koenitz 2019).

3. ANALYSIS OF ONLINE INTERACTIVE VIDEO DESIGN FOR ICH CRAFTS BASED ON DIGITAL NARRATIVE THEORY

3.1 Online learning data research for students of blended ICH craft teaching

In data collection, the focus was primarily on online video courses for innovative blended teaching of traditional ICH crafts, specifically Guangcai Porcelain. The aim was to examine the online learning status and habits of students who have participated in these courses and to identify and record any issues.

On the online video course learning platform, the target course involved the traditional craft of Guangcai Porcelain firing techniques, and the course type was recorded video. Data collected included daily active users, average comprehensive scores, chapter tasks, and chapter quizzes.

The course was launched on related online video course learning platforms in March 2022 and was integrated into offline workshops for synchronous teaching in November of the same year. To date, it has combined with offline workshops for two sessions of blended teaching for traditional ICH crafts.

The online recorded course content is related and concurrent with the offline craft workshops, and the online video course grades are calculated together with the offline workshop grades.

The total number of participants for the two courses was 30 each. For the Autumn 2022 course, the daily active users averaged 3, the average comprehensive score was 2, the average progress of chapter tasks was 9, and the average progress of chapter quizzes was 1.

From the data results and my personal experience volunteering in offline workshops, it's evident that the engagement in online courses is low, and there is a significant contrast between students' online and offline performances.

Combining the literature research "core elements between students and online courses" (as shown in the table2) with the data on traditional ICH craft online courses, it raises questions whether online video courses in ICH crafts also face issues like low student initiative, poor attendance, lack of emotional engagement, and lack of data feedback evaluation? Or could there be other problems due to the course category? To address these questions, user research was conducted focusing on learners' experiences in online learning of traditional crafts.

Table 1: Competitive Analysis of Interactive Videos and Online Video Education (Hou 2021)

Core elements between students and online courses	
Self-awareness of learning	<i>Poor students' self-control, Poor students' initiative, students' attendance is low, students are addicted to the Internet, lack of time management, time planning is unreasonable</i>
Learning evaluation	<i>Unmeasurable learning outcomes, lack of immediate feedback, data feedback evaluation, aversion to online exams</i>
Others	<i>Poor interaction between teachers and students, the design of interactive links is not in line with the online cognitive law, and the lack of emotional engagement</i>

3.2 User interviews

The method of user research adopted for this study was interviews, inviting 12 learners who participated in the online recorded courses of traditional ICH Guangcai Porcelain as interviewees. The interview questions were designed around the learners' experiences in the online recorded courses of Guangcai Porcelain.

The interview outline was divided into four categories: impression survey, experience survey, knowledge construction survey, and interactive video experience willingness survey.

The impression survey aimed to corroborate the results of previous literature research. The interviews revealed that users' views and attitudes towards online recorded video courses were consistent with the literature research results, finding online recorded courses boring and dull, leading to issues like low student initiative and poor attendance.

In the survey on the experience of the Guangcai Porcelain recorded courses, over half of the respondents felt that, as a highly practical craft, the cultural essence of Guangcai Porcelain firing techniques could not be deeply understood through mere recorded video lectures.

In the survey on knowledge construction, the majority of respondents believed they gained little applicable knowledge from the course, making the post-course exercises and assessments challenging. They needed to supplement their learning with additional resources.

In the survey on willingness to experience interactive videos, all participants expressed optimistic

expectations for interactive video courses on Guangcai Porcelain. They believed that such courses could potentially address issues of low engagement and poor interactivity in traditional online courses, enhancing user engagement through multisensory involvement, and achieving a synergistic effect greater than the sum of its parts.

Based on the interview results, the following conclusions were drawn:

The online recorded video courses on Guangcai Porcelain face issues of low student initiative, poor attendance, and lack of emotional engagement.

As a highly practical traditional ICH craft, the mere recorded video lectures cannot fulfil the learning expectations for Guangcai Porcelain firing techniques.

These issues affect the students' ability to absorb key knowledge points effectively, impacting their ability to construct knowledge autonomously, leading to poor performance in post-course exercises and assessments.

Users have high expectations for the combination of "interactive videos" and "Guangcai Porcelain online courses." Given the relative ease of implementing interactive video technology, its low operational threshold, and its potential for widespread dissemination, it aligns with the strategy of "interactivizing" the online recorded video courses for Guangcai Porcelain.

4. ONLINE INTERACTIVE VIDEO DESIGN FRAMEWORK FOR ICH CRAFTS BASED ON DIGITAL NARRATIVE THEORY

Combining the literature and user research findings, it's evident that online recorded video courses generally suffer from low engagement, dull explanations, and poor student initiative. Additionally, the traditional and highly practical nature of Guangcai Porcelain firing techniques means that the monotonous and singular online teaching format also affects its cultural transmission and development. Therefore, this study combines Henry Jenkins' digital narrative theory with the standard processes of Guangcai Porcelain firing techniques to design an interactive learning model for online video courses on traditional ICH crafts.

4.1 Narrative structure of online interactive videos for traditional ICH crafts

4.1.1 Evocative spaces

Visually and auditorily, to resonate with most viewers' perceptions of Guangcai Porcelain craftsmanship, the videos incorporate traditional

Chinese elements and materials related to Chinese porcelain craftsmanship. This includes the characters' clothing, scenes and tools used for porcelain making, choice of background music, and the selection of Mandarin and Cantonese voiceovers, all aimed at evoking viewers' inherent impressions of Guangcai Porcelain craftsmanship.

In terms of plot setting, the story is set in the Republic of China era, featuring characters like a master familiar with Guangcai Porcelain techniques, an apprentice learning the craft, and several merchants ordering Guangcai Porcelain. The master informs the apprentice of the merchants' requirements, and the apprentice must fulfil different orders and thus complete different pieces of Guangcai Porcelain. By setting a relatively complete main storyline, the video gradually guides viewers through the story, allowing them to experience the past glory of Guangcai Porcelain in commercial trade.

In terms of video interaction, the method draws inspiration from existing interactive film works, such as "Black Mirror: Bandersnatch" and "Her Smile," where viewers progress the plot by choosing different options. The primary goal of the video is still to facilitate learning about Guangcai Porcelain. Choosing options is not only for advancing the plot but also for creating a quiz-like atmosphere for users, who can deepen or adjust their understanding and cognition of knowledge through feedback from the story.

4.1.2 Enacting stories

In plot settings, taking cues from some interactive videos and RPG games, a controllable protagonist – a Guangcai Porcelain apprentice – is established. Users can observe and advance the story through the "apprentice's" perspective, enhancing their sense of immersion in the story.

In video interaction, users control the "apprentice" to make choices that advance the production of Guangcai Porcelain orders. Different actions lead to different plot developments and reactions from the protagonist, with scene settings and background music changing accordingly.

Visually and auditorily, the protagonist's expressions and actions vary with the plot. For example, when making a choice, the protagonist's gaze turns towards the option box, and if the choice is wrong, the protagonist looks disappointedly at the user, indicating the need for reselection through dialogue or actions. The video features voice actors from Guangdong for a bilingual (Mandarin and Cantonese) voiceover. The realistic voice acting,

and the inclusion of Cantonese consider the regional culture of Lingnan, all aiming to enhance the user's immersion in the story.

4.1.3 Embedded narratives

Visually and auditorily, users build their understanding of the knowledge by combining visual elements from the screen and auditory elements from the background sound with the plot, then make their choices. Feedback on the correctness of the choices helps users adjust their thinking and ultimately construct a correct knowledge framework. In terms of plot arrangement, the video leads users through the story with the "apprentice" as the main character. The character's dialogue includes clues to the correct options, allowing users to discover hints through the storyline and dialogue, and piece together their thoughts to make the right choice.

In option design, the video mainly uses text on the options as hints. Users can associate the text with the plot and visual elements, aiming to allow users to piece together clues to complete their knowledge construction.

4.1.4 Emergent narratives

In terms of plot design, three main storylines are created for users, allowing them to choose different orders at the beginning of the video to make different types of porcelain. The final product depends on the choices made by users throughout the video.

For interactive design, users are provided with an environment to "create" their own story by making choices in the interactive video, leading to different story branches and ultimately their unique "storyline."

In learning interaction, the user's own "storyline," including story branches and interactive nodes, is significant. In most existing interactive videos, users can view their interaction nodes within the video, a feature present in interactive videos on platforms like iQIYI and Bilibili. Users can review their interaction nodes to reinforce and better form their knowledge framework.

4.2 Interactive learning model system architecture

Based on the digital narrative theory of Henry Jenkins, this study will design an interactive learning mode for the online video course on Guangcai porcelain based on the conventional process of porcelain firing techniques. The learning mode structure and system diagram are as follows:

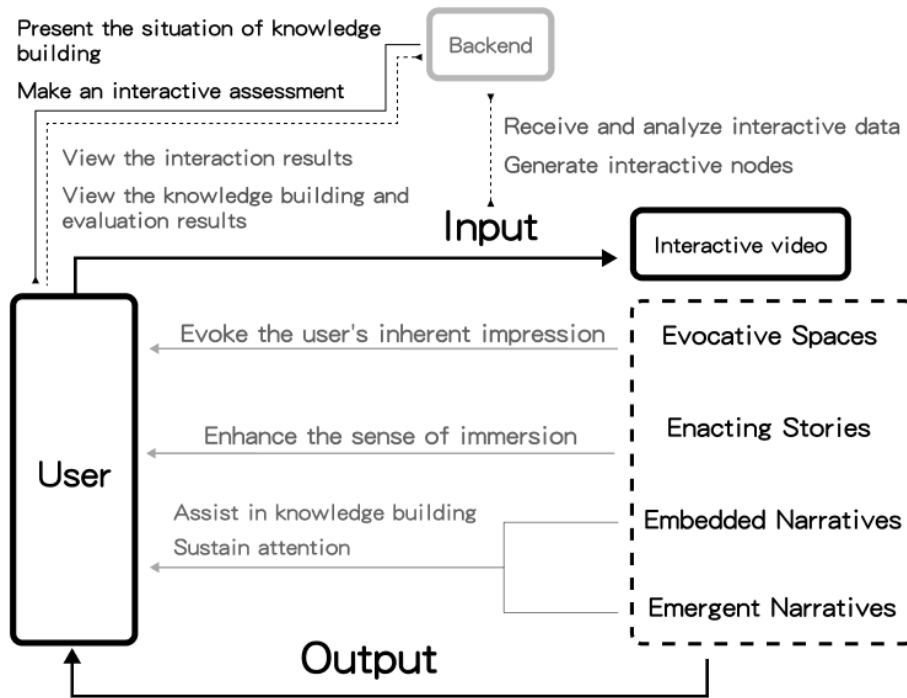


Figure 1: Interactive learning model architecture for online guangcai porcelain video courses.

In the design phase of the interactive learning model for online Guangcai Porcelain video course, it's envisioned to combine with traditional recorded video courses. Interactive videos will be a part of the learning process in traditional recorded video courses, integrated into the same learning platform, sharing learning data and test question banks.

In this interactive learning model design, the student learning process is divided into three steps: knowledge learning, knowledge testing, and knowledge consolidation.

First step, knowledge learning: Students learn about the history, craftsmanship, and production process of Guangcai Porcelain through watching traditional recorded video courses and interacting with interactive videos.

Second step, knowledge testing: After watching the course content, students can start knowledge tests for corresponding chapters, and take exams at the end of the course. In interactive videos, since branching options also have a testing nature, interaction data is recorded in the backend. Thus, when students interact with the videos, they are simultaneously "learning" and "testing."

Third step, knowledge consolidation: Students can consolidate their learning by reviewing test results, interaction nodes in interactive videos, and revisiting course materials to deepen their impression of the knowledge points and form their knowledge framework.

Teachers and the system assist students in learning, monitoring learning status and tracking learning after class. At the system end, the data of user video viewing and assessment test are analysed and summarized, and corresponding feedback will be given, such as test accuracy rate and interactive nodes of interactive video. The teacher can adjust the course according to the students' learning data, such as refining the guide, adding or optimizing the teaching content.

5. GUANGCAI PORCELAIN ONLINE INTERACTIVE VIDEO DESIGN PRACTICE

In combination with the integrated materials and research data in the early stage, this stage will focus on digital narrative theory and make interactive video demo for the interactive learning mode of constructing online recorded courses of Guangcai porcelain based on digital narrative theory.

The first work is the production of interactive video demo. This stage is guided by iQiyi's interactive video production standards, and starts with the production and editing of materials, as well as the design of interactive content. Considering the production cycle and ease of experimentation, Bilibili was chosen as the production platform for interactive video demo.

The main work completed in this stage includes: storyboard design, branching design, visual element design, Mandarin dubbing recording, material editing and production.

In the production of storyboards and processes, the focus is on the overall plot framework, and the background and characters of the plot are determined, as well as the steps of porcelain production, storyboard sequence, picture composition and character lines of the video. The video plot is divided into 7 steps, which are: selecting orders, selecting porcelain, selecting patterns, selecting motifs, making pigments, inking, filling colours and firing. At present, we have completed the production of one orders.

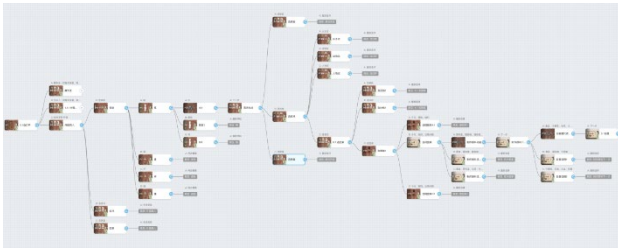


Figure 3: Plot branch of guangcai porcelain interactive video

The branching design needs to take into account each interaction point of the interactive video and what plot trend each interaction point will cause, which can reflect the evolution logic of the entire interactive video.



Figure 4: Visual elements design.

In the design of visual elements, 2D style is mainly used, and the distinction of character material, object material and pattern material is made. Design multiple expressions for the main characters and make them change coherently during editing to enhance the vividness of the characters and the audience's sense of immersion.



Figure 5: Screenshot of guangcai porcelain interactive video.

6. DISCUSSION

Based on the digital narrative theory, this paper discusses the digital communication and interactive learning mode of ICH. Taking Guangcai porcelain as an example, combined with the results of theoretical research, competitive analysis and user research, it builds an online interactive video framework and designs an interactive learning mode. It aims to solve the problems of the traditional ICH teaching and communication, such as the inability of learners to immerse themselves in the learning process and the single teaching mode of teachers.

Henry Jenkins' digital narrative theory provides a new learning mode for ICH learning. The Evocative Spaces, Enacting Stories, Embedded Narratives and Emergent Narratives proposed by Henry Jenkins provide a new narrative mode for the production of ICH interactive videos. The online interactive video of intangible traditional handicraft designed based on this theory not only expands the application of this theory, but also expands the application of ICH. Further solve the problem of ICH digital learning and dissemination.

However, due to the differences and uniqueness of different ICH, the interactive learning mode provided in this study is not necessarily applicable to all ICH interactive learning. Moreover, the sample data investigated in this study needs to be increased in order to systematically improve the interactive learning mode of Guangcai porcelain. This paper will also provide a new idea for expanding the road of ICH digital dissemination, and help ICH better develop.

7. CONCLUSION AND FUTURE WORK

Universities in China and other countries have opened online teaching of intangible traditional handicrafts, most of which are disseminated and exported in the form of video courses on online course platforms such as MOOC. As mentioned

above, the problems of ICH online recorded video courses faces mainly include:

- (i) Due to media restrictions, it is difficult for online learners to obtain real handicraft creation experience on online platforms;
- (ii) The teaching mode is relatively simple, lack of "interaction" and "interest", hard to get the immediate attention of learners;

Teachers and the system side assist student learning by monitoring learning status and tracking post-lesson learning. The system side analyses and summarizes data from video watching and assessment tests, providing feedback such as test accuracy rates and interaction nodes in interactive videos.

We will continue to improve the production of the video, and we are already working on the iteration and story optimization of the video. In the future, we will also conduct A/B control test between the traditional handicraft teaching online course and the interactive video online course in this design, and let different students learn the course separately and do the same set of exercises test to see whether the learning effect of interactive video is better when it is put into ICH teaching.

At the same time, we will also combine the test results of interactive video to further improve the design of interactive learning mode, and build a more diversified path for the digital dissemination of intangible cultural heritage and the learning mode of handicraft bearers.

8. ACKNOWLEDGEMENT

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Evaluating the Impact of Artificial Intelligence Generative Technologies on Representations and Artistic Creation in Women's Books Nüshu

Zheng Wang
Nanyang Technological
University
Singapore
wang1796@e.ntu.edu.sg

Xiaolin Zhang
University of
Auckland
New Zealand
hxza058@aucklanduni.ac.nz

Ze Gao
Hong Kong University of Science and Technology
Hong Kong Polytechnic University
Hong Kong SAR
zegao@polyu.edu.hk

Artificial Intelligence-Generated Content (AIGC), such as text and image generators, provides a way to generate content automatically. However, these technologies have created questions about social dimensions such as representation and identity. Based on AIGC and traditional Chinese women's writing culture, this paper explores how it has evolved into a unique system under extreme conditions and influenced today's women's movement. It further explores the development of AI and other technologies on it. Unfortunately, the data trained by AIGC still has a gap with reality and a particular algorithmic bias. The authors hope this study will remove bias from art creation and alleviate the disconnect between AI art, artistic integrity, and cultural equality.

Nüshu. Artificial intelligence. Generative art. Encoding decoding. Intangible cultural heritage.

1. INTRODUCTION

Nüshu (see Figure 1) is a mysterious writing system based on Chinese characters used in a very narrow context (Liu 2004). In the past, it was used only by a few women in a Han Chinese village populated mainly by the descendants of immigrants from Guangxi during the Ming Dynasty (Liu 1997). Nüshu was gradually studied in the modern era at the Cultural Center of Jiangyong Country before gaining notoriety (Idema 2012). Fortunately, Jiangyong Nüshu was inscribed on the first National Intangible Cultural Heritage List in 2006 (<https://www.ihchina.cn/Article/Index/detail?id=15067>). It has gained further attention and development in recent years, such as a recent screen poster on Beijing Road in Guangzhou that caused everyone to stop and watch, with an LED screen displaying excerpts from the Nüshu work *Mulan Poetry*, written by 106 Chinese women (see Figure 2). The authors can also see audio and video recordings of Nüshu in the "AI Nüshu" (see Figure 3) installation by Sun et al. (2023). Notably, Xiangnan Tuhua (the Folk Dialect of the Southern Hunan) (Hou et al. 2019), a creole language taking

elements from both ancient Chinese and Lu-Mien words has become the 'lingua franca' for communication between the local Han Chinese and Lu-Mien ethnic groups, and between researchers and users of Nüshu. Users of Nüshu showed researchers their fans, embroidery, and rice paper filled with delicate symbols. They were full of intricate patterns resembling Chinese characters but with a more schematized and graceful touch something ethnic and feminine (Hall 1973). A woman read off the symbols from the rice paper as if she were the only shaman endowed with the powerful script, which can summon spirits and memories (see Figure 4). As scholars and artists gradually got familiarized with Nüshu, it began to appear in multiple forms, and new curiosities spawned. Following this trend, Nüshu has been recently incorporated into digital media and art. Scholars began to ponder: What is the significance of Nüshu in today's context of AIGC (Artificial Intelligence-Generated Content), which increasingly becomes the fundamental condition for a contemporary visual culture where we make and exchange meaning?

A few terms shall be clarified before the authors delve into the depths. The sisterhood embodied here by the Nüshu women is to be understood not as a strong feeling modern women feel in the social project of fighting for their rights but as the close relationship and trust among women based on the sharing of ideas and aims ("sisterhood" Oxford English Dictionary 2022). This is an important distinction to be carried along with as the authors continue the investigation of Nüshu, even in the AIGC context. Quintessentially, sisterhood does not necessarily involve the modern notion of feminism, in contrast with the popular conception of this subject. Still, it can be related to something not limited to feminism. Additionally, although AIGC has shown a broad array of applications and implications for contemporary life, the authors focus on Nüshu as the case study to enlighten future research into other directions. Here, Nüshu is an example of how the authors approach linguistics, gender issues, and cultural preservation from technological and philosophical perspectives.

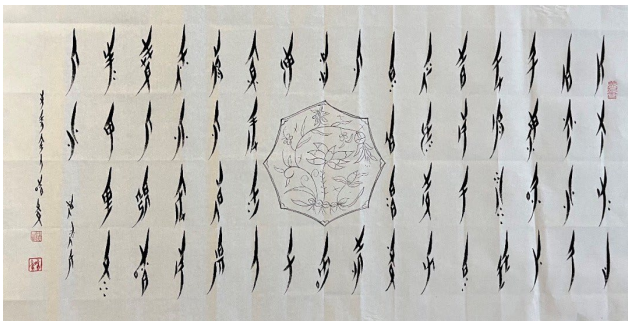


Figure 1: Nüshu's Calligraphy of "Seven Rhymes Reply to a Friend", Mao Zedong.

2. HERITAGE AND WHAT NOW?

Ever since the original "discovery" of Nüshu, its status has shifted several times. From a local mystery, it became a local attraction (Hu 2022a). As China turned its attention to its own history and tradition after the disastrous aftermath of the Cultural Revolution, the government's interest in the subject grew in the eighties and made a series of investments in salvaging and promoting Nüshu culture. In the late nineties, Nüshu became a local heritage. In the new century, it became a UNESCO intangible cultural heritage (Hu 2022b), which turned Nüshu into a famous icon for tourism and cultural industry. Over the decades, scholars like the pioneers, such as Zhou Shouyi and Gong Zhebin, and their followers, like Zhao Liming and Xie Zhiming, also made successive efforts to study and understand Nüshu (Xie 1990; Zhao 1998). As a result, works like the *Nüshu Dictionary* (Chen 2006), the *Nature of the Writing System of Nüshu* (Xie 1990), and *Female Script and Female Society* (Gong 1995) have a seminal impact on how

scholars view Nüshu as a unique system of communication that sheds light on how females in a patriarchal society develop sisterhood, resist oppression, and pluralize storytelling. Despite the consistent scholarship and attention, Nüshu as a linguistic tradition can hardly escape the fate of being commercialized or marginalized (Morgner et al. 2022). As Theodor Adorno and Max Horkheimer (1944) describe in *The Culture Industry: Enlightenment as Mass Deception*, the increasing presence of Nüshu signboards and postcards, accurate or not, might provide "enlightenment as mass deception." Likewise, the multiple cultural products derived from the



Figure 2: Mulan Poetry, written by 106 Chinese women. 2023. Source: National Day and Mid-Autumn Festival, "national tide" and "non-heritage" become new consumer hotspots, www.163.com/dy/article/GIBK2R80530QRMB.html. Accessed on August 28, 2023.

Nüshu hype might look different or even edgy, but they could be understood as the variations of the same mentality by which Hollywood marginalizes film and radio defies classical music. The ironic contrast between the soaring widespread interest in Nüshu and the dwindling literacy and understanding, or that between the potential value of Nüshu as a unique example of linguistic and gender history and the inevitable reality of it as a dying system, makes us wonder about an alternative route. If we use the Nüshu spectacle in Guangzhou, Mulan Poetry as the material for reflection, we realize the role of technology in cultural preservation and how technology can turn the legacy of Nüshu into a sustainable project and

put it in dialogue with other ideas and movements that are crucial to contemporary life [20]. As pointed out by scholar Mieke Bal (2022), the term "cultural heritage" is also problematic: "It suggests the passive reception of a gift. But a heritage is something entrusted to us, with the command to do something with it – now," so the authors are investigating Nüshu's "existence in the present," through a "renewed activity" (Bal 2022). Regarding this "activity," what is more present than AIGC to test its renewed significance?

3. LITERATURE REVIEW AND PAST PRACTICE

Overall, three types of projects stand out within the technological engagements with Nüshu: Nüshu as a subject for documentation, Nüshu as a material for experimentation, and Nüshu as an object for aestheticizing. The second type will be the emphasis of this article since it touches upon AIGC as the medium and approach to which the authors pay special attention.

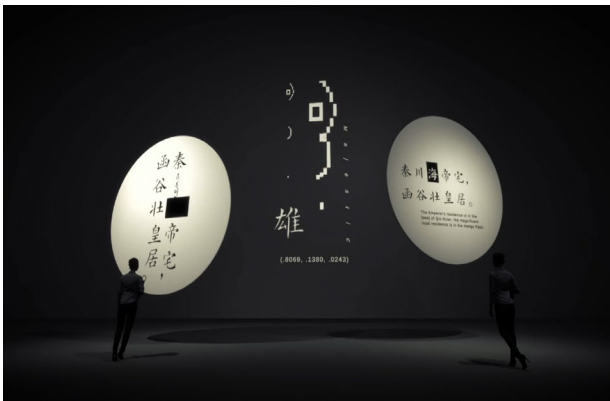


Figure 3: AI Nüshu. Credit: Sun, Tang, Gao et al. 2023.

Although the three types respond to the respective interpretation of Nüshu and its value, the third type is the most self-evident. So far, very few artistic works have included Nüshu as one of its elements, but there are some famous ones: films like *Snow Flower* and *Secret Fan* and Oscar-shortlisted *Hidden Letters* have effectively aroused popular interest in the peculiar form of the script. While those films have highlighted the feminist or private aspects of Nüshu, its esoteric meaning has been overshadowed by the intriguing form that has left a deep impression on many. The formalism made Nüshu a powerful object for aestheticizing. Its feminine elements contributed to this process. In the design field, schematization makes a font handy to manage while the "written-ness" makes a font interesting and alive (Han Xu and Xing Zhiqiang 2023). In an article on Chinese font from the *ZHUANGSHI* journal, authors point out that "info-visibility" has a levelling effect on sensorial experience and destroys the possibilities of plural storytelling while the "written-ness" as a temporal (see Figure 5), spatial narrative and metaphor, can

break the shackles of schematization and fulfil the aesthetic potential of a font for both popular interest and heritage preservation (Han Xu and Xing Zhiqiang 2023). Following this vein, we can argue that although Nüshu is distinct from a Chinese font, at least in form and functionality, it epitomizes both schematization and "written-ness" because the previous scholarship has produced a standardized corpus of Nüshu characters without utterly severing its relationship with "written-ness" that is how it was originally produced as calligraphic forms on different mediums, thus making its aesthetic value sustainable. In other words, it becomes a suitable object for aestheticizing. This aspect also reveals how Nüshu is removed from the practical realms as well, unless as a material for experimentation, which is inseparable from the role of Nüshu as a subject for documentation.



Figure 4: He Jingua, writing the phrase "mysterious scripts through the ages" in Nüshu characters.

As a historical medium for carrying meanings, Nüshu becomes a subject for documenting how females communicated with each other and formed bonds in a private, domestic, and education-deprived milieu. It documents the spoken language of Xiangnan Tuhua itself and its gendered dimension — how it was spoken, written, and, most importantly, altered by women for storytelling and secrecy. Its written form is the material documentation of historical, linguistic, and cultural value, while its aesthetic attributes are also meant to reflect this aspect.

The first two types of engagements become the foundation for its incorporation into AIGC, a medium that seems at first glance farfetched or even far-removed from Nüshu. Moreover, in the third type of engagement, the authors can observe three intersecting tendencies: generative, ideological, and philosophical. The *Mulan* poem, even without AIGC, is an aesthetic rendering. Simultaneously, it is also ideological. The scale of the display, the number of participants, and the common identity of the participants as women have made the poem a

feminist and national project of heritage preservation or (in a more ideological way) "rejuvenation," a decades-long approach for China to establishing a national branding and bolstering patriotism based on a political understanding of traditional Chinese culture. Nevertheless, it does not treat Nüshu as a material for experimentation but merely an object for aestheticizing because it is not generative as in the G of AIGC. To understand how AIGC turns Nüshu into a material for generative processes, the authors must understand what AIGC can and cannot do. Accordingly, Nüshu: Virtual Reality Design and Narrative Popularization for Intangible Cultural Heritage Characters 3 is a suitable example. It is a virtual reality interactive work to preserve the Nüshu through digital technology (see Figure 6).

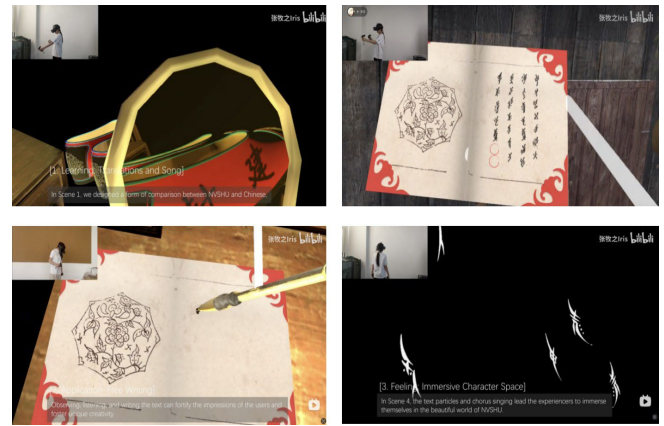


Figure 6: Nüshu: Virtual Reality Design and Narrative Popularization for Intangible Cultural Heritage Characters. credit: Zhang et al. 2023.

罔	女	盖	鸣	爱	吊	始	海	剑	云	寒	天
谈	慕	此	凤	育	制	咸	号	腾	来	地	玄
彼	贞	身	在	黎	文	河	巨	致	暑	玄	黄
短	洁	发	竹	首	罪	淡	雨	雨	往	黄	
靡	男	四	白	臣	乃	鳞	珠	露	秋	宇	宙
恃	效	大	驹	伏	服	潜	称	结	收	宙	洪
己	才	五	食	戎	衣	羽	夜	为	冬	荒	荒
长	良	常	场	羌	裳	翔	光	霜	藏	荒	
信	知	恭	化	遐	坐	推	龙	果	金	日	月
使	过	惟	被	迓	朝	位	师	珍	生	盈	晨
覆	必	鞠	草	壹	问	让	火	李	丽	岁	
器	得	岂	赖	率	垂	有	鸟	菜	玉	律	辰
欲	能	敢	及	宾	拱	虞	官	重	出	吕	宿
难	莫	毁	万	归	平	陶	人	芥	昆	调	列
量	忘	伤	方	王	章	唐	皇	姜	冈	阳	张

技进乎道

Figure 5: Samples of 'Founder CAA Jindao Font.' 2023

The interactive mode and immersive experience can deepen the user's understanding and impression of Nüshu. The project can be understood in four scenes. In the first scene, the author compares Nüshu and Chinese fonts to give users unfamiliar with this script a preliminary understanding. In the second scene, the author incorporates sound to let the user experience the phonetic charm of Nüshu and interact with and learn from the book's features through gamification. The third scene encourages users to write virtually, fully allowing them to participate in creating Nüshu. The fourth scene immersively displays the text of Nüshu through particle effects, which makes users feel as if they had come to the era of Nüshu in the distant past. This project provides new possibilities for preserving and innovating Nüshu through digital interaction. The author expects new media and technology intervention to increase the public's motivation to explore Nüshu from multiple aspects: reading, writing, chanting, and appreciating the unique form in the same way as they would experience a participatory artwork.

Besides, AI Nüshu is also an apt example for the linguistics and power dynamics involved. This AI installation turns Nüshu into a material for understanding the origin of a language using computational linguistic methodologies. As summarized by the artists, the project demonstrates "How Emergent Language among Machines Resonates with the Ancient Women who Created their Language amidst Patriarchal Constraints" (Sun et al. 2023). Specifically, the project "employs a multiagent learning system to simulate the communication dynamics within a sisterhood" that "resonates with the emergence of non-human machine language under human authority" (Sun et al. 2023). Instead of letting humans lead, this project let two AI agents develop their communicative capacities through "iterative optimization" (Sun et al. 2023).

Two components stand out in this process: the Learning Game and Symbolic Expression. The Learning Game is the process wherein the two AI agents iterate the role of speaker and listener from scratch to eventually reach a Consensus to become AI-Nüshu-literate (Sun et al. 2023). The Symbolic Expression selects "24 fundamental elements from Nüshu" and transforms "each newly created AIN (AI Nüshu) character's 768-dimensional vector" into "a unique 3-D vector using Principle Component Analysis" (Sun et al. 2023). This project transforms Nüshu almost like reverse engineering — it not only uses the Nüshu dictionary as its input data for training the agents, it also puts it in dialogue with the Chinese dictionary and lets the machine simulate the learning process of Nüshu (peer learning) to simulate its origin and transmission. According to the artists (Sun et al. 2023), this installation demonstrates "the power of collaborative, non-hierarchical linguistic innovation, thereby challenging the conventional norms surrounding linguistic authority" (Morley 2006).

However, this statement is only partially true on the one hand, as it does turn Nüshu into a material of deconstructivity for reimagining the emergence and development of Nüshu, or any language based on observation and reiteration in a simulated environment through the five-step process of Speaker Generation, Speaker Encoding, Listener Decoding, Speaker Feedback, and Consensus. Additionally, the "sisterhood" is reflected through this iterative Learning Game wherein the roles of speaker and listener are equally shared and rotated, thus assuming a "non-hierarchical" position. Additionally, the Symbolic Expression also "replicates" the process of turning a vectorial system of symbols into actual written forms. In this case, linguistic power reflects social power.

On the other hand, this generative experimentation suffers (although it also benefits) from this abstraction. The ideological component is rather lost, or circular compared to the generative narrative. It sets out to understand the linguistic sisterhood of two agents. Still, it simplifies the ideological bonding so complex as a sisterhood to a presumed Utopian exchange of speaker and listener roles while other factors that can complicate this process should be considered. This model would be most adept at simulating the transmission of Nüshu but not at the emergence because the origin of any language is conceivably "messy" and multilateral rather than bilateral. As a result of the AI Nüshu process, the new AI characters demonstrate "the semantic capacities of machines and the cultural diversity in media arts" because the new AI Nüshu dictionary (the Consensus) showcases a system that has different vectorial relationships amongst semantic units, an influence of "the environment in which the agents are trained" (Morley 2006). Still, it fails to explain the generative potential of other factors, for instance, whether this "cultural identity" results from the gendered environment. Conceivably, if the authors put more artifacts as variables like weaving looms or stitching pads, could the authors be able to find an AI Nüshu wherein "Weave" or "Stitch" is closer to "Song" even than "Sing," "Music," "Poem," or "Dance?" The established scholarship already realized the cultural diversity in Nüshu due to the interplay of various environmental factors distinct from the general society, but what else can the authors learn from AIGC that exceeds this understanding? Or other structural threads that are lost to the human eye?

Lastly, the exhibition format of the Symbol Expression of AI Nüshu turns Nüshu, again, into an object for aestheticizing, thus making it no further possible for either the audience or machine to join and continue the generative process, let alone hiking into the philosophical dimensions. However, the potential of

AIGC to expand on the ideological and philosophical aspects of Nüshu also lies in its generative aspect. Still missing is the human element that would not weaken this machine-oriented process but make it stronger.

This human element is manifold: the decoding process is never a five-round questionnaire but entangled with power dynamics. The reality of sisterhood is never a non-hierarchical exchange. AIGC should enable us to deal with the complexity of Nüshu in history and real life if the authors are to investigate in nuanced terms the ideological and philosophical dimensions. In this vein, the following section expands on the Encoding-Decoding model of Stuart Hall (1973) to ameliorate the process.

4. NEW THEORY AND POTENTIAL IMPLEMENTATION

To further explore the ideological and philosophical dimensions of Nüshu through AIGC, the authors propose expanding on Stuart Hall's (1973) Encoding / Decoding model. The original Encoding / Decoding model examines how messages are produced, disseminated, and interpreted within media and communication contexts. It views audiences as actively interpreting, rather than passively consuming, who process media messages based on their cultural backgrounds and experiences.

The authors suggest incorporating the Encoding / Decoding model into the AIGC process for Nüshu by having human participants take on encoding and decoding roles. This measure introduces the human element missing from solely machine-driven approaches like the AI Nüshu installation. In the encoding stage, participants could be presented with source materials like Nüshu dictionary entries, poems, embroidery patterns, etc. Their task would be to encode semantic concepts and cultural meanings from the sources into symbolic Nüshu characters. This encoding would involve each participant's subjective interpretations and decisions in translating concepts into symbols. In the decoding stage, different participants would be shown the encoded Nüshu symbols without access to the sources. Their task is to decode the symbols back into semantic concepts and meanings based on their cultural knowledge and experiences. By comparing the sources, the encoded symbols, and the decoded interpretations, this process can provide insights into how meanings evolve, shift, or lose nuance through iterative encoding and decoding. It can illuminate differences in cultural decoding based on the participants' backgrounds.

Figure 7. The Expanded Encoding/Decoding Typology (text-relative version)

		Encoding Positions		
		Dominant-hegemonic encoding	Negotiated Encoding	Indifferent Encoding
Decoding Positions (Image-relative)	Image-accepting position	Image-acceptance of dominant-hegemonic Image	Image acceptance of a negotiated Image	Image acceptance of indifferent Image
	Image-negotiation position	Negotiation of dominant-hegemonic Image	Negotiation of negotiated Image	Negotiation of indifferent Image
	Image-Indifferent position	Image-Indifference reading of dominant-hegemonic Image	image-indifference reading of negotiated Image	Image-Indifferent reading of indifferent image=difference

Figure 7: The Expanded Encoding/Decoding Typology (text relative version). Credit: the authors, 2023.

It can uncover latent meanings and significance in the source materials that are not obvious through machines alone. The authors hypothesize that this expanded encoding/decoding approach with human agency

Implementation will improve the AI incorporation of Nüshu. To produce optimal results, this process would require recruiting participants with diversity in gender, age, region, etc., to decode the symbolic messages from their varied cultural perspectives. This proposed expansion of the Encoding / Decoding model through an AIGC lens offers the potential for unlocking deeper philosophical and ideological insights from Nüshu as an intangible cultural heritage.

In addition, from an image-based perspective, Stuart Hall's system (1973), later modified by Ross (2011) and Morley (2006), can be further expanded based on W. J. T. Mitchell's (1986) theory of "Imagetext". Ross (2011) and Morley (2006) expanded Hall's Encoding and Decoding system into ideological and text-related versions, but the text version can be further extended regarding the renewed character of a text. In AIGC, one of the latest observations is the convergence of image and text, or in W. J. T. Mitchell's words, the contamination of image on text and vice versa. In AI Nüshu, the text takes a "pictorial turn", and to understand the power dynamics of this moment, the process of encoding and decoding "is with language's entry into (or exit from) the pictorial field itself, a field understood as a complex medium that is always already mixed and heterogeneous, situated within institutions, histories, and discourses: the image understood, in short, as an image-text" (Morley 2006; Ross 2011). This shift has rendered Ross and Morley's text-related system insufficient in addressing the composite nature of AI Nüshu. In an age of digital reproduction, the picture becomes more crucial than text, and in parallel, every digital text becomes

a pixelized matrix, an imagery. Correspondingly, the authors are proposing an image-related system of encoding and decoding for AIGC (see Figure 7). From this version, there are a few critical changes. The "text-relative" becomes "image-relative," and in accordance, Ross' (2011) category of "text-oppositional" has to be changed to "image-indifferent" because, in most AIGC images, the audience would not be oppositional regarding an image in a binary sense. Concerning artistic audiences, the authors are modifying the three decoding positions to be the "image-accepting position," "image-negotiation position," and "image-indifferent position." Following this, the authors modify "oppositional encoding" as one of the encoding positions to be "indifferent." Conceivably, when a layman audience sees Nüshu characters, the most common response will be image-based rather than text-based due to the relative lack of literacy beyond specialized scholars and women villagers. When the interested audience who can recognize Nüshu characters not as accurate enough word-to-word texts but as images representative of the Nüshu culture, see AI Nüshu, the response will fit the category of "negotiation of negotiated image." Another scenario could be that if an audience also recognizes Nüshu characters as the images but also the symbols of ancient sisterhood and national heritage, the audience could produce "image-acceptance of dominant-hegemonic image" of Nüshu as the sisterhood and nationalist symbol. Otherwise, if the audience has a different take on this "mainstream" symbolization, the process will produce "negotiation of the dominant-hegemonic image," which challenges the dominant reading and generates something new.

Lastly, it is likely that for the large portion of the layman audience, indifference could also prevail. Hence, this process could produce "image-indifference reading of dominant-hegemonic image," which produces indifference, which is probably something the authors will try to avoid as

ineffective education or exhibition. In the particular case of AI Nüshu, the result would essentially or hopefully be "negotiation of negotiated image," which makes "negotiation" generative and this process productive because the encoding is not necessarily a faithful transcription of the dominant-hegemonic but a negotiated abstraction when the dominant-hegemonic is regarded either too simplistically nationalist-feminist or too ambiguously a message to be read as a text anyway.

As an image text, Nüshu characters will always generate negotiation for most audiences. If the authors allow the encoding to be more randomized, or, for instance, to put AI Nüshu corpus as the new encoding images, then it could produce an "image-indifferent reading of indifferent image," which applies to more scenarios because even the authentic Nüshu corpus as a collection of images would not effectively carry any messages clear enough to be either dominant-hegemonic or negotiated, considering the prominent role of Nüshu as an object for aestheticization. However, this bottom right corner might be the most interesting result because it suggests a "difference" in contrast with "indifference" and the volatility to play with the "uncertain" and "contingent." This volatility can be strategically utilized by AIGC to produce more unpredictable results that challenge the dominant hegemonic reading and maximize the interpretive decoding potential of human or machine agents. Moreover, the visual functions of not text-based but image-based AIGC, such as Midjourney, can also be incorporated to highlight and expand Nüshu as image text to help produce more "negotiating" positions.

Another element lost in the AIGC rendering of Nüshu is gender identity. Only the simplified interpretation of sisterhood is built in and represented as the egalitarian five-question exchange between the two machine agents. Linguistic equality imbues the imaginary agents with a relatively levelled relationship, but this relationship does not necessarily lead to a shared identity as complex and historical as woman. AIGC is adept at constructing and simulating simple relationships but not complex ones. Still, an identity is the nexus of numerous relationships. It requires specific identifiers or signifiers to unify and condense these relationships to a coherent whole: the woman identity. The question inevitably becomes: How can AIGC simulate (although abstractly and hypothetically) the emergence and development of Nüshu without omitting the woman's identity? The woman identity is such an important factor in approaching Nüshu. Drawing from pre-existing examples of digital representations of woman in spaces like online forums, games, metaverse, and even sci-fi films like *Her*, the authors can observe that the AI

construct of woman relies on deep learning and data training from existing data which by and large create and reinforce the stereotypical images of woman. This is the hidden presumption for data input. In that case, the authors can find that Nüshu "becomes" feminine not because of its formal beauty and tenderness that is so representative of a recognizable woman identity, at least, not a modern one, but because of its marginalized position and history as something most women have suffered as a shared condition to resonate with.

Additionally, creating a visual reference of a woman's identity is unnecessary now. The only textual reference to a presumed woman identity from AI Nüshu is from the new Consensus, wherein some symbolism or imageries are gendered and closely related to other terms traditionally considered private and domestic, thus providing this connection to a woman's identity. However, this could be the result of encoding. The original Nüshu dictionary or even the Chinese dictionary as the inputs might have already placed specific terms in a gendered correlation that is algorithmically inescapable. If starting from another slightly sociological perspective, the authors can also turn to the field study of the Nüshu society, find the degree to which the Nüshu women are isolated—the gender ratio in the village and the Nüshu literacy rate of all villager women, the number of women in most Nüshu gatherings for learning and communication, the power relations in most Nüshu-learning scenarios in terms of hierarchy and network, and eventually, reflect the discoveries through parameter adjustment and structural design as closely as possible within AIGC.

For an identity as complex as woman, it will remain an issue that needs to be resolved by technology in analysing gendered systems like Nüshu. Conversely, AIGC could also facilitate a different scenario where the artists input a different Nüshu dictionary or Chinese dictionary, the authors are also pluralizing the gendered identity of Nüshu and explore the alternative, for example, a radicalization of Nüshu more in alignment with the global feminist project. However, this would also require more interdisciplinary collaborations between art and computer science and between tech art and social science, such as anthropology, gender studies, and linguistics, to paint a fuller picture of the original Nüshu community.

In conclusion, AIGC has demonstrated three scintillating aspects of Nüshu: a subject for documentation, a material for experimentation, and an object for aestheticization. The first and third aspects touch upon the ongoing project of Nüshu as both a nationalist legacy and a feminist symbol. In contrast, the second extends the artistic

possibilities into multiple directions. This article mainly focuses on the second aspect and identifies a few issues with the previous practice and scholarship. Accordingly, it proposes an expanded version of Stuart Hall's Encoding and Decoding system to maximize the process' generative power and incorporate the woman identity into AIGC to radicalize and rethink Nüshu in a new context. Finally, a few limitations should be clarified, and new ground should be established for future research. The current art practice to engage Nüshu with AIGC, such as AI Nüshu, is an extreme simplification of Nüshu's learning and development, thus making it subject to further adjustments and modifications, especially in the number of factorial agents, the complex way the teaching was developed, and the important element of human participation. The process can be calibrated for human involvement by incorporating interdisciplinary approaches such as anthropological field studies and sociological surveys to bring out the overlooked issue of woman identity underlying Nüshu history and reproduction.

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The Depth and Complexity of Traditional Painting Versus AI-Generated Art: A comparative analysis using Van Eyck's Arnolfini Portrait

Mengyao Guo
Shenzhen International
School of Design, Harbin
Institute of Technology
Shenzhen, China
coco.mengyao@gmail.com

Yuan Zhuang
Shandong University
Jinan
Shandong
China
zhuangyuan12138@163.com

Feng Gao
Peking University
Haidian District
Beijing
China
gaof@pku.edu.cn

Ze Gao
Hong Kong University of
Science & Technology, and
Hong Kong Polytechnic U.
Hong Kong SAR, China
zegao@polyu.edu.hk

This paper explores whether artificial intelligence (AI) can replicate the depth and complexity inherent in traditional art, using Jan van Eyck's The Arnolfini Portrait as an exemplar of traditional painting. Through analysis of AI art techniques like generative adversarial networks (GANs) and creative adversarial networks (CANs), the study identifies limitations in AI's intentionality, cultural context, creativity, originality, and emotional expression compared to human artists. It reveals gaps in AI's ability to consciously employ light, texture, and deviations from realism for artistic intent. While AI can mimic styles and patterns, it operates within computational constraints versus the subjective experiences of human artists. The study argues AI cannot replace the profound understanding of the human condition and nuanced aesthetic vision encapsulated in The Arnolfini Portrait. However, AI offers complementary capacities like novel combinations and democratized creation. Thus, this exploration of the intricacies of The Arnolfini Portrait and the boundaries of AI art contends that the future likely lies in integrating, rather than replacing, traditional art's irreplaceable qualities with AI's emerging potential.

Artificial intelligence. Generative Art. Jan van Eyck. Arnolfini portrait. Aesthetics.

1. AI IN THE CONTEMPORARY ART SCENE

The earlier explorations of contemporary art and artificial intelligence (AI) can be traced to the works of artist Harold Cohen, who utilized AI to create autonomous art-making systems as early as the 1970s (McCosker and Wilken 2014). He proposed rethinking big data, viewing it as a massive information collection and a visual phenomenon with aesthetic and cognitive dimensions. In recent years, the application of AI in art has exploded, with artists leveraging its capabilities to create an increasing number of new forms of interactive and generative art. For example, artist Refik Anadol uses data and AI to create immersive and aesthetic art installations (Anadol 2019). The pivotal moment in AI and art occurred in October 2018, when Christie's auction

house made a historic sale of an "AI art" piece. The artwork, "Portrait of Edmond Belamy," was the brainchild of the French art collective the Obvious (see Figure 1). This work employs a machine learning algorithm to process millions of images, creating a dream-like, hallucinatory visual narrative that blurs the line between reality and AIGC. It gained significant attention despite the collective's lack of established reputation and the piece's lack of technical innovation. This art piece, resembling a low-resolution, vaguely Edwardian portrait printed on canvas, fetched a staggering \$432,500 – nearly 45 times its initial estimated value (Cohn 2018). However, following the auction announcement, the most potent reactions emerged from other artists engaged in AI. Many of them critiqued the portrait, deeming it lacking originality and creativity.



Figure 1: *The Obvious, Portrait of Edmond Belamy, GAN algorithm, inkjet printed on canvas, 70 × 70 cm, 2018.*

These examples demonstrate that the collaboration between AI and art is not futuristic but a current and emerging reality reshaping the art world. The work of Elgammal et al. (Elgammal, Liu, Elhoseiny and Mazzone 2017) demonstrates that AI can provide a unique perspective on art creation and interpretation, challenging traditional notions of creativity and the artist's intent. They introduce Creative Adversarial Networks (CAN) – a form of Generative Adversarial Networks (GAN) designed to generate art by learning about styles and deviating from style norms. Their approach is to train the model on a dataset of artworks, enabling it to learn and reproduce various art styles. It then leverages this knowledge to create new, original art pieces that deviate from the learned styles.

While AI brings exciting possibilities to the art world, the question remains whether it can genuinely replicate and represent the depth and complexity inherent in traditional painting. To explore this question, we use Jan Van Eyck's masterpiece, the Arnolfini Portrait (see Figure 2), as a focal point. The Arnolfini Portrait showcases the intricate detail of its formal elements and the profound symbolism embedded within the painting. For example, the oranges catching the light, the arrangement of the signature location of written Latin "Jan van Eyck has been here," and the spiritual or religious significance represented in the mirror's narrative dimension all contribute to the painting's depth and complexity. The use of the mirror in the painting enlarges the spatial dimension and reflects the artist's geometric knowledge. This technique influenced future artists, such as Velázquez in his work *Las Meninas*, and projected an infinity in consciousness and a psychological infinity. This Arnolfini Portrait simplifies the real and symbolic worlds into equivalents, interacting with each other. We argue that the context and the subsequent influence it exerted on future art embedded in this iconic work

exemplify the depth and complexity that traditional painting offers – that AI, in its current state, struggles to emulate and even replace.



Figure 2: *Jan van Eyck, Arnolfini Portrait, oil on oak panel of three vertical boards, 82.2 × 60 cm, 1434.*

2. DEPTH AND COMPLEXITY OF ARNOLFINI PORTRAIT

Jan van Eyck, a pioneer of early Netherlandish painting, is celebrated for enhancing painting methodologies and inventing oil paint. His style, rooted in Gothic art, surpassed it in many aspects, offering a naturalistic and realistic perspective on the world. Using his exceptional skills with oil, van Eyck could blend and layer paint to accurately reflect reality (Gombrich and Gombrich 1995). His renowned work, the "Arnolfini Portrait" (1434), is an oil-on-oak depiction of Giovanni Arnolfini and his wife in their Bruges residence. The painting showcases a room with remarkable precision and is acclaimed for its extraordinary detail and mastery of light, featuring symbolic objects and a convex mirror reflecting the couple and unseen figures.

The enigmatic nature of van Eyck's work has intrigued art historians for generations. Scholars have endeavoured to uncover his pieces' geometric and spatial consistency, from the spatial composition to the use of mirrors. Italian historian Bartolomeo Facio extolled van Eyck's exceptional proficiency in geometry (hnanews 2020). Moreover, Maximiliaan P. J. Martens, in his discourse on van Eyck's "optical revolution," proposed that van Eyck gained expertise in geometry and optics through the mathematical advancements of Alhazen, an 11th-century Arab mathematician, astronomer, and

physicist after re-evaluating the influence of Pliny the Elder on van Eyck (Borchert, Dumolyn and Martens 2020). This evidence substantiates the theory of van Eyck's familiarity with the scholarly works of these two luminaries. Consequently, it is plausible that he incorporated geometric and optical knowledge into his artwork.

The tiny medallion featuring Christ's Passion in the convex mirror frame might symbolize God's promise of salvation for the figures reflected on the mirror's surface. The mirror precisely captures and differentiates surface appearances and textures, some related to Christ's life on the husband's side. It could also symbolize God's omniscient gaze, witnessing the marital vows and the Virgin Mary's purity. The mirror reflects two figures at the entrance, possibly including the painter himself, validating the marriage's legitimacy. Van Eyck's signature on the wall is a testimonial document, affirming his presence as a witness.

Van Eyck's technical mastery is evident in using thin layers of semi-transparent oil paint to create a painting rich in deep tones and vibrant colours, showcasing the Arnolfinis' affluence through their material possessions. He utilized the wet-into-wet technique (*Alla Prima*), applying fresh layers of paint onto previous layers that were not yet dry, allowing him to blend colours and manipulate light and shadow effects to enhance the painting's three-dimensional illusion. This technique enabled van Eyck to precisely capture and differentiate surface appearances and textures, such as the optical effects of direct and diffuse lighting from the window on the left. He also significantly enhanced the couple's attire's textures, details, and sensibilities, ensuring their stability and longevity in colour rendition. Complex elements, such as the representation of lions above and below the bride's wrists, were preserved despite their placement in the room's darker regions and neutral brown tones. According to scholar John L. Ward, the mirrored expressions of the lions symbolize demonic figures, and their positioning around the bride's wrists suggests potential threats to the marriage and the exchange of vows (Ward 1994).

In terms of the application of orthogonal projection in the painting, mathematician Karl Doehlemann asserted in a 1905 journal article that the parallel lines in the space of the Arnolfini Portrait do not converge to a single point. Instead, they converge onto a circular area with multiple vanishing points (Doehlemann 1906). Similarly, James M. Collier argued in his work, *Perspective in the Arnolfini Portrait*, that the spatial representation in van Eyck's piece is fundamentally chaotic, with perspective being depicted only intuitively (Collier and Carleton 1983). In the article *On the Arnolfini Portrait and the Lucca Madonna: Did Jan van Eyck Have a*

Perspectival System?, American art historian James Elkins noted that the extension lines of the floorboards in the painting converge to a singular vanishing point (Elkins 1991). However, he inferred that while van Eyck had a grasp of perspective, it was not entirely accurate, considering the hyper-realistic detail in works by Northern Renaissance artists that could compete with modern photography.

Despite this, several scholars persist in uncovering a concealed order beneath the painting's seemingly chaotic surface. Recent research has unveiled a remarkably ordered structure in the probability diagram of vanishing points within the Arnolfini Portrait, with four primary points periodically arranged along a marginally inclined vertical axis (see Figure 3) (Simon 2021). Leveraging the Helmholtz principle, Gilles Simon not only confirmed this fishbone-like pattern in the Arnolfini Portrait but also discovered similar structures in other van Eyck works, such as *Saint Jerome in His Study*, the *Lucca Madonna*, the *Dresden Triptych*, and the *Madonna in the Church*. This pattern would only emerge when employing a perspectival device with two degrees of freedom. The reconstruction of a 3D model that aligns with this pattern also suggests that van Eyck's device addressed questions regarding how to depict space aesthetically and scientifically in a manner most akin to human vision.

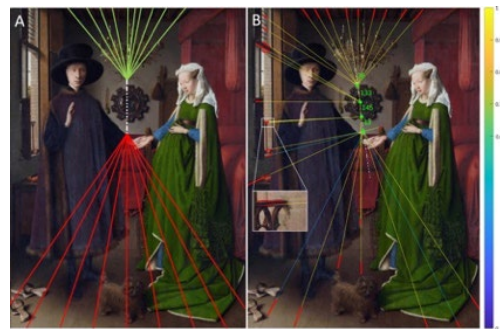


Figure 3: Gilles Simon, *Jan van Eyck's Perspectival System Elucidated Through Computer Vision*. (left) Manual reconstruction. (right) Reconstruction obtained with the help of computer vision, 2021.

Hermann von Helmholtz, the pioneer of contemporary perceptual understanding, introduced the Helmholtz principle. This principle articulates how objects are perceived in images: objects invariably appear in the field of vision as they would need to be to generate the same impression on the nervous system, assuming the eyes are being used under ordinary, normal conditions. Helmholtz acknowledged that illusions would arise if the environmental conditions or the functioning of the nervous system were abnormal. He further recognized that by reversing the process from illusory phenomena, the principles of normal and abnormal function could be inferred, enabling perception to transcend the limitations of the

physical object world and reveal its true nature (Gregory 2008, p.119). Nearly fifty years post van Eyck's demise, Leonardo da Vinci sketched a simplified version of what he referred to as a "perspectival device." This sketch illustrates and elucidates the method of using glass to formulate a perspective drawing: arrange a sheet of glass and secure it firmly between your eyes and the object intended to be drawn. Anchor the head behind the glass and position the glass so it is in a 2:1 ratio between the object and the artist. Subsequently, close one eye and trace the sections of the object visible through the glass on the glass, transferring this onto paper.

Through 3D reconstruction, Gilles Simon posits that van Eyck's device was more precise than Da Vinci's "perspectival device." In van Eyck's apparatus, the glass panel could move freely within its plane. This setup generated a configuration with multiple eyepieces evenly distributed along an inclined axis. This arrangement allowed van Eyck to trace the partial contours of natural objects viewed through each eyepiece and assemble them into a comprehensive image, thereby avoiding distortions at the edges of the drawing. Simon conjectures that van Eyck's multi-perspectival device likely evolved from earlier single-viewfinder devices, such as those envisioned by da Vinci. He hypothesizes that van Eyck would have alternated between closing his left and right eyes to provide two viewing modes for his device.

The Arnolfini Portrait showcases van Eyck's mastery of pictorial space through the depiction of a mirror (Ward and Carleton 1983; Seidel 1989). Janna Levin notes that the painting is often mentioned for its perfect depiction of non-Euclidean geometry, referring to the underlying geometric knowledge employed by van Eyck (Levin 2002). The distortions in the spherical mirror are accurately depicted, save for a few areas (Criminisi, Kemp and Kang 2004). In the article "Reflections of Reality in Jan van Eyck and Robert Campin," the authors put forth some simple yet rigorous technical analyses of the geometric accuracy of the convex mirror, drawing upon substantial computer vision literature. Remarkably, they refer to the area of composite imaging formation known as catoptric imaging. They evaluate the geometric fidelity of the mirror and the perspective rendering generated from the mirror's viewpoint, obtaining similar results for the spherical assumption and parabolic generation after making three different assumptions about the distances between three-dimensional scene points and the mirror. This suggests van Eyck intentionally modified the geometric shapes of certain parts of the mirror image (Hanley 2007). This remarkable discovery substantiates the artist's mastery of geometric knowledge and the transcendence of knowledge of image representation in geometry.

3. AI AS A NEW MEDIUM IN A LIMINAL STATE

AI art is in a liminal state and not yet fully mature. Artists can use tools like Google's DeepDream (Deep Dream Generator, 2023) and OpenAI's DALL-E (OpenAI 2023) to generate art pieces, creating dream-like or text-based images using Convolutional Neural Networks (CNNs), GANs, and Transformer Models based on deep learning and Natural Language Processing (NLP). However, AI art still has limitations compared to human-created art, particularly in depth and complexity.



Figure 4: Vasily Kandinsky, *Composition 8*, oil on canvas, 140.3 × 200.7 cm, 1923.

In "Generation of Kandinsky Art," the authors present a programmed experiment to automatically generate art in the style of Kandinsky during his Bauhaus years (see Figure 4) (Zhang and Yu 2016). The program that the authors developed analyses the artist's paintings based on the artist's art theories and the authors' understanding and observations of Kandinsky's artworks. The authors describe the generation process in detail and share and discuss sample-generated images styled according to four of Kandinsky's paintings (see Figure 5). However, these paintings are produced by simply analysing the style of the picture's colours, shapes, and other elements and drawing patterns to create works that appear stylistically uniform but are not the artist's own. It is important to note that Kandinsky did not use bright, rosy reds and bright purples during his artistic career, and even the yellow that appears in Kandinsky's paintings does not produce a bright yellow that exceeds the colour of the canvas due to the transparent properties of the pigment combined with the initial colour of the canvas. These mere resemblances and overlapping shapes still form an impalpable spiritual divide between art and AI. The interaction between the various paints and shapes that the artist applies to the canvas and the materiality of the space in which they are placed is not present in the flatness of the generated content. As Kandinsky brought his study of colours and shapes into his teaching (Jacobsen 2002), and even in the case of shapes, he spent an entire chapter on triangles in his book (Kandinsky 2012), a spiritual

choice that an AI does not have as a "personal preference."

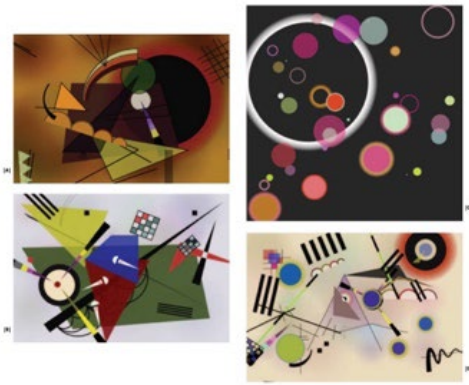


Figure 5: Kang Zhang, *Four Generated Paintings*, AIGC, 2016.

Lack of Intentionality: AI can generate images by analysing vast amounts of data, mimicking styles, and enhancing patterns (Cao et al. 2023). However, it lacks the understanding, intention, and creative vision behind its creations. The "illusion" created in the artwork does not result from AI's creative vision. As a product of mathematical functions and algorithms, AI has no emotional connection to the artwork and cannot construct spatial representations or convey personal messages through its "windows." Its output is determined by programming and data rather than an inherent "desire" to create.

Absence of Historical and Cultural Context: Art often reflects the time and culture in which it was created, as seen in "The Arnolfini Portrait" by Jan van Eyck, which is deeply embedded in the context of the Northern European Renaissance (Hall 1997). AI, however, cannot understand or reflect upon such contexts in its art. It generates art based on patterns identified in its training data, mimicking styles and generating novel combinations without understanding the meaning or context behind them (McCormack, Gifford and Hutchings 2019; Elgammal, A., Liu, B., Elhoseiny, M. and Mazzone, M., 2017). While AIGC might be aesthetically pleasing and technically impressive, it lacks the historical and cultural depth that often gives human-created art its significance.

Creativity and Originality: Creativity and originality, often considered hallmarks of art, involve generating new ideas, using materials innovatively, and creating unique aesthetic experiences. Human artists like Jan van Eyck create unique pieces influenced by personal experiences, insights, and cultural and historical context. In contrast, AI's artistic output heavily depends on its training data, lacking the personal experiences, insights, and conscious artistic choices that drive human creativity (Boden 2016; Du Sautoy 2019). While AI can

generate novel combinations and mimic styles, its "creativity" stems from algorithms and computations rather than a conscious, imaginative process, distinguishing human-created art from AIGC art.

Emotional Depth: Art often serves as an emotional outlet for artists and a medium for audiences to connect with these emotions (Schaverien 2005). The feelings an artist expresses through their work are crucial to making art human and relatable, imbuing it with depth and meaning. In contrast, AI lacks subjective experiences and emotions, making it challenging for viewers to connect emotionally with AIGC, even if they appreciate its aesthetic or technical qualities (Weiss 1995).

4. REVEALING THE GAP

Artworks are born from a complex timeline that evolves throughout creation. Artists must continuously adapt to the shifts in light and time throughout the day, adjusting the scenes they are crafting (Albers 2013). They operate on what could be described as a "massive, unpredictable database" that undergoes daily changes. This database is around them, a world that never ceases to change, where the light, colour, shape, and texture are constantly in flux. Artists are tasked with navigating their creative journey amidst this ever-changing environment. They must generate and conduct their scenes within the context of this dynamic landscape, a process that demands continuous adjustment and repetition. Unlike AI, artists need considerable patience and perseverance to bring their vision to life. As the natural light and reflections on objects continually shift, so do the artists, who adapt according to their circumstances. Just as the world changes, so does the artist's perception and interpretation, making the process of creating art a living, breathing endeavour.

In "The Arnolfini Portrait," the scene is not a photograph nor a perfect optical reproduction of reality. The "witnessing moment" captured in the scene is a purposeful selection, meticulously crafted by the artist from a sequence of time points. The artist employs light within the artwork to create a sense of depth and dimensionality. This light illuminates the couple and the objects in the room, creating highlights and casting shadows, enhancing the sense of realism. This light illuminates the couple and the objects within the room, instigating highlights and casting shadows that bolster the sense of realism. The natural light is visualized as coming from the window, and the artist has conceived of the light as a point source. We understand that the sun's trajectory determines the variance in the light streaming through the window during morning, midday, and late afternoon hours. As a result, the artist must adjust his "optical eye" to

his deeper heart of constructed and "imagined" scenes to present the dynamic interplay of light and shadow as accurately as possible. Apart from the constructed and "imagined" scene, which has its creative interpretation of light, Van Eyck's use of light and reflection is generally accurate in his artistic accomplishment. Still, there were minor inconsistencies or artistic liberties in the overall composition and aesthetic effect. When a human artist takes artistic liberty, they deviate from realism or convention for a particular effect or message (Danto 1981; Elkins 2019). They might exaggerate certain features, simplify others, or use colours and lighting in ways that aren't strictly realistic but serve their artistic vision.

As for the formal elements, particularly in terms of actual texture and visual texture, AI faces significant challenges when attempting to create a masterpiece like the "Arnolfini Portrait." AI cannot truly understand and recreate the subtle, dynamic interplay of light, shadow, and texture that gives a piece of art its unique character. This limitation becomes evident when we consider the intricate actual textures from oil paints and the visual texture in The "Arnolfini Portrait," From the richly depicted fabrics to the reflective surfaces, the final visual effects are an intricate interplay of actual and visual textures (Harbison 2012; Panofsky 1966). These textural details contribute significantly to the painting's lifelike quality and emotional resonance, elements that AI cannot fully emulate (see Figure 6).



Figure 6: Jan van Eyck, *The Detail of the Visual and Actual Textures in Arnolfini Portrait.* (left) The visual texture of the dog's fur. (right) The Actual texture made by oil paints, its physical property allows the audience to see the different light reflections from different perspectives, oil on oak panel of three vertical boards, 1434.

5. SURPASSING THE TECHNICAL LIMITATION – THE CHALLENGE OF AI ART

Despite its remarkable advances, AI still faces significant challenges in art creation. One limitation is the lack of understanding and interpretation of context and emotion. AI can replicate patterns and styles but cannot understand or convey the human experience as a human artist can. Another significant challenge is the reproduction of texture

and light, as seen in masterpieces like the Arnolfini Portrait. The subtle interplay of actual and visual textures, the dynamic shifts of light and shadow, and the emotional resonance these elements create are currently beyond the reach of AI technology.

According to Ron Cheng, a board member of the Yale Visual Arts Collective, there is a concern that the ease with which AI can create art might inadvertently lead to a reduction in the perceived value of art and a diminution of the artist's societal status. Furthermore, despite AI's capabilities to generate intricate concepts and striking illustrations, some argue that AI art lacks authenticity and fails to offer any meaningful critique of the world. Cheng believes there are enough human artists, and that AI shouldn't need to create art (Yale Daily News 2023). Brennan Buck, a senior critic and active architect at the Yale School of Architecture, utilizes AI as an auxiliary tool. He explains that during the initial stages of a project, AI assists him in tasks such as image colourization and upscaling. However, he emphasizes that these minor contributions from AI do not influence the creative or conceptual aspects of the design process (Yale Daily News, 2023). Yosvany Terry, a saxophonist, percussionist, composer, and senior lecturer on music and director of Jazz Bands at Yale, highlights another limitation of AI in art creation (Mineo 2023): "That sense of interplay, or the ability to react in the moment, is something that AI can't reproduce."

Harold Osborne placed his scrutiny on the surface of a work of art and started from its "unchanging qualities." He pointed out that the "vehicle" of the work of art is a kind of thing that has experienced time and remains unchanged when perceived and understood by the outside world – "enables the same organization of material to enter the experience of different persons at different times" (Osborne 1952). In contrast, AIGC art does not have physical properties that could be treated as unchanging qualities. The pictures change constantly when users input their prompts, even if they input the same content. These unchanging qualities in art, which do not exist in AI, persist beyond perception and have withstood the test of time, creating multiple possibilities for the same work of art in different experiences at different times.

According to the theory of Arthur Danto, who is a prominent art critic and philosopher, it has proposed the idea that the "Geist" (a German term often translated as "Spirit") of age could be understood through its finite material manifestations, including artworks (Birnbau 2023). This concept suggests an interrelation between physical objects and the larger socio-cultural context within which they exist. Since AI is a machine learning model programmed by humans, it doesn't possess personal experiences, emotions, or intentions in the human sense.

Therefore, the "intent" behind AI art could be considered as that of the programmers who designed the AI or the users who deploy it, but it is not the artistic intention. Instead, it is a technological intention.

Therefore, the definition and boundaries of AI in the art world may not have undergone such a great change. The symbols and data information of AI-generated art training models have not finally departed from the psychological category within the existing cognitive boundaries of humans. Since it cannot surpass the existing cognitive boundaries of humans, how can it create so-called "artworks" solely by relying on knowledge learning? If AI-generated art is called "original," it inevitably raises questions about the definition of artworks. Once again, it considers whether artworks can exist without aesthetic value. The latter is an entirely false proposition. The practice of stripping aesthetic value from artworks accelerates the death of art, which is the "emperor's new clothes" under Danto's art theory viewpoint, that is, directly equating art with abstract philosophical ideas, eliminating the most basic "expression" essence of art, and dismantling the marriage between artistic creation and aesthetic production.

In terms of the context of AI-generated art, it is still in the development process of contemporary art, which means it has to face the debate on the aesthetic value of contemporary art. Unlike postmodern art creation in the late 20th century and the first decade of the 21st century, AI art challenges the metaphorical and symbolic nature of the artistic expression of life reality at the virtual reality level. This is embodied in the further flattening of the meaning of language and image symbols in AI-generated art. Therefore, from the perspective of semiotics, analysing the symbol phenomenon of AI-generated art and its challenges to the generation of symbolic meaning and the embodiment of deep cultural connotations is an inevitable and indispensable process to explain the complexity of AI-generated art.

Taking the narrative dimension of the mirror as the access point, corresponding examples include Jan Van Eyck's masterpiece "Arnolfini Portrait," and Velázquez's artwork "Las Meninas", which reflect a narrative approach created through a "deep mode" of visual behaviour that emphasizes a subjective self-reproduction model. Through the mirror, the absent creator and the object represented in the painting are placed in the same visual field. The emergence of the mirror extends and creates a space for aesthetic appreciators to fully exert their imagination in an inherent two-dimensional image space, which establishes a holistic state structure for aesthetic appreciators to read and deconstruct the linguistic and pictorial meaning of artworks, forming

a symbol field combining virtual and real. The dynamic correspondence between the signifier and the signified in this field creates a birthplace of aesthetic value and meaning.

AI cannot truly possess "artistic intention" since AI is a machine learning model. It doesn't have self-awareness, emotions, or experiences and, therefore, cannot have a genuine artistic intention like a human artist. When we talk about AI "creating" artwork, we're essentially describing how AI generates output based on how it's programmed and trained. For example, if an AI is trained to mimic a specific artistic style, its works will reflect that style. If an AI is trained to mimic more artistic styles and has been asked to have its own, it collages partly from the given styles instead of creating. These are not because the AI consciously chose this style but because its designers and users decided on it. So, the role of AI in artistic creation at this stage is more akin to a tool or medium. As co-creators, human artists, designers, or users can guide the AI's output by setting parameters, choosing training data, and providing input, and this process can be partly seen as a manifestation of their artistic intention while it is still far away from the artist's spirit.

The spread of art, the value of artistic memory, artistic styles, and the formal elements of physical works are indeed driven by human processes. Human experiences, cultures, emotions, and subjective interpretations largely shape these aspects. While AI can produce art, it does not contribute to the development of art history as humans do. AI can be a tool for creating art and may influence the art world in various ways. The development and evolution of art history are fundamentally human endeavours. As of now, the ability of AI to understand and contribute to the complexities of art in a meaningful way is limited.

6. COMPLEMENTING, NOT REPLACING – THE FUTURE OF AI AND ART

The debate over AI's role in art often concerns whether it can or should replace human artists. However, AI can be seen as a complementary tool that enhances traditional art practices, working within parameters set by human developers. While AI can generate innovative and aesthetically pleasing artworks based on algorithms and machine learning, it lacks personal inspiration and emotional expression. This positions AI as a unique tool that can assist artists in exploring new creative possibilities (Colton 2012) without diminishing the value of traditional artmaking methods, just as the invention of photography did not replace painting but rather expanded the boundaries of visual art.

AI can process vast amounts of data, generate variations on a theme at an unmatched speed and volume (Colton and Wiggins 2012), and democratize art creation by making it accessible to people without traditional artistic skills. However, the AIGC art of today may be seen as a mere curiosity or fad in the grand scheme of art history. As AI technology advances, current AI artworks might be viewed as simplistic technical demonstrations rather than genuine artistic expressions, lacking human emotion, personal experience, and contextual understanding. The ease of generating AI art may lead to oversaturation, diminishing its novelty and perceived value over time. Future generations may regard today's AIGC art as a minor footnote in art history, with the art world ultimately rejecting AI as a legitimate creative force and maintaining the importance of human artists and their unique ability to convey emotion, tell stories, and reflect on the human condition.

7. CONCLUSION

Our exploration consistently shows that while AI is a powerful tool with the potential to revolutionize many aspects of art, it cannot replace the depth and complexity of traditional art, supporting our thesis that AI is a complementary tool rather than a replacement for human artists. The Arnolfini Portrait exemplifies the intricacies and depth of traditional painting, imbued with a profound understanding of the human condition, a nuanced interpretation of culture and society, and a deeply personal artistic vision. These elements, born from the artist's lived experiences, emotions, and subjective interpretations, add layers of meaning and complexity that AI cannot replicate. AI can mimic styles and generate visually pleasing images but lacks the emotional depth and experiential understanding inherent in human creativity.

Although AI brings unprecedented capabilities in data processing, pattern recognition, and production speed, traditional art offers an irreplaceable depth of emotion, complexity, and human connection. The future of art likely lies in the fusion of these two distinct yet complementary realms. As we explore and harness AI's capabilities in art, we should also appreciate and uphold traditional art's unique and invaluable qualities that make us intrinsically human.

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Landscape Seeing: An immersive stylistic visualisation of 3D scans of a Hong Kong urban park

Hin Nam Fong
City University of Hong Kong
School of Creative Media, City
University of Hong Kong, Run Run
Shaw Creative Media Centre, Level 7,
18 Tat Hong Avenue, Kowloon Tong,
Hong Kong, China
Hnong5-c@my.cityu.edu.hk

Landscape is a popular genre of visual arts. Artists translate their embodied experiences into images to express their admiration for nature. Now, landscapes in urban spaces are no longer natural but artificial. This research aims to understand what constitutes artificial landscapes. Therefore, the paper proposes the landscape seeing, an art-based approach that emphasises the embodied experience of the environment and seeks to recognise beyond forms. The paper has three parts. It first discusses the nature of artificial landscapes from the urban design point of view by comparing the cultural significance of artificial and natural landscapes. The next part discusses the imagery representations of landscapes, encompassing a geographic study of visual experiences of urban parks and a historical study of landscape paintings. These studies establish a foundation for the landscape seeing practice. The last part analyses the 3D point cloud scanning and visualisation of Nam Cheong Park inspired by the painting style and observational technique of the 20th-century Chinese open-air paintings. By adopting the landscape seeing approach, this paper suggests a novel understanding of artificial landscapes beyond traditional analytical and retrospective studies in urban planning, geography, and art history.

Artificial landscape. 3D scanning. Point cloud. Urban parks. VR

1. URBAN PARKS AS ARTIFICIAL LANDSCAPES IN HONG KONG

Urbanism, an urban design principle, values the 'synthesis of the city and the country' (Velegrinis and Weller 2007). In urbanism, landscapes determine the liveability of a city to some extent. Thus, the garden city is proposed to balance between cities full of buildings and rural life close to nature. Architects and planners make great efforts to integrate landscapes into urban spaces. One of their tactics is to design artificial landscapes in the city. For example, Zaha Hadid Architecture introduces the artificial landscape formation in the One-North masterplan in Singapore. Hadid integrates 'streets, cross-streets, squares and alleys, and formally manipulates the whole ensemble into one artificial landscape'. (Ibid.) In Hadid eyes, the One-North area is a mimesis of landscape orchestrated by buildings and greeneries. The artificial landscape

manifests innate admiration by imitating the form of natural landscapes.

Meanwhile, landscape urbanist architects and planners constantly synthesise public spaces between cultural and natural systems. Landscapes, including artificial ones, are tools to articulate cultural identity. For instance, the Gardens by the Bay in Singapore aims to manifest the country's garden city aspiration via landscape design. It serves as a 'botanic garden, a garden show, a civic park, a theme park, and a research centre into an ecologically instructive and spectacular landscape'. (Ibid.) Singapore uses the Gardens by the Bay to represent the versatility of the country and celebrate the 'Western bourgeois values, such as environmentalism, multiculturalism, education, health and biodiversity.' (Ibid.) The Gardens by the Bay is the realisation of Singapore's ambition of being an international city through artificial landscapes.

Manifesting cultural identities through landscapes is a tradition in many places. In the 20th century, Chinese painters personified famous Republican-era sites to express patriotism. Mount Huang, also known as the Yellow Mountain, has been portrayed as a masculine national icon 'exemplifying all Chinese mountains' (Dongnan jiaotong zhoulanhui xuanchuanzu 1935). The superior nature of Mount Huang inspired Republican Chinese painters to create numerous paintings with Chinese ink and newly adapted linear perspective to celebrate the majestic landscape. No matter the artificial landscape designs in Singapore or the paintings of Mount Huang, landscapes are agents to address cultural aspiration via environments. Aspirations for artificial landscapes are rooted in the traditional admiration of the landscape. How do landscapes generate cultural identities? What makes an artificial landscape beyond an imitation? The following part reviews two studies of landscapes, *The Visual Quality of Urban Park Scenes of Kowloon Park, Hong Kong*, and *The Optical Vision and New Modes of Depiction in Chinese Ways of Seeing and Open-Air Painting*. The review summarises the different perspectives on conceiving landscapes to establish a new foundation for recognising artificial landscapes in urban spaces.

2. THE LANDSCAPE IN URBAN PARKS AND 20TH-CENTURY CHINESE OPEN-AIR PAINTINGS

The definition of landscape varies in different disciplines. This part reviews the two articles, one from geography, and the other from art history. It aims to integrate points of view from different disciplines to suggest a new perspective to recognise artificial landscapes.

2.1 *The Visual Quality of Urban Park Scenes of Kowloon Park* by Wong and Domroes

Wong and Domroes identify urban parks as artificial natural settings delighting urbanites (Wong and Domroes 2005). This definition partially aligns with the objective of open area planning, or specifically urban park design in Hong Kong according to the definition of the Planning Department of the Hong Kong government. An open space should be safe, identifiable, and accessible while creating local identities and a sense of community as well as facilitating parental or mutual care of different groups (Planning Department 2015). Kowloon Park is a combination of active open space, which 'contains outdoor recreation facilities', a recreation space, which provides the 'indoor purpose-built venue', and a passive open space, which is 'landscaped as a park, garden, sitting out area...' according to the Hong Kong Planning Standards and Guidelines. (Ibid.) Passive open areas with plants are 'amenity

areas (that) provide landscaping for visual relief, enhance civic design and contribute towards a better environment' (Ibid.). Therefore, Kowloon Park in Hong Kong which Wong and Domroes study is an artificial landscape in terms of its design principle and method. Wong and Domroes' article reflects the correlation between the visual quality of artificial landscapes and their likeability. They aim to provide insights for planners, managers, and urban green space users by analysing visitors' 'visual experiences in the landscape and their emotional reactions' (Wong and Domroes 2005). Thus, they analysed the feedback of local and foreign visitors to Kowloon Park with photos of the park scenes. The key finding in the article is the polarised opinion on natural and built scenes. Most participants identify the photos with more natural elements as pleasing, and vice versa. In addition, the vegetation is a vital attribute of the park scenes. Their finding shows the 'likeability of urban park scenes diminished with increasing artificiality' (Ibid.). Wong and Domroes conclude that the amount of greenery and the presence of water make an urban park pleasing, while artificiality makes an urban park less attractive. Their findings align with their hypothesis that greenery and water are preferable to man-made surfaces in artificial landscapes. The research clarifies the dualism between natural and artificial elements in the context of artificial landscapes. Apart from the basic facilities, such as pavements or footbridges, the more natural elements, the better the artificial landscape. In general, natural elements are the essence of artificial landscapes.

2.2 *Optical Vision and New Modes of Depiction* by Yi Gu

Wong and Domroes use photographs to represent the urban park scenes. However, their photographs only capture the park scenes, instead of signifying the park as a landscape. In comparison, paintings signify the landscape directly, especially in Chinese ink art. Painters reflect their unmediated responses to nature through art, particularly with open-air painting (Gu 2020). In the 20th century, Chinese open-air painters adopted linear perspective to create landscape paintings. They were enthusiastic about the open-air painting genre (Xiesheng), the 'sketching from life emphasising visual representation as the result of a direct encounter between painter and subject' (Gu 2020). Based on The Western open-air painting tradition and the linear perspective, painters have developed rules to convert their observations into landscape paintings. Following the rules, they first take views (Qujing) and compose the framing (Goutu). Then, they identify the perspective (youshi) according to the viewpoint (shidian) and horizon (Dipingxian). Painters usually integrate multiple observations in one painting. Thus, 20th-century open-air paintings often had more than one vanishing point and were panorama-

like (Figure 1). These paintings capture painters' journeys of landscape visiting. The journeys are translated into paintings, which conceptualise the landscapes from one's embodied experience in the environment. Therefore, landscapes are vessels to project romanticised narratives, such as the artistic personification of Mount Huang with the 'strong, militant and masculine' character (Gu 2020).



Figure 1: Jiang Danshu, *Mount Huang* 黄山圖, 1935.
Reproduced in *Jiaoyubu dierci quanguo meishu zhanlanhui guanli weiyuanhui*, ed., *Jiaoyubu dierci quanguo meishu zhanlanhui zhuanji: di'erzhong, xiandai shuhuai*.

2.3 The Landscape Seeing

Wong, Domroes, and Gu suggest different ways to see the landscape. Wong and Domroes use a quantitative method to suggest the correlation between natural elements and visual pleasure in artificial landscapes. Gu summarises the observation and making of open-air paintings in China. The two approaches recognise landscapes differently. Wong and Domroes' approach is

retrospective. They review the park user's visual experiences of an existing artificial landscape. Gu's approach is prospective. She conceptualises the landscape signification in Chinese open-air paintings. If painters back then drew artificial landscapes, how would the buildings change their observation? What makes a painting with both natural and artificial elements a landscape painting? Ultimately, what defines a space as a landscape? I propose the landscape seeing, a practice-based method that meticulously follows the framework of making open-air paintings to study artificial landscapes. This method rationalises the artificial landscape formation from an artistic point of view. In the following part, I demonstrate the application of this method to study Nam Cheong Park, an urban park in Hong Kong.

3. THE LANDSCAPE SEEING AND IMMERSIVE STYLISTIC VISUALISATION OF NAM CHEONG PARK

The immersive stylistic visualisation of 3D scans is the realisation of the landscape seeing with 3D scanned data. It follows the observational framework of open-air painting while the visualisation appropriates this framework to present 3D scans of artificial landscapes. The result is a scan-based procedural VR animation of Nam Cheong Park, an artificial landscape in Hong Kong. Its objective is to recognise artificial landscapes through embodied experiences and artistic representations. This part discusses the visualisation of Nam Cheong Park in Hong Kong. The discussion covers the scanning progress, scenic composition, 360-degree visualisation and change of perspective, and the aesthetics of visualising point cloud data.

3.1 *Qijing*: The scanning progress

Qijing means view-taking. It is the 'very moment at which the painter encounters nature' (Gu 2020). The scanning progress is a rendezvous with the park, an artificial landscape. I have scanned parts of Nam Cheong Park with a light detection and ranging (LiDAR) scanner to capture 3D point cloud data of the environment. Point cloud data are geometric data of points recording the cartesian coordination and the colour of the environment. (Bugeja et al. 2022). The scans capture the spatial data of Nam Cheong Park. Before the stylistic visualisation, I rendered simple previews of the scans. They are not the artistic interpretation of the park but tools for selecting the area to scan. Eventually, I scanned areas consisting of natural and artificial elements, such as the bushes next to the running trail since the principle of landscape seeing is to study artificial landscape formation (Figure 2).

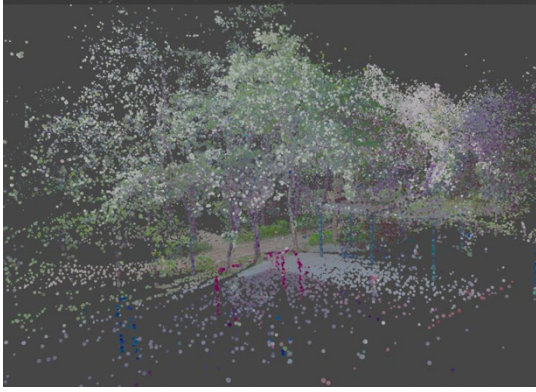


Figure 2: The simple visualisation of 3D scans of Nam Cheong Park (top), a panoramic photo of the scanned scene (bottom)

3.2 Goutu: the scenic composition

Goutu is 'derived from the two characters gou (constructing) and tu (picture), as "the construction of a picture" is self-evident', in English, the composition (Gu 2020). The composition of the VR scene resembles the park. I did not scan the entire park due to the terrain of the park. A large proportion of Nam Cheong Park is the lawn, which is flat and

hard to scan. Therefore, I only scanned the area with vertical elements such as trees or pavilions. The limitation of scanning also contributes to the composition of the VR scene. The scene is composed in an additive principle. Unlike photography, LiDAR scanning cannot scan elements far from the scanner since the technology relies on receiving the rebounded laser beam to estimate the coordination of points (Bugeja et al. 2022). The additive principle integrates multiple scans proportionally to compensate for the limitation. Coincidentally, the limitation of LiDAR scanning is related to the 'initial decision regarding the position of the picture and the selection of tasteful subjects from nature' (Wu 2006).

The composition of the VR animation is temporal. The scene is formed by three parts based on their locations. A virtual camera moves through these parts along a curve passing through them (Figure 3). The virtual camera is the object that locates the rendering viewport. As the composition is temporal, all parts are not visualised together in the entire animation. When the camera is out of the designated part, the scenes vanish. Only one part is rendered at a time. The additive principle and the temporal arrangement allow the audience to experience a dynamic composition. Besides, the moving virtual camera resembles my path of scanning. The Qujing and Goutu represent my embodiment in an artificial landscape.



Figure 3: Top view of 3D scans of Nam Cheong Park with original colour and the path for camera movement (left), Three groups of scans in different colours with the path (right).

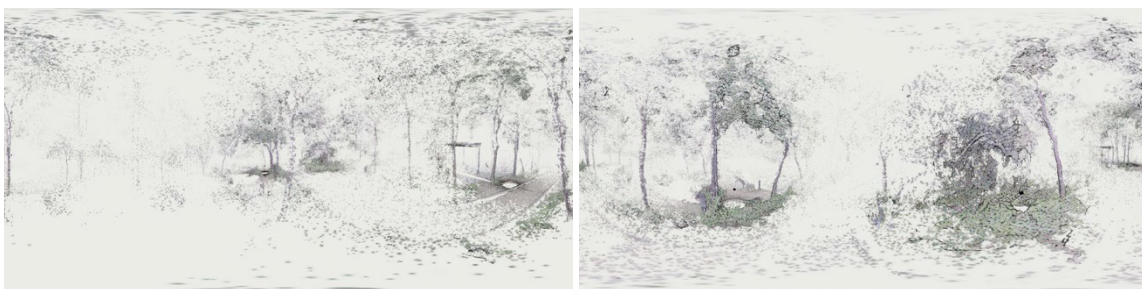


Figure 4: The rendering of the final VR animation (flattened) of frame 1600 (left), and frame 2400 (right).

3.3 Toushi and Dipingxian: 360-degree visualisation and the change of perspective

Toushi and Dipingxian are the visual representations of pictures. Toushi means linear perspective, the technique to portray space with optical distortion. In this case, foreshortening occurs in the linear perspective (Winfield 2023). The closer the object is to the viewport, the bigger the object is, and vice versa. Toushi provides a sense of distance in an image similar to human seeing. Dipingxian means horizon, a concept of setting a line as the foundation for composition. Conventionally, the horizon should be at 'one-third of the height of the picture surface' (Chen 1934). It sets a standard for representing the distance and facilitates the foreshortening in Toushi.

Since the virtual camera moves over time in the animation, the distortion changes along the moving viewport. The change of viewport visualises the scans from different positions (Figure 4). When the camera moves to the periphery of the scan, the scene becomes blank since less data were captured at the edge of the scan. When the camera moves to the centre of the scan, the points surround the viewport. These points fade out by distance from the viewport. The 'perspective' of the viewport and the scans are contrary. Although both visualise more in the front and less from the far, linear perspective captures and shrinks the image away from the viewport, while the LiDAR scanning does not capture the 3D data distant far from the scanner. The camera movement interplaying with the two 'perspectives' suggests a new spatial experience. Along with the camera movement, sometimes the man-made structures in the park are magnified due to the foreshortening, such as the pavilion and the rubbish bin. These structures occupy a larger area in the immersive environment and make the landscape less pleasing, according to Wong and Domroes' research. The immersive animation visualises the seen and unseen in perspectives, as well as artificials and greeneries in the park.

3.4 The aesthetic of visualising point cloud data

As aforementioned, point cloud data contain the cartesian locational data with the x, y, and z coordinates and sometimes the colour data in red, green, and blue (Ivsic et al. 2021). Based on these data, I iterate the scan visualisation twice. The first iteration is rendering with a translucent shader. The transparency of this shader is not even. The shader visualises each point with a relatively opaque core with transparent edges. In each spherical point, the transparency increases gradually in the periphery (Figure 5). As a result, the points are diffused colour dots representing the scanned environment. There are two objectives for this shader design. The first objective is to create an impressionist virtual

environment. The shader keeps the shape of the scans recognisable but removes its materiality. The blurry representation unifies the materiality of artificial and greeneries in the park. As the Hong Kong Planning Standards and Guidelines suggest, district open spaces like Nam Cheong Park should provide 'facilities for the core activities and for passive recreation to meet the needs of a district population' (Planning Department HKSAR 2015). Therefore, functions brought by the artificial facilities are as important as the vegetation that 'adds aesthetic quality to the urban design' (Ibid.). Artificial structures are the components of artificial landscapes instead of add-ons of natural landscapes. Even though artificial structures in urban parks are less visually pleasing than natural elements, they share the same value in contributing to the cultural aspiration and identity of urban parks as artificial landscapes. Therefore, I decided to blur and unify the material of the artificial and greeneries in the VR artistic representation. The second objective is to blur the boundaries of the scans. Recognisable borders of the scans occur due to the maximum scanning distance limitation for LiDAR scanning. The translucent shader softens the edge of the scans. The area with fewer points visually dissolves into the background due to its transparency. The translucent shader uses an impressionist style to harmonise and soften the scans.



Figure 5: A rendering of the scans with the transparent shader.

The second iteration is the volumetric approximation. It is a procedural modelling method that builds meshes by sampling the distribution of points. The objective of the volumetric approximation is to outline the scans. Unlike the translucent shader, the volumetric approximation objectively defines the structure of the scanned scene by the density of the points. It offers a spatial analysis of the scene that visualises the formation of the scene purely by the locational data. The volumetric approximation references the brushstroke for outlining in Chinese ink painting. The brushstrokes outline subjects to define the form or texture of objects. In the Nam Cheong Park visualisation, I sample the points in the scan into volumes by their density. Volumes are voxels representing the density of the space. The higher the

density, the more voxels are generated. Only the areas with a certain number of points are sampled into volumes. The volumes then generate meshes by evaluating the number of voxels. There is a threshold value determining the direction of the surfaces of meshes. If the number of voxels is larger than the threshold value, the face towards the voxels, also known as the normal, is the inside. By patching all faces, the meshes are created. I generate wireframes from the meshes to imitate the outlining brushstrokes in Chinese paintings (Figure 6).

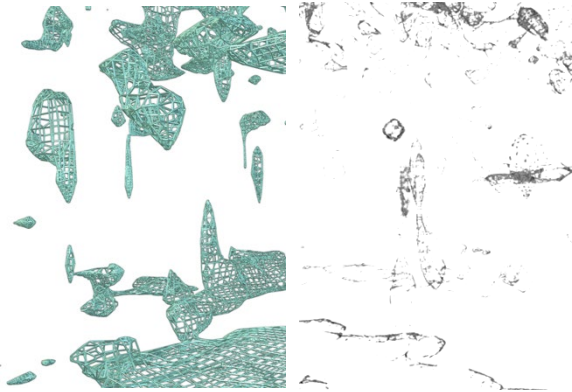


Figure 6: Renderings of volumetrically approximated models with solid colour (left), and the transparent shader (right).

A translucent shader is applied to the wireframes to create strokes with dynamic thickness. Since the shader is translucent, most of the wireframes are barely visible. Nevertheless, the overlapped parts or the joints of the wireframes are dark and visible with this shader. As a result, the 'outlining' wireframes define the scans. These outlines are three-dimensional. When the viewport changes over time, the outlines still trace the scans.

Both iterations only appear when the camera passes through the corresponding part. They are dynamic programmes that are adaptive to different scanned data. The final visualisation is an approximately two-minute VR animation (Figure 7). The animation is a cruise of the stylistic visualisation of the point cloud scans of Nam Cheong Park. The scans are rendered with translucent spheres and wireframes generated

with the volumetric approximation. The entire animation comprises three compound scans only visualised when the viewport passes through them. The animation is desaturated to black and white to blend natural and artificial elements further. In the VR animation, audiences can experience a painterly immersive environment of the park. The animation addresses the novel landscape seeing to recognise urban parks as artificial landscapes.

4. CONCLUSION

The paper first introduces the artificial landscape, the mimesis of the natural landscape in urbanism. Artificial landscapes compensate for men's admiration of nature in urban spaces. They are usually in the form of urban parks nowadays. The paper then compares Mount Huang in China and Gardens by the Bay in Singapore by their cultural significance as landscapes. The comparison suggests artificial landscapes are beyond imitation. After that, the paper reviews Wong and Domroes' quantitative analysis of the visual quality of an urban park and Gu's qualitative study of the creation of the open-air painting on the landscape in 20th-century China to establish a theoretical framework for studying artificial landscapes. The reviews lead to the landscape seeing, a practice-based method that follows the framework of creating Chinese open-air paintings to 'portray' artificial landscapes. The paper elaborates on the landscape seeing with the immersive stylistic visualisation of Nam Cheong Park via 3D scanning. Referencing the view-taking (Qujing), composition (Goutu), perspective and horizon (Toushi and Dipingxian), the visualisation appropriates the tradition of open-air painting to the VR animation. Lastly, the paper discusses the aesthetics with the translucent shader and volumetric approximation. The aesthetic addresses a sense of tranquillity to recognise urban parks as artificial landscapes in the animation. The immersive scan-based animation finds the landscape seeing a tool to perceive and represent the embodied experiences in artificial landscapes, which eventually recognises their authenticity.

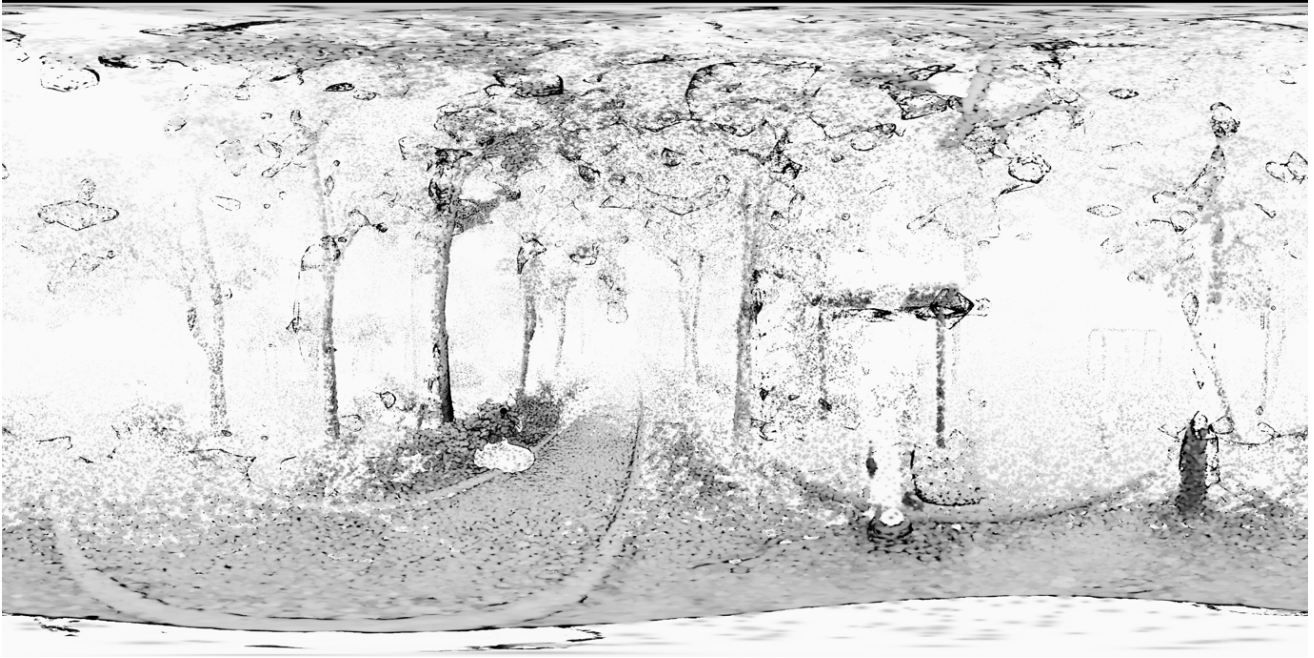


Figure 7: A rendering of the final VR animation (flattened)

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Subverting Syntax: Experimental narratives from the Post-Lingnan School of Painting

Racelar Ho
York University
Independent Various Art Space
Toronto, Canada
racelar@yorku.ca

Sarah Vollmer
York University
Independent Various Art Space
Toronto, Canada
vollmer@yorku.ca

Xiaolong Zheng
Guangxi Normal University
Independent Various Art Space
Guangxi, China
2008_zhenglong@sina.com

Post-Lingnan School of Painting (PLSP), an artistic project deeply embedded in both research and praxis, enjoys the endorsement and support of the Memorial Hall of Lingnan School of Painting. As an extension of the Post-Bits Human Universe (PBHU), an ever-evolving interdisciplinary art initiative, PLSP stands as an experimental foray that transcends conventional visual and aesthetic boundaries. It simultaneously upholds the core artistic tenets of the Lingnan School of Painting and its contemporary successor, the post/Neo-Lingnan School of Painting. This is achieved through the adoption of multifarious and pioneering methods. This project is composed of a multifaceted combination of forms and media. It harnesses artificial intelligence and computer vision algorithms, diverging from traditional paradigms by prioritising CPUs for generating art that resonates with a dynamic, natural flow. This innovative approach disrupts pre-existing perceptions through a reconceptualization of algorithmic art and the incorporation of semantic models, which vivify historical scrolls with an evolving narrative. PLSP also shows its radical stance in the real world by turning e-book readers into modern digital canvases. These canvases show a transformative mix of digital and traditional art, based on post-humanist ideas and a dedication to the ongoing development of artistic expression. In the coming March, PLSP will be exhibited as part of the first exhibition after the recent renovation of the Memorial Hall. This exhibition, a confluence of artistic revival and commemoration of the Lingnan School, will also mark the momentous occasion of the 114th anniversary of the birth of one of its legendary artists, Li Xiongcai. PLSP, thus, stands as a manifesto of the Lingnan School and PBHU for the future, proclaiming its commitment and determination to the continuous development of its artistic and aesthetic expression and intellectual and spiritual legacy of transcending beyond ideological shackles and bracing inventiveness in the age of intense confrontation and rapid integration between artificial and natural intelligences, as well as diverse cultures.

Post-Lingnan School of Painting. Lingnan School and post/Neo-Lingnan School. Meta-reflective imagery. Reflective imagery. Meta-pictures. Hyperion. Subverting syntax. Biological intelligence. Artificial intelligence.

1. THE LINGNAN SCHOOL

The Lingnan School, also recognised as *the Cantonese School of Painting*, *lingnan pai*, or *lingnan huapai* (the Lingnan School of Painting), epitomises a revolutionary art movement that burgeoned in the early 20th century. This school's distinction lies in its deviation from the typical constructs of art history studies concerning movements, trends, and revolutions. Rather than merely existing as an artistic movement or painting school with a geo-cultural identity rooted in Lingnan—the ancient designation for southern China's region, beyond the Wuling mountains, encompassing Guangdong and Guangxi provinces and centred around the Pearl and West River drain basins—it represents an ever-evolving ethos of rebellion, innovation, and radicalism. This ethos consistently challenges outdated notions and constraints, setting the Lingnan School apart as more than a mere historical period or regional style. In parallel, the term "Lingnan School" also denotes

the *zhezong pai* (eclectic school), epitomising a serene, reflective, and pluralistic philosophy. It melds Eastern and Western aesthetic sensibilities and artistic techniques, blending the ancient with the modern. This integration, advocated by the Lingnan School trio—Gao Jianfu, Gao Qifeng, and Chen Shuren—serves as a vanguard of ideological classification and recognition, denoting a significant ideological shift closely intertwined with the era's prevalent atmosphere of uncertainty, turmoil, and volatility during which the trio made their mark.

1.1 Revolutionary Art Movement (1900s-1930s)

As the vanguard of an art movement, the Lingnan School—perhaps more aptly referred to as *zhezong* or *nanfang shan pai* (the "South of the Mountain School") to its first generation—stood as a counter-current to the ideological renaissance and aesthetic transformation inherent in traditional Chinese painting through its embodiment of *xin* (new).



Figure 1: A preview of the upcoming PLSP exhibition, featuring a 270-degree immersive video installation complemented by a constellation of nine overhead LED screens, displaying algorithmically generated images.

Thirty years since its inception, the school has indeed indubitably accomplished its historical mission in the annals of art, notwithstanding the founding trios' lack of intention to entirely overturn and renounce the aesthetic paradigm and application of traditional Literati painting. In his seminal work, *My View on Modern National Art*, Gao Jianfu persistently emphasises the revolutionary role of art in intellectual awakening and its societal duty to educate and enlighten the populace. (高劍父 Jianfu, 1955) It is imperative, he argues, for art to be comprehensible, appreciated, and embraced by the wider public, thereby ensuring its fidelity to the veracity of life. Furthermore, Gao posits that artists, in their integration, reference, and assimilation of Western art culture, should transcend beyond mere surface-level replication of Western aesthetics, striving instead to steadfastly preserve the intrinsic cultural roots and the core of the national ethos inherent to their own heritage. Within this revolutionary aesthetic paradigm, the founding trios advocate naturalness as the cardinal principle, engaging it through a judicious amalgam of rational analysis and subjective selection in the artistic process, transcending mere appearance imitation of the natural world, remaining true to the essence of reality, and challenging conventional frameworks and visual-representational paradigm in painting composition.

1.2 Aesthetic and ideological transformation (1930s – 1980s)

In the aftermath of mainland China's political unrest and civil strife, the foundational trio of the Lingnan School, engulfed in a mood of melancholy and desolation, gradually receded from their once fervent socio-political engagement. This withdrawal marked a pivotal transition, as the second generation of Lingnan School artists emerged into prominence, heralding a new phase in the school's evolution from merely an art movement to a transformative force in aesthetic ideology. Moreover, in response to the turbulent political landscape of China, numerous disciples of the Lingnan School's founding trio, confronting the vicissitudes of their homeland, opted to relocate to Hong Kong, Taiwan, and diverse diasporic communities globally. This relocation has significantly broadened the Lingnan School's impact, heralding a new epoch in its artistic and cultural influence.

The artists of this generation, inheriting the ethos of amalgamating Eastern and Western artistic techniques and aesthetic sensibilities, embarked on an innovative journey, crafting a distinctive aesthetic and ideological style. This generation, diverging ideologically from their predecessors, accentuated individualistic consciousness over traditional National Painting themes such as animals, insects, mountains, and natural landscapes, typical of naturalism painting. Boldly, they integrated contemporary themes, reflecting the multifaceted socio-political context of their time,

including societal disparities, industrial transformation, and the impacts of war. Renowned artists like Guan Shanyue and Li Xiongcai, pivotal in this generation, integrated these varied elements, significantly contributing to the Lingnan School's legacy in Chinese art history.

However, this period was not without formidable challenges, deeply embedded in the tumultuous socio-political and cultural transformations of the era. As they navigated through political instability, including the Japanese invasion and subsequent civil war, these artists found their creative expressions both influenced and constrained by the surrounding upheaval. This era demanded a delicate balance between upholding the rich heritage of traditional Chinese painting and embracing novel Western art elements, a synthesis that elicited both recognition and critique. Moreover, while they were instrumental in defining a unique artistic identity, their journey within the traditional bounds of Chinese art was marked by a mixture of triumphs and controversies, often engaging in critical discourse over the departure from conventional themes and techniques in the quest for a balance between artistic integrity and public reception.

1.3 End or demise of the Lingnan School? (1980s – 2000s and present)

As the 1980s progressed, the Lingnan School's artistic community experienced momentous change, with artists dispersing to various locations. While some chose to stay in mainland China, they embraced a more traditional painting style, a move that was also indicative of a conservative shift in artistic approach. This dispersion presented challenges in establishing artistic influence in new environments. During this transformational period, the Lingnan School's status in the Chinese art world shifted from a vibrant collective to a historically significant entity. Its essence, once dynamic and evolving, achieved symbolic culmination in Hong Kong, emerging as a monument to past glory rather than an active force in the contemporary art scene.

Within the discourse on the 'Lingnan School', persistent declarations about its 'demise' and 'the end of the Lingnan tradition' resonated intensely beyond its regional boundaries, in stark contrast to the divergent narrative emerging from Guangzhou, the stronghold of the Lingnan School. Here, thanks to a strong affiliation with the Guangzhou Academy of Fine Arts (GAFA), the essence and ethos of the Lingnan School endured uninterrupted. Yet, this continuity did not equate to a serene landscape among the emerging artists and critics engaged in the discourse surrounding the school. Discontented with a perceived decline in innovative spirit and trite aesthetic representations in the contemporary

Lingnan School, these burgeoning artists and critics introduced the concept of *hou-lingnan pai* or *xin-lingnan pai* (the 'post/Neo-Lingnan School'). Concurrently, art critics and historians engaged in vigorous debates over the definition of what constitutes the Lingnan School, grappling with whether it represented merely a school of painting or an art movement, and whether it had truly reached its denouement. These passionate debates and assertions reached their zenith between 1991 and 1993, reflecting a period of intense reflection and re-evaluation within the art community.

In the wake of the Lingnan School's evolution, the late 1990s witnessed a flourishing of artists and exhibitions linked to the 'post-Lingnan School' in the Lingnan region. This new wave of artists, infusing Western contemporary art's aesthetic, cultural, and philosophical critiques into their work, embarked on a process of deconstructing and reconstructing the entire visual language of creativity. This period featured a diversity of 'post-Lingnan' styles in exhibitions, ranging from complete abstractions from traditional Chinese ink painting to efforts that transcended the limitations of single forms of artistic expression. Despite the apparent thriving of the 'post-Lingnan School', underlying issues persisted. The debate whether 'post-Lingnan School' signified a new variant of the 'Lingnan School' painting movement or marked an aesthetic and revolutionary shift remained contentious.

In the early 1990s, art critic Wang Huangsheng saw the 'post-Lingnan School' as new artists' strategy to forge distinct identities, leveraging the 'Lingnan School's' renown (王璜生 Huangsheng et al. 2002). Scholar Li Weiming in 1997 interpreted 'post-Lingnan' as redefining 'Lingnan' in a modern context, using 'post' for cultural critique and identity (李伟铭 Weiming 1997). Huang Yihan, an initiator of 'post-Lingnan', sought differentiation from 'Lingnan' and alignment with global trends (黄一瀚 Yihan 1997). Hu Bin described 'post-Lingnan' as a group of critically aware artists, challenging the 'Lingnan School's' conservatism and driving National Painting innovation (胡斌 Bin 2009).

The 2002 Guangdong Museum of Art seminar on 'Post-Lingnan' and 'New Guangdong Ink Painting' encapsulated diverse artistic perspectives yet remained anchored in the ink painting tradition, leaving the 'Lingnan School's' destiny an unresolved aspect in Chinese art's narrative. The waning interest in the 'Lingnan School' among English-speaking scholars, focusing on art historical analysis, was evident. An extensive search by the author revealed a stark absence of discourse on 'post-Lingnan' or 'Neo-Lingnan' in

Western academia, suggesting the 'Lingnan School's' revival since the 1980s has been insular to its region. The Lingnan School, since the 2000s, has significantly influenced GAFA, instilling a revolutionary spirit among its students that is now integral to their approach to creativity and life. This transformative spirit at GAFA, as observed and articulated by the authors who are the alumni, has catalysed the formation of collectives like the 'post/Neo-Lingnan School' and the 'Independent Various Art Space' (IVAS), the latter founded by the author in 2017, proving the enduring influence of the 'Lingnan School' ethos. The Memorial Hall of Lingnan School of Painting's collaboration with the author's IVAS, especially on the PBHU project, further attests to the 'Lingnan School's' enduring influence as a dynamic artistic and aesthetic force.

2. POST-LINGNAN SCHOOL OF PAINTING

'Post-Lingnan School of Painting' (PLSP), a construct under the 'Post-Bits Human Universe' (PBHU), exists in a realm of continuous evolution, distinctively merging artificial with natural intelligence. This fusion, deeply embedded in posthumanist and postmodernist ideologies, challenges the conventional aesthetic and theoretical norms of the traditional Lingnan and 'post/Neo-Lingnan' Schools. Although PLSP is not an official successor of the Lingnan School, it embodies a transformative avant-garde spirit—a spirit commissioned by the Memorial Hall of Lingnan School of Painting. This intricate relationship is further complicated by PLSP's deliberate disavowal of traditional Lingnan legitimization, asserting a unique, autonomous identity. Consequently, PLSP emerges as a testament to the enduring pioneering spirit of the Lingnan School, whilst simultaneously weaving in the narratives, aesthetics, and theoretical frameworks of its progenitor, PBHU. Thus, PLSP represents a dual declaration for both entities, advocating for continuous artistic and intellectual progression. It daringly surpasses conventional ideological boundaries, catalysing innovation in an era characterised by the melding of artificial and natural intelligences, alongside a plethora of cultural dynamics.

2.1 “Post-” not “post/Neo-” Lingnan School of Painting

In stark contrast to the post/Neo-Lingnan School, where 'post-' traditionally embodies a cultural strategy anchored in Lingnan's local and indigenous identities, PLSP's interpretation of 'Post-' represents a marked deviation, transcending its typical sequential marker role to signify a profound ideological shift. This shift aligns with the post-Anthropocene era, embracing post-humanist theories, and gravitates towards the concept of

'worldlessness,' a cornerstone of PBHU's foundational ethos. This realignment heralds a significant departure from established norms, steering PLSP towards a multi-faceted theoretical framework. This framework, diverging from the historical and geographical foundations of the 'post/Neo-Lingnan School', weaves in the intricate concepts of post-humanism and 'worldlessness', signalling a paradigmatic shift in artistic ideology and practice.

Furthermore, the interpretation of 'Post-' within PLSP markedly diverges from its historical usage in the Lingnan School, where it embodied a convergence of Eastern and Western artistic sensibilities. In the traditional context of the Lingnan School, knowledge transference was single-directional; artists ventured abroad, imbibing international artistic insights, and subsequently interweaving these with local traditions upon their return to China. Contrarily, PLSP ushers in a multi-directional exchange paradigm, representing a significant departure from this linear approach. This multi-directional model nurtures a global artistic dialogue, where each participant, rather than merely absorbing, actively contributes to a collective pool of diverse cultural wisdom. Such an evolution in PLSP signals a shift towards a more inclusive and collaborative artistic landscape, one that highlights the intricate interplay of varied cultural perspectives, enriching the artistic milieu with a rich tapestry of shared knowledge.

2.2 Hypericon and meta-pictures

The hypericon and meta-picture concepts astutely illuminate the intricate nexus between the core aesthetic paradigms and ideologies linking Chinese National Painting with the Lingnan School. This analysis is pivotal in grasping how PLSP disrupts the traditional creative syntax of the Lingnan School, signifying a deviation from established artistic standards. The *Jieziyuan Huapu (JZY)*, emblematic of the Qing dynasty's printmaking pinnacle, offers an exhaustive exploration of Chinese artistic traditions, setting benchmarks in art education and profoundly influencing traditional Chinese painting's aesthetic and technical spheres. Revered in Chinese art, the manual functions both as a foundational reference and a critical model for interpreting and conceptualising Chinese imagery. Its comprehensive instructions and vivid illustrations have rendered it a vital reference for successive generations of Chinese artists, notably shaping the Lingnan School. The *JZY* thus establishes a paradigmatic framework, enhancing the understanding of traditional Chinese aesthetics, artistic methods, and philosophical principles. In the context of Mitchell's 'metapicture' notion, the *JZY* represents this concept within the expansive narrative of Chinese art, surpassing mere technical

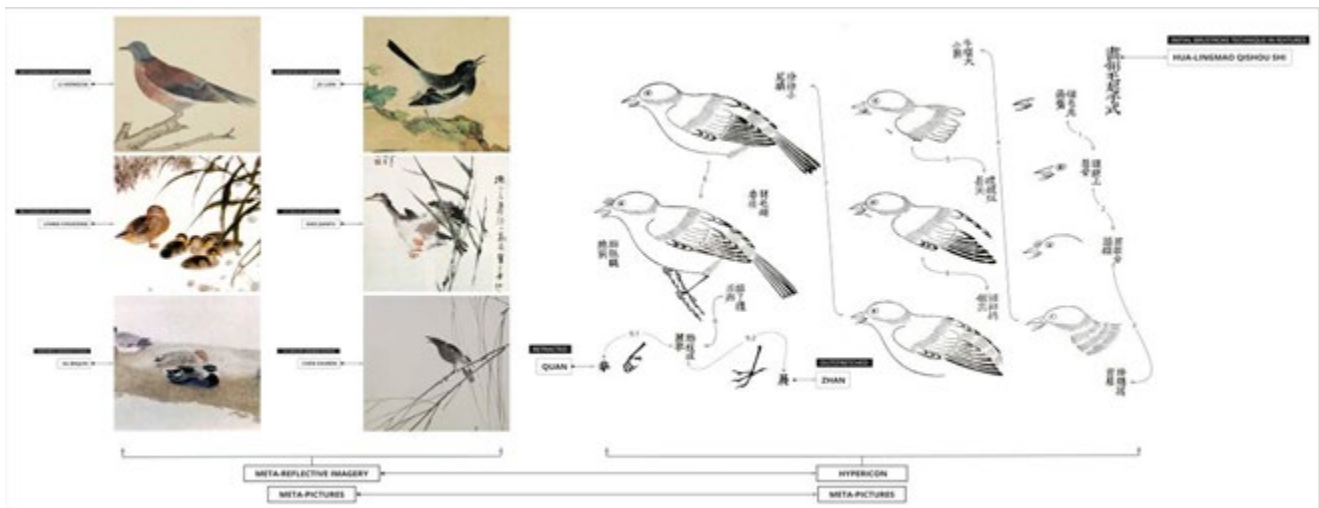


Figure 2: (From right to left, top to bottom) Illustrating the JZY. (王樂 Gai 1701) as a pivotal hypericon and metapicture, this diagram encapsulates the transformative dialogue between the traditional Lingnan School and the innovative PLSP. See <https://miro.com/app/board/uXjVN8PHd9c=?moveToWidget=3458764575525574927&cot=10>

painting, embracing its philosophical and aesthetic dimensions. The Lingnan School viewed the JZY as a linchpin of tradition and a catalyst for artistic renewal, with its founders striving to assimilate contemporary concepts and techniques while preserving the essence of traditional Chinese painting as delineated in the manual. The Lingnan School's artists, in their interaction with the JZY, simultaneously embraced its role as a foundational hypericon, cementing the essence of Chinese artistic aesthetics, and as a transformative metapicture, prompting a critical reassessment of these traditions, thereby masterfully blending modern elements into their evolving aesthetic language. This engagement epitomises a dialogue between tradition and modernity, re-envisioning and reinvigorating traditional forms and methods to articulate innovative ideas and adapt to contemporary artistic contexts.

Figure 2 charts the JZY in its dual capacity as a hypericon and a metapicture, revealing its profound impact on the historical arc of Chinese art and its meta-reflective dialogue with Lingnan School artists. Here, the JZY is not merely archived as a trove of traditional aesthetics and techniques but also serves as a prism through which artists reassess and reinvent their artistic lineage. The visual schema underscores how Lingnan School's oeuvre, as meta-reflective imagery, does not only self-contemplate but engages in a broader conversation about the essence and purpose of imagery. Concurrently, it positions the artworks of the Lingnan School as a meta-picture for PLSP, which provocatively redefines traditional artistic paradigms, nurturing a deepened engagement with the JZY's established iconography. This synergy breathes life into a vibrant exchange between JZY's storied legacy and the avant-garde dynamism of Lingnan School, crystallising in PLSP's transformative ethos, weaving a visual

narrative that connects the threads of past and present, tradition and innovation, into a coherent tableau.

2.3 Subverting syntax – reflective imagery

The intricate interplay of hypericon, metapicture, and meta-reflective imagery, as evidenced in the nexus between the JZY and the Lingnan School, imparts a nuanced layer to the PLSP. Within this paradigm, visual components act as reflective agents that encapsulate the metapicture essence, critically introspecting their existence and engaging with the expansive discourse on visual representation. Such imagery signifies an embedded self-awareness and a profound engagement, offering a contemplative dimension within the images themselves. Hence, the PLSP adopts a strategic aesthetic and theoretical approach informed by PBHU to challenge and reconceptualize the established paradigm and syntax of aesthetics. In this pursuit, we have fostered a critical methodology that purposefully opts for CPUs over GPUs, a choice that stands as an act of resistance against the dominant narrative of acceleration in digital art production. This decision is a critical engagement with the temporal qualities of artistic creation, echoing the meditative and deliberate pace of Lingnan painting, and posing a challenge to the immediacy that digital technology often seeks to impose.

In the first strategic facet of this subversive methodology, two sophisticated AI models have been meticulously crafted and trained by the authors. These models, informed by the Lingnan School's rich digital archives, extend beyond mere generation; they are interpretive frameworks capable of rendering visual narratives that resonate

with the profound historical nuances embedded within traditional manuscripts, including those previously undisclosed to the public gaze.

The second strategy unfolds as a nuanced, integrated system of algorithms (Figure 3) delving harnessing a diverse constellation of computer vision algorithms. This intricate analysis transcends the superficiality of aesthetics, penetrating the meta-pictures of the Lingnan School to unveil and reinterpret layers of concealed meaning, thereby challenging the viewer's understanding and perception of conventional forms (Figure 4). By

employing CPUs for this elaborate computational work, the authors embrace the unpredictability inherent in artistic creation. This approach mirrors the natural, harmonious flow of traditional art, where each brushstroke is infused with a unique temporal and pressure signature—attributes that CPUs emulate through their more measured and intentional processing cycles. Consequently, the visual outcomes from this process are not mere static representations but dynamic entities, reflecting the fluid temporal and aesthetic states of their creation.

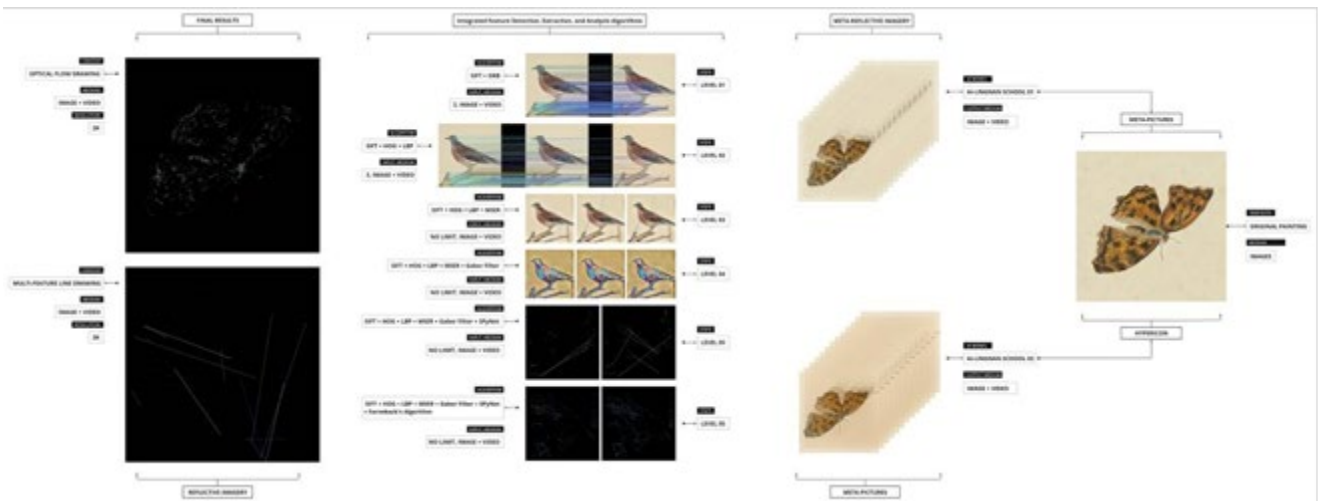


Figure 3: (From right to left, top to bottom) A visualisation of the complex algorithmic process revealing the relationship between the generated reflective imagery and the original Lingnan School artworks as meta-pictures. See <https://miro.com/app/board/uXjVN8PHd9c=?moveToWidget=3458764575530545286&cot=14>

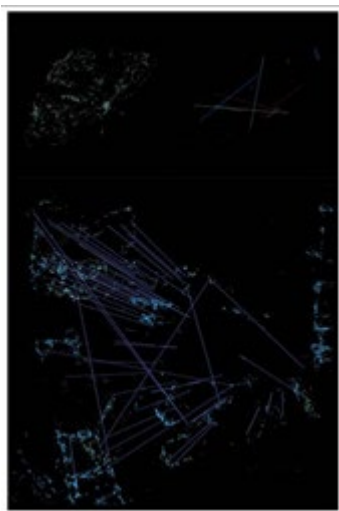


Figure 4: Algorithmic output illustrating the evolution from linear and optical flow sketches to the algorithmic re-imagining of Lingnan School paintings.

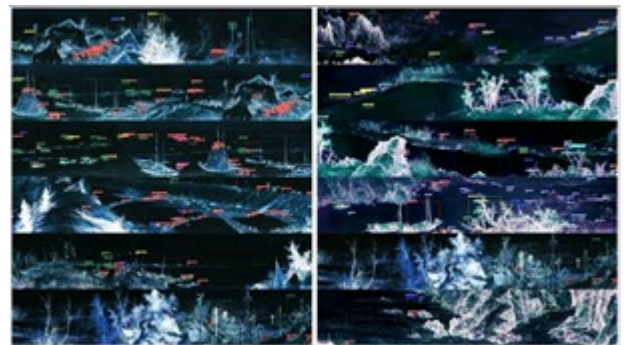


Figure 5: Semantic segmentation and labelling of Li Xiongcai's (left) and Guan Shanyue's (right) scrolls.

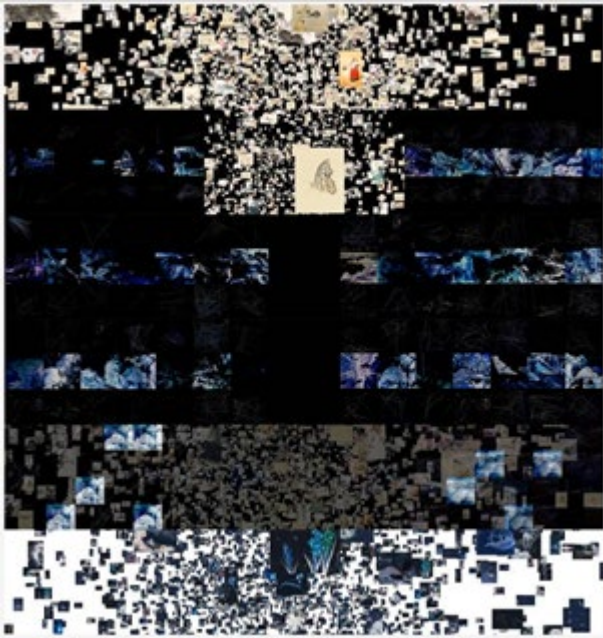


Figure 6: Video snapshots from PLSP's immersive projection contrasting Lingnan School's artworks with PLSP's AI-generated dynamic visuals.

In the third and final strategic component, a semantic segmentation labelling model has been intricately developed by the authors to annotate the revered scrolls of Li Xiongcai and Guan Shanyue (Figure 5). This model, a creation of meticulous training and nuanced understanding, transcends the realm of basic labelling to act as a hermeneutic tool that deciphers and weaves complex narratives within the historical tapestry. It embodies a re-imagining of Lingnan artistic principles through a contemporary lens, where traditional static elements of the scrolls are reinterpreted into dynamic animations.

These animations are not mere aesthetic additions; they serve as critical commentaries, challenging the temporal fixity of the artworks by introducing a fluid, evolving narrative structure. This innovative approach catalyses a dialogue between the artwork's storied past and its potential future, thereby infusing a new narrative dynamism that prompts a re-evaluation of traditional artistic canons (Figure 6). It invites viewers to engage with the artwork in a transformative light, redefining their interaction as an active, interpretive experience that is both critical and revelatory.

2.4 Subverting syntax – physical manifestation

Without syntax and communication protocols, nor without the need for connection, the development and establishment of communication devices seems unlikely even in the broadest of terms. Wherein section 2.3 established the profound capacity of futuristic technocracy redeployed on historical contexts, this dynamic is subverted once again into a participatory formation of co-option and

collusion at the physical and tangible level of inter-rather than intrapersonal connection. During discussions with Memorial Hall and Lingnan School representatives, a curious openness to exploring further technological interactions was uncovered.

Thus, following in a purported historical path of the Lingnan School's founding ethos, the authors pushed expansion into a basis imploring the flow of free and open-source democratisation of technology and community and an exchange of ideas across micro- and macroscopic scales. Centring on the balance of accessible technology with pre-existing global support, e-book readers, popularised by Amazon's Kindle line, provided a foundation for this physical manifestation of subversion. Figure 7 summarises key steps and a frame of reference for accessing the e-paper, or e-book, reader at a root level.



Figure 7: Subverting communication syntax technically, the paperwhite Kindle (top-centre) undergoes dual tapping through software (right side, bottom-left) and hardware (top-left, bottom-centre), with firmware reimaged to support both protocols.

The low-level hardware and software access is done through reverse engineering old and repurposed Amazon Paperwhite (PW) Kindles. Along the top of Figure 7, starting from the left to centre is the PW kindle with a USB to TTY (serial) communication protocol translator which has been soldered via serial port connections on the inside electronic components of the kindle. These serial port connection tabs can be seen in the bottom centre figure segment and this connection is established as a hard back-up to the software 'jailbreaking' - a term used for syntactically subverting the commercial context of an electronic device (in North America, and specifically Canada, wherein this context occurs, 'jailbreaking' or reverse engineering a legally obtained electronic device is well-established and a protected form of discovery. Caveats and limitations apply). In this case, the subversion is established to further extend the meta-scape of imagery and visual syntax through manipulation of the display scene itself. The e-reader is used to connect the modern-day viewer through a portal of re-imagining and re-imagining. The right side of Figure 7 highlights an imposed menu context – syntactical manipulations of software files are loaded as standard e-books.

This software 'hack' style is often developed through a standard process rich in its decades long historical foundation of interaction between technical communities inspired by security, global democratic access rights, curiosity, and evolving innovations (the Kindle Developer's Corner on MobileReader is particularly active and provided foundational reference). The left side of Figure 7 is a screenshot of terminal output as the authors connect to the kindle's root system and parallels the unique pretext that is found in software, hardware, and firmware – it is not often clear to the casual observer if the context is nefarious and where a picture of root access often invokes more imaginative speculation beyond that which literally appears. The creation and re-imagining of a subsystem at its core distinctly require the access of the inaccessible with a very literal syntax subversion indeed and is curiously mediated through what is often the most basic origin form of computer communication.

Once access was established, the e-book reader was quickly repurposed to digitally transfer still frames extracted from the algorithmic re-imaging of the Lingnan School paintings. Figure 8 highlights a selected series of ten such frames. Ongoing collections of these extractions are updated to remote digital storage and refreshed sets are transferred to the e-paper devices which will be on display. Additional schematics will be provided for 'Do-it-Yourself' (DIY) projects en masse to the public who might want to build their own re-imagining-imaging-machines. Individuals can opt to subscribe to live updates of the artwork frames and continue to use the e-book as a digital painting, able to be hung at home, subverting the conventional paradigms of ownership and the forms of expression of artworks. The meta-picture is realised on a global front, abstracted into the daily lives and PBHU-inspired worldlessness of the 'every-person'.



Figure 8: Algorithmic re-imaging of a Lingnan School painting (refer to Figure 4), adapted for greyscale Kindle. Displayed as ten stills, the sequence progresses from left to right, top to bottom.



Figure 9: An 'alpha' prototype of TBBE by Joey Castillo from *The Open Book* project, with plans for custom PCBs through a multinational, cross-cultural collaboration for exhibition display.

To further capture the ethos of our framework and integration of the Lingnan School style, PLSP will be reimagined onto and into a set of custom printed circuit boards (PCBs). The e-paper display will remain central to the *communication device* however custom colour and visual markings will be etched directly to an extended PCB size and offer two-sided comparative syntaxes of original and subverted depictions from the Lingnan School paintings and form. Extending the existing 'alpha' prototype of *The Open Book* e-reader (TOBE, see <https://www.oddlyspecificobjects.com/projects/>), an open-source version of eReaders such as the Amazon Paperwhite Kindle, the authors will integrate the framework developed for the Memorial Hall exhibition with this prototype, working in tandem with Joey Castillo of Cornell Tech, to provide 'kits' for assembly and donation in honour of the esteemed momentous occasion. Figure 9 captures side-by-side stills of the existing *The Open Book*. Students from the International Intelligent Interaction Design Lab at Guangdong University of Technology, led by Professor Ji, along with their peers from the Guangzhou Academy of Fine Arts form part of the 'founding Lingnan members' journey home after exploring abroad to re-formulate and re-invoke cultural exchange within a native context.

3. FUTURE ECHOS

In anticipation of the exhibition's debut, discussions with Castillo, Professor Ji Yi, and the director of the Memorial Hall have illuminated the project's ethos: a synthesis of tradition with technological innovation. This venture transcends conventional artistic boundaries and marks a pivotal moment in cultural exchange, showcasing the integration of traditional Chinese painting techniques with modern digital mediums, reflecting a journey of art that echoes within a globalised context where geographical constraints dissolve. The conclusion of this exploration is significant, highlighting that interview, offering a spectrum of perspectives on this project, will be accessible by summer 2024 on IVAS's website. This archive will not only attest to collaborative achievements but also illuminate

pathways for future intersections of art and technology. Anticipation intertwined with deep respect for the audiences' forthcoming insights. Their perspectives are crucial in sustaining the dialogue between traditional ethos and innovative practices, affirming the authenticity and vitality of artistic endeavours.

4. ACKNOWLEDGEMENTS

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Indoor Tourist and Digital Scenery: Rethinking the Chengdu Immersive Art Gallery

Shupeng Chen
Sichuan University
Chengdu
China
1315427267@qq.com

Huan Fan
Sichuan University
Chengdu
China
crisly@foxmail.com

Jonathan P. Bowen
London South Bank University
London, UK
<http://www.jpbowen.com>
jonathan.bowen@lsbu.ac.uk

1. INTRODUCTION

New media art, the opposite of traditional art, has developed in mainland China for over 30 years since the first video artwork was created by Peili Zhang (Fan & Bowen 2023). The applied technology contains video, computer animation, 3D printing, multimedia, VR, AR, AI, and so on. The incorporation of digital media in work by Chinese artists grew with the national economic soar and the accessibility of technology.

The year 2017 was a crucial turning point for the development of new media art in China when three immersive art exhibitions by the *teamLab* (<https://www.teamlab.art>) art collective took place in key north, south, and east cities. (Fan & Bowen 2023) In that year, the immersive design combined with art exhibitions to become a new media art fashion trend in China. In this paper, we will analyse the ecology of immersive art in China and rethink the immersive permanent exhibition hall in Chengdu.

2. CHINA'S IMMERSIVE INDUSTRY AND CHENGDU'S UNIQUE

“According to a white paper released by NextScene Research last year, the scale of China's immersive industry stood at 4.8 billion yuan (\$750 million) in 2019. The categories in the industry increased to 35 in 2019 from 21 in 2018, with 1,100 single items for people to entertain.” (Zhu & Su 2021).

The immersive design industry in China contains many aspects such as immersive scripted murder games, immersive role-playing murder mystery games, immersive art exhibitions, Immersive restaurants, immersive magic, immersive study rooms, and so on.

According to the data in an Illuthion (2019) white paper, published before the implementation of China's COVID lockdown quarantine policy, the immersive industry was prospering in the cities of Shanghai (上海), Beijing (北京) and Chengdu (成都). Furthermore, the percentage of immersive items sprouting in Shanghai and Beijing together declined to 40% in 2019 from 55% in 2017, while the city of Chengdu had a slight increase, which means a great potential space to grow. It also noted that the percentage of immersive live-action entertainment items in Chengdu is 52.6% (see Figure 1), which has increased over Shanghai (30.3%) and Beijing (42.2%). In other words, the people living in Chengdu have a willingness to consume and construct a positive business environment in the immersive industry.



Figure 1: Categories of Immersive items accounted in the immersive industry in three cities; A: Immersive new media art exhibitions; B: Immersive live-action entertainment; C: Immersive shows; D: Other immersive items. (Source: <http://illuthion.com>.)

The data also shows the level of immersive art exhibitions in Chengdu as 12.8% (see Figure 1), relatively weaker than the other two cities since new

media art developed slowly in Chengdu before 2018 (Fan & Bowen 2023). However, the government of Chengdu has supported artistic cultural exchange by hosting the Chengdu Biennale (Bowen & Fan 2022), a contemporary art exhibition that has been held for over 20 years, inviting a wide range of national and international artists to participate even during the COVID pandemic time from 2019 to 2022.

3. IMMERSIVE PERMANENT EXHIBITIONS

The Huan Art Center (Beijing), mainly engaged in digital media art, was the first independent digital media exhibition space in China in 2018.

The Japanese group teamLab plans to extend its display duration from half a year to three years. The teamLab Borderless Art Museum opened on 5 November 2019, in Huangpu Riverside (Shanghai), operated a trial exhibition for three years, which was then announced as a permanent museum in 2022. TeamLab Super Nature Space opened in Macau in 2020 and covers an area of 5,000 square meters. TeamLab Massless Art Space opened on 19 November 2022 in Beijing, with a total area of approximately 10,000 square meters. Seen from the location of the permanent exhibition halls (see Figure 2, the yellow route), the strategies to seize the market are like the ones they chose when they hosted the digital exhibit in China in 2017 (Fan & Bowen 2023).

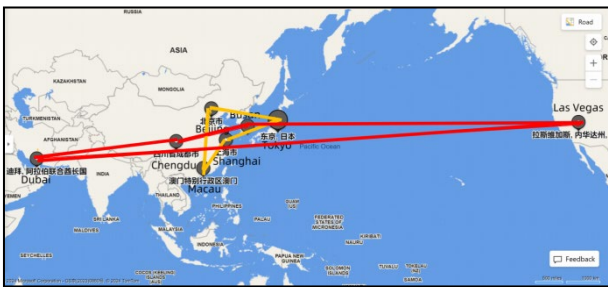


Figure 2: The red route is the d'strict domain; the yellow route is the teamLab domain.

The Chengdu Immersive Art Gallery (ARTE Chengdu) is a permanent exhibition hall built by d'strict (<https://www.dstrict.com>), a leading international digital media design company that originated in Korea, and is the largest immersive digital art museum, opened on 28 April 2023 in Chengdu. In the nearly 5,000-square-meter space of ARTE Chengdu, there are 11 groups of digital artworks, including natural and cultural scenery. Differing from the teamLab approach, the d'strict

strategic route is Chengdu–Las Vegas–Dubai–Busan (see Figure 2, the red route), which is a worldwide approach to capturing the digital art market. The Arte Museum Las Vegas (<https://lasvegas.artemuseum.com>) opened on 30 November 2023 in the United States, and Arte Museum Dubai (<https://dubai.artemuseum.com>) opened on 19 February 2024, with both covering an area of about 2,800 square meters. Korea and Japan are keen to seize the Chinese digital market.

4. COMPARISON WITH CHENGDU STOLEN HEART IMMERSIVE THEATRE

The number of visitors to ARTE Chengdu was about 300,000 from 28 April 2023 to 14 March 2024, of which 76.3% were women. The audience covers all ages, among which ages 31 to 40 years are the most, accounting for 40.9% of the total, followed by adults aged 24 to 30 years, accounting for 30.9% of the total. The proportion of local visitors was 43.1%, which means that 56.9% of visitors came from elsewhere China. The ticket price is divided into five types, which are 88 CNY (UK £9.53), 108 CNY (UK £11.69), 138 CNY (UK £14.94), 188 CNY (UK £20.35), and 228 CNY (UK £24.68).

Chengdu Stolen Heart immersive theatre with digital scenery has been created by Chengdu Usunhome Co., Ltd., and Meng Jinghui, who is a well-known Chinese avant-garde theatre director, with actors improvising in the venue, covering an area of 8,000 square meters. From June 2019 to December 2021, the immersive theatre hosted a total of 300 performances (on Fridays, weekends, and holidays) and attracted 5 million young people, of which 30% were tourists from other cities. The age of spectators is from 18 to 28 years old, with 76% of the audience being well-educated females, and the repurchase rate is 41%. The tour time is usually two hours, and the ticket price is divided into three types, which are 198 CNY (UK £20.69), 280 CNY (UK £30.17), and 380 CNY (UK £40.95). The total number of visitors is higher than that of the Chengdu Biennale which had 1.1 million free tickets (Fan & Bowen 2023) in 2021, and the price of the show is more expensive than teamLab in 2017, which was 80 CNY (UK £8.62), 120 CNY (UK £12.93), and 150 CNY (UK £16.16).

5. ACKNOWLEDGEMENTS

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The Status and Challenges of Online Exhibitions in Art Museums in China – Based on Interviews With Curators

Xiaoyue Zhang
University of Dundee
UK
2408699@dundee.ac.uk

This study explores online exhibitions in public art museums in China. The paper discusses the current state of online exhibitions in art museums and the challenges curators face in online curation from the curators' perspective. The research methods use structured interviews with curators at the Sichuan Art Museum, Chengdu Art Museum, and Shangrao Art Museum, as well as a literature review and case studies. The study found that online exhibitions are primarily based on existing physical displays, and due to a lack of funding, the development of online exhibitions is limited. The study explored the lack of opportunities for curators to develop digital skills to engage with online curation and the need of an additional 'support role' to assist the main digital department to complete the online exhibition. This study reflects that although public museums have been promoting digital engagement, the development of online exhibitions has varied among different museums in China, and some museums are still in an initial exploration stage. Finally, the study offers recommendations which respond to the interviews with curators and the art museum's current status which include: offering digital technology training, online exhibition toolkits, and online resource shares in order to better support curators as they face these challenges and promote the innovation and development of exhibitions online.

Online exhibition. Curator. Public art museum. Online curation.

1. BACKGROUND

In recent years, art museums in China have started to use digital engagement to establish more interaction with their visitors. One way that museums utilise digital engagement is via different social platforms, such as Weibo, WeChat and Little RedBook to publish daily information, exhibition information, etc. According to the Dunhuang Academy reports, the Digital Dunhuang application has had more than 200 million online interactions since it launched in 2020, totalling more than 60 million visits. Another use of digital engagement is to heavily promote online exhibitions, which has become a key direction for digital engagement in museums in China. Art museums hosted more than 2,000 online exhibitions in 2020, with more than 5 billion visits in China (Gao 2020). Also, China Daily (2022) describes museums as having hastened digitization efforts as a result of the COVID-19 epidemic, so those who are housebound could enjoy exhibitions online, according to which the Palace

Museum in Beijing hosted 90 online exhibitions. About 700,000 artworks have been digitized, with 70,000 to 80,000 added annually. This data not only reflects the visitors' needs for digital cultural experiences but also highlights the attempt by museums to respond to visitors' needs and the changes in their requirements in the digital era, with online exhibitions that have become a significant trend in the digital engagement of museums.

Some scholars continue to focus on online curation research. Particularly in the post-COVID-19 pandemic, Annet Dekker provides a brief overview of the massive shift in curation from traditional art organizations to the web as a result of the COVID-19 epidemic in *The Broken Timeline* (2021). It is urgent to rethink online curation as expressed by the authors Dekker and Tedone (2019, p.12):

Not merely as a counter-strategy to conventional models of curating, but as a way to reconsider the influence different systems (human and machinic) exert on curatorial practices, while introducing alternative ways of thinking about how online

curation could operate under these socio-technical conditions.

However, the authors discuss online curation as based on more than the web environment of art, focusing on the transformation of a set of objects into conceptual and operational processes. Their attention is not paid to online curation from traditional art institutions, but instead to the interconnection of different human and machine agents, objects, and practices. Nevertheless, whether it is web-based curation or traditional institutions' online curation, as Dekker and Tedone (2019) describe, 'The Web profoundly influences the role of the curator in new ways'. In addition, Connor (2020) also proposed that online curation is a real experience in itself, which should not only focus on the artwork but also on the interaction and interactive exhibition experiences that result from the artwork and the use of digital technology. It follows that the status of online exhibitions and how the role of the curator continues to evolve are worth exploring, particularly in traditional institutions. Online curation is not only an innovative response by the art museum field but also a crucial step in redefining curatorial practice in the digital age.

To highlight the importance of the changes in curatorial practice, this study includes interviews with Qina Caozheng (Chengdu Art Museum), JianMing Liu (Shangrao Art Museum), and Curator Shi Feng (Sichuan Art Museum). All three interviewees have long careers in curatorial practice and experience working with public museums in China to promote the participation of local artists in the global art discourse. Each of these three museums holds different kinds of collections. The Sichuan Art Museum focuses on local Sichuan art and uses collections to sort out the history of modern Chinese art. Chengdu Art Museum is the foundation of the Chengdu Art Gallery, built in District A (Chengdu Tianfu Art Museum) and District B (Chengdu Museum of Contemporary Art) in 2021; it is an extensive and comprehensive art museum. In addition to maintaining a focus on traditional Chinese art, it also features contemporary artwork including, multimedia, abstract, installation, and digital art. The Shangrao Art Museum is a museum newly established in 2022, with the entire museum still in the initial developmental stage. It focuses on the curation and research of ancient and modern calligraphy and traditional Chinese painting.

The methodology of this study primarily used structured interviews which included questions based on the museum's self-development, the status of online exhibitions, and the curators' challenges when faced with developing online exhibitions. This is accompanied by a collection of the combination of a literature review, case studies, and the three museums' online content, to integrate and analyse.

These data were collected from August to October 2023 in Chengdu and Shangrao, China.

This study begins with the state of online museum exhibitions, focusing on the online exhibition format. The following section explores how curators in traditional institutions address online curation, particularly the challenges faced, and analyses the reasons for these challenges.

2. ONLINE EXHIBITION PRESENTATION IN ART MUSEUM IN CHINA

Online exhibitions in China are frequently based on the physical collections of the museums in Chinese art museums. In some cases, these online exhibitions offer digital replicas of offline exhibitions, including the surrounding interior and tour routes. An example of this is the Chengdu Art Museum (Figure 1), which has created online exhibitions for all its physical exhibitions. These online exhibitions are complete replicas of the museum, beginning with the external environment and taking visitors through to the internal halls and exhibits. A different example is when online exhibitions serve as extensions of physical collections and provide the opportunity to reinterpret artworks through digital tools. The Sichuan Art Museum (Figure 2) has added virtual exhibition halls built with artworks or artists' portfolios, these include introductions to the artworks and artists, that utilise audio, video, and images.



Figure 1: Clip from 'Chengdu Biennale 2023' on the Chengdu Art Museum website (2023).

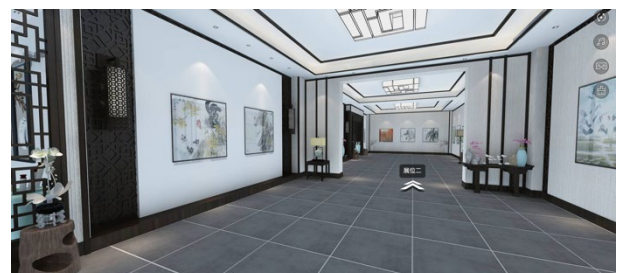


Figure 2: Clip from 'Shimin Liang Art Exhibition' on the Sichuan Art Museum website (2021)

Online exhibitions can also be based entirely on 'born-digital' art, a work of art that is entirely based online, from the artwork's generation to the

exhibition's presentation, it all happens digitally (Meehan 2020). The three curators interviewed observed that there are few online exhibitions featuring born-digital art presented by traditional public art museums in China. While this limits opportunities to promote the development of born-digital exhibitions, it is worth noting that more traditional art museums continue to embrace digital and multimedia art. For example, the Chengdu Art Museum, at the beginning of the design of the exhibition centre, planned two exhibition halls for online exhibitions or born-digital artworks, called the Multi-state Art Exhibition Hall. The curator Qina Caozheng commented:

At the beginning of the planning of (Chengdu Art Museum), we also hoped that digital art and new media art would be involved, it is indispensable, as a very important part of contemporary art. We have also continued to collaborate with various organisations and curators, such as ZKM | Center for Art and Media as well as curator Philipp Ziegler [...] We don't know what the future will look like. As for the two exhibition halls (the Multi-state Art Exhibition Hall), if possible, we hope that there may be more digital devices in them, such as some virtual access devices to present [...] Although our curators may not have enough information about digital art, we are very interested in getting more people involved in this work.

As described by Qina Caozheng, both the presentation of online exhibitions and the expansion of exhibit types to include digital and online media are ways for museums to establish interaction with the visitor audience. However, although most museums are developing online exhibitions, online exhibitions are used as more of an 'aid' to establish and assist the interaction with visitors. It can provide a longer online visiting period for some temporary exhibitions. Its purpose is primarily to overcome the limited space of offline exhibitions while expanding the scope of exhibitions and increase the number of visitors and their participation.

3. THE STATUS AND CHALLENGES OF ONLINE CURATION

3.1 Lack of financial support

Curator Shi Feng (Sichuan Art Museum) described the importance of funding for museums and stated that 'art museums are a rich people's game'. She explained:

The economy is the foundation of the development of art museums, 'Rich' does not refer to a single person or museum but refers to the economic development of a region and is a social group presentation. The museum is struggling without money. In fact, in recent years, many huge art galleries have been built in China,

which are completely unable to operate, and both public and private museums are facing funding problems (2023).

These museum funds are closely related to regional economic development. According to Wang (2019) research, art museums are facing the problem of fund shortages in China. There is a large gap in the funding of public art museums in different regions of China. The eastern regions, such as Shanghai, Guangdong, Zhejiang, and Jiangsu, have relatively high investment, while the central and western regions have relatively low investment. This is also related to the funding sources of museums which is largely dependent on the government in China. Additionally, while most museum exhibitions are free, due to the differences in culture and policies in each region, some museums obtain income through ticket sales for some exhibitions or income from cultural and creative products. Finally, some museums receive donations from society, but this is more of a rare occurrence. In this context, funding becomes very limited in terms of use and planning, because museums must prioritize their funding to address the daily operating costs of the museum. This includes the conservation and management of the collection, including human and material resources, and the costs of making content for the exhibits. As curator Jianming Liu (Shangrao Museum of Art) explained:

We are a new museum and we have plans for online exhibitions [...] However, at this stage, our funds are only sufficient to support the purchase of collections (2023).

The funding problem is complex and difficult to solve, especially in the context of public art museums curators have limited functions and scope and rarely play a role in the face of funding issues. Both curators Shi Feng and Jianming Liu indicate that if the funds are sufficient, they are willing to try more digital possibilities, but when the funds are insufficient, they must think of other ways to develop content to achieve the purpose of the exhibition. In short, this funding structure creates the problem of insufficient cultural investment and uneven development among regions faced by the public museums, this means only some museums can support the development of online exhibition components. With limited funds, the development of online exhibitions will be delayed, and prevent museums from exploring new digital attempts and breakthroughs.

3.2 Digital capability challenges for curators

All three curators interviewed said that their primary duties are still to organize archival collections and curate offline exhibitions and that all their curatorial practice is based on physical exhibits. New concepts

such as digital curators and artificial intelligence (AI) curators have emerged in recent years, for example, The Museum of Wild and New-fangled Art in New York 'designed' an AI curator that is an intelligent robot that learns how to curate by looking at a dataset about exhibitions (Mitchell 2021). However, traditional curators play more of a 'support' role in these kinds of online exhibitions as they do not always have the experience or digital capabilities to curate online exhibitions independently. When supporting online exhibition curation, curators often offer their support by providing models and writing texts of physical exhibitions for digital departments or third-party organizations and giving specific reference suggestions rather than engaging directly with the production and presentation of online exhibitions.

In a recent study, Marty and Buchanan (2021) analysed the challenges that museums face in terms of digital capacity, which became increasingly visible during the COVID-19 pandemic. They identified critical issues of the lack of resources, digital skills, and communication and collaboration with other departments. The authors recommend that museums increase training in digital technology and provide more resources to help staff use available technologies better. Also, an increasing number of art museums have started to recruit digital curators, which also emphasizes the growing impact of digital technologies on curators' work. As argued by Wallerstein (2019), the emergence of the role of the digital curator has re-established the authority of art management in the digital world. Although no single definition of a digital curator exists, multiple practices that extend traditional curatorial concepts while staying connected to specific artistic practices have emerged. Curator Jianming Liu (Shangrao Art Museum) also suggests that curators should be concerned with the capabilities and the uses of digital technology; he says:

Curators should learn to use digital technology and try to really 'push the wall'; if you push down the physical wall but build a virtual wall in the invisible, it is meaningless [...] The combination of technology and curatorial thinking let online exhibitions will lead the visitors to participate and think, constantly expanding the connotation of the exhibition and generating new knowledge (2023).

As digitisation continues to evolve, the role and responsibilities of curators will also transform from traditional curation to building exhibitions using digital networks, including digital file formats, online platforms, and digital presentations. Online curation is not limited to the reproduction of physical exhibitions; it also needs to move beyond building on the web and the reduction of 'browsing the catalogue

with a new interface' (Dekker 2021, p. 19). How curators respond to visitors through the form of online curation is crucial in redefining curatorial practice in the digital age.

Another issue to consider with online curation is the digital capabilities that include digital resources and digital copyrights, as copyright management has become a critical issue for museums that want to make their collections available online (Pluszyńska 2021). Digitization involves gaining additional reproduction and communication rights for artworks in collections (Benhamou 2016). In recent years, copyright infringement of artworks has become a frequent issue in the art market. For example, in 2022, due to a lack of legal protection for original copyright, which resulted in artwork infringement, the first case of piracy of NFTs was heard in a Chinese court (Lam and Xu 2022). It also demonstrated that the laws and processes governing the digital realm had failed to keep up with the rapidly changing environment, especially concerning the legal issues and controversies surrounding the field of digital art copyright.

Taking Chengdu Art Museum as an example, Qina Caozheng (2023) said that they (Chengdu Art Museum) are different from the Sichuan Art Museum, although they have enough financial support and enough space, they lack digital or physical resources, and many exhibits are on loan or call for artworks, these efforts are laborious. She also said that resources and copyright are closely related, as long as they involve the use of artwork, whether offline or online, to the museum will face copyright issues. She stated that although there are legal documents and regulations to avoid these issues, there is a lack of specific standards. She used the word 'trust' to describe this situation, she explained:

As a curator, you must be able to avoid infringements through legal documents, the reality is that a 'good reputation' is the indicator of a curator's work in the industry and is the primary means of gaining the trust of artists and organizations.

Although China implemented the 'Law of the People's Republic of China on Safeguarding the Public Cultural Services' in 2016 and the 'Copyright Law of the People's Republic of China' in 2020, China's copyright laws are still lagging behind. Wu (2020) described copyright laws still need to be enhanced in China to establish the foundation for copyright protection, this would combat problems such as the difficulty of defending rights, the high cost, and the weak awareness of creators.

4. CONCLUSION AND SUGGESTIONS

In summary, this study combines interviews with curators from three public art museums in China with the findings of a literature review and case studies. The study analyses the status of online exhibitions in art museums, and the curators' need for more digital capabilities, including digital resources, copyright resources, and use of digital tools. Based on these findings, the following recommendations are provided to offer curators more comprehensive support to better meet the challenges of developing online exhibitions.

- (i) Digital technology training: provide digital technology training for curators. The content of the training should include how to use digital platforms and basic knowledge of virtual reality and augmented reality. The aim is to enable curators to better understand how to use digital tools and technologies to present online exhibitions.
- (ii) Online exhibition toolkit: the toolkit contains curatorial steps, the creation of online text samples, and legal information on digital resources. In addition, reference cases are provided for each module. Through the toolkit, curators can learn about online curatorial models and develop specific skills for online curation.
- (iii) Co-operation to establish online exhibitions: Collaboration among museums can be increased from offline to online, with online resources shared, thus reducing financial costs, and increasing opportunities for interaction.

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Eternalising a Unique Construction in VR: Shek Kip Mei Park Fountain in Hong Kong

Elke Reinhuber
School of Creative Media
City University of Hong Kong
CMC, 18 Tat Hong Avenue
Kowloon Tong
elke.r@cityu.edu.hk

Benjamin Seide
NTU Singapore
ADM School of Art, Design and Media
81 Nanyang Drive
637458 Singapore
bseide@ntu.edu.sg

A captivating fountain adorned with an artificial waterfall reflects the futuristic aspirations of a recent past with its pastel pink and light blue tiles, once framing splendid vistas on Kowloon and the Hong Kong Bay. However, the passage of time and the monsoons have taken a toll on this architectural marvel from the 1980s, leaving it in a state of decay. To preserve its legacy, a project is underway to create a digital replica – a digital twin. The project aims to capture the fountain’s dimensions and unique features using various techniques such as LiDAR scanning, photogrammetry, and Gaussian splatting with an artistic approach. The project draws inspiration from the authors’ previous endeavours, such as the preservation of Singapore’s Yunnan Garden. The goal is to create an immersive artistic interpretation of the fountain, capturing its slow deterioration and transforming it into a virtual experience. The paper discusses the initial approach for the project, and explores the balance between preserving authenticity and artistic expression, working towards merging realistic representations with abstract point-cloud landscapes. Future plans include comprehensive dynamic elements, such as the subtle movement of visitors to bring the virtual environment to life. By meticulously incorporating these details, the project aims to deepen audience engagement and create a heightened sense of presence within the virtual landscape. Through innovative techniques and a blend of realism and abstraction, the objective is to safeguard the memory of the place in the face of change.

Virtual heritage. 3D reconstruction. Gaussian splatting.

1. INTRODUCTION

Nestled in Kowloon’s Shek Kip Mei Park, a captivating architectural marvel awaits to be rediscovered, recorded and digitally preserved—a fountain graced by an artificial waterfall. Its aesthetic charm pays homage to a bygone era, embodying the futuristic architectural anticipation of its 1980 completion. Adorned with pastel pink and light blue tiles, the three-story structure was well appreciated by the surrounding communities.

As reported in 1982 in the local papers (Anon 1982), after the opening of phase 1 of the 7.5-hectare wide Shek Kip Mei Waterfall Park, it was the largest in whole Hong Kong. It soon became a popular location for the surrounding communities to gather, relax and enjoy sport activities. For nearby residents, the fountain transcends its visual appeal,

providing shelter in the sweltering heat or the thunderous monsoons during physical activities and evoking fond memories from art lessons spent sketching its cascading beauty (Castells et al. 1990).

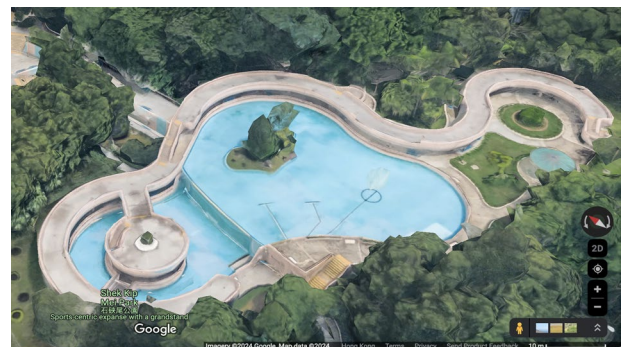


Figure 1: Satellite image of Shek Kip Mei Park Fountain. Map data: Google, ©2024 Airbus, Maxar Technologies

However, the passage of time has rendered the waterworks inactive, causing the tiles and the underlying mechanics to wither. Like the destiny of most inconspicuous urban furniture, they might only be remembered on some family photographs after the structures are revamped or removed. However, even the best photographs cannot pay justice to the dimension and represent the unique shape of this structure.

With our experience and interest in highlighting overlooked and disappearing environments and transferring them into an artistic context, we are currently exploring diverse methods to transmit the experience of wandering along Shek Kip Mei Park Fountain into a virtual setting. In our previous project, capturing Singapore's Yunnan Garden before its reconstruction, we employed different immersive techniques such as omnidirectional video, photogrammetry and subsequently remodelled the vanished garden in 3D for the VR experiences *Gone Garden*, *Yunnan Garden VR*, *Flux Garden* and *Garden of Changes*. This project went through several stages with a series of outcomes of both free artistic interpretation and detailed photorealistic representations.

Thus, we are exploring the possibilities of novel techniques and advanced tools in a different but similarly unique and captivating environment that we consider worthy to preserve digitally. In this paper,

we introduce our first approaches to create an immersive artistic interpretation of the location.

2. APPROACH

The construction of Shek Kip Mei Park Fountain spans over a large area on a slope of the foothills of Lion Rock. It consists of three storeys of walkways that surround the large water-basin and are connected through several staircases. An artificial waterfall, an island with trees, a small and a large pavilion which served once as a kiosk are important components of the whole complex, as seen on the satellite image (Figure 1). Although the pool is still filled with water, the waterfall and the kiosk are out of service and tiles that came off may no longer get fixed. Therefore, we endeavour capturing the large structure digitally with its charm of slow decay and transferring it through an artistic interpretation into an immersive experience.

After applying photogrammetry and drone capture as starting points in our previous project, we decided to begin with acquiring the fountain with the newly available Canon Dual Fisheye lens for 180° VR and proceeded with LiDAR scanning for a better understanding of the spatial dimension of the whole complex. We attempted a range of techniques to record three-dimensional representations to transfer the location into an immersive experience.



Figure 2: Shek Kip Mei Park Fountain captured through the Canon dual fisheye lens

2.1 180 VR with dual fisheye lens

With the experience of our earlier 360° VR video project *Secret Detours*, we anticipated the launch of the Canon Dual Fisheye lens for the R5 camera (Berndt et al. 2023) with great expectations. As discussed in an earlier paper (Reinhuber et al. 2018), the 360° video offers a high level of immersion and allows the viewer to look into all directions. However, the low resolution of the video and the difficulty to stitch the footage in post-production were obvious disadvantages. As the audience in general needs to be encouraged through movements or audio cues to turn their heads around, the hemisphere of the 180° recording provides a satisfactory level of detail of the features and their surfaces. Through the extreme wide angle of the lens, a good representation of the depth can be achieved when viewed in a headset (Figure 2).

Another appreciated feature is the ease of use for stereoscopic capturing. The two parallel lenses record instantly a stereoscopic image or video which is an important addition for increasing the sense of immersion over a monoscopic 360° video. However, the lenses are fixed and do not allow fine-tuning of the 3D offset for proximity or distance. Viewed in a headset, the result is convincing to provide an impression of the depth for nearby and smaller objects such as benches, staircases or pavilions but fails to convey a general understanding of the dimension of the space. Although this setup does not offer the best option for keeping an adequate representation of the fountain itself, it is ideal for recording videos with live-action and performance for an immersive sensation in a headset that does not require the full 360° sphere.

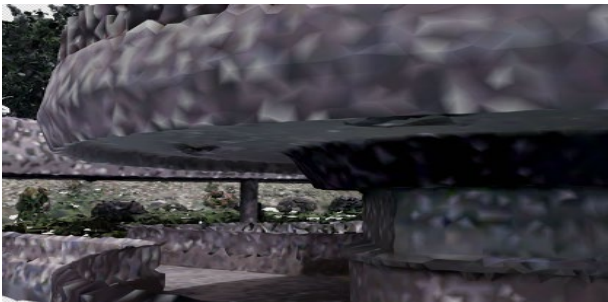


Figure 3a and 3b: LiDAR scan of Shek Kip Mei Park fountain, textured polygon mesh and point cloud

2.2 Lidar scan

The first approach for digitising the construction for a walk-through immersive VR experience was realised with the Leica LiDAR scanner BLK 360 (Rapuca and Matoušková 2023). The scan process itself was more time-consuming than expected as the range of the scanner covers only a radius of roughly six metres with higher accuracy and requires some overlap. Several parts of the environment were not possible to record. The wire mesh of benches and the reflecting water in the basin caused significant errors during the scan process. The scanner was operated from a distance via an app as remote control to have as little disturbance as possible, caused by movement of people or plants. To record the whole environment, 130 scan positions were required. The footage was subsequently combined in the software Cyclone by Leica Geosystems and further edited in Blender.

The device proved ideal to record the spatial dimension and formal uniqueness of the construction while the immediate disadvantage was that there was no satisfactory representation of the surface. The low quality of the texture can be seen in Figure 3a. For the representation of the space itself, the visualisation as a point cloud however worked quite well as an abstract visualisation of the fountain (Figure 3b), with the potential to be experienced in a headset and providing a promising foundation for further exploration.

A promising novel technique is Gaussian splatting which will be explained in the following section.

2.3 Gaussian splatting

Gaussian splatting, a technique yet primarily prevalent in computer graphics and computer vision, can be instrumental in the reconstruction of surfaces or images from disparate data points (Chen and Wang 2024). Already widely applied in point-based rendering and 3D reconstruction scenarios, Gaussian splatting proves particularly advantageous when visualising or reconstructing irregularly sampled data points. It adeptly addresses challenges inherent in uneven sampling, providing a refined representation of the underlying data.

In our specific application, focusing on a high-detail environment replete with flora, experimentation with this emergent technique is deemed worthwhile. Our preliminary investigations, based on video sources acquired by traversing the walkways of the fountain area, align with the conceptual framework outlined by Kerbel et al (2023), employing the scripts disseminated by Stephens (2023). The initial test utilised a video capturing approach akin to photogrammetry, wherein the camera circumnavigated a static object, covering all surface

points comprehensively. The scene featured a seating area encircling a column with an overhead structure, enveloped by intricately detailed vegetation (Figure 5).

Surprisingly, the processing time for this first test proved considerably swift, a fraction of the anticipated duration typical of photogrammetric methods. Encouraged by this outcome, we extended our experimentation to longer walkthrough videos, aspiring to encompass a large expanse of the park. However, this endeavour yielded only partial success, as processing time escalated exponentially, yielding inconsistent levels of detail in the results, often manifesting as a “foggy” appearance due to insufficient data. Despite its aesthetic allure, we discerned that our initial optimism had led us from a “very simple” undertaking to one deemed “basically impossible” in a few steps.



Figure 4: *Gaussian Splatting reconstruction of main fountain with insufficient level of detail*

This refined approach aims to yield a general overview of the entire park with a level of detail suitable for a bird's-eye user perspective and, concurrently, several highly detailed ground-level views.

Regarding the equipment utilised, the video footage was captured on a 2023 iPhone 15 Pro and exported as stills with one frame per second, while the Gaussian Splatting computations were executed on a workstation equipped with an Nvidia RTX 4090 GPU.

2.4 Photogrammetry

The Gaussian Splatting technique excelled in capturing intricate details, particularly noticeable in elements like park foliage and fences. However, our initial attempts to integrate this high level of detail into virtual reality (VR) using Gaussian Splatting Unreal Engine plugins encountered challenges. The resulting visuals either appeared overly artistic or caused significant performance issues, leading to unacceptable lag, even on powerful hardware like the RTX 4090.

The performance implications of Gaussian Splatting in VR warrant further investigation for future refinement. In the meantime, our team has opted for a blended approach, utilising photogrammetry to create detailed meshes for fundamental surfaces such as floors, walls, and columns. Figure 6 shows the seating arrangement adjacent to a column, reconstructed using photogrammetry techniques within Agisoft Metashape. As anticipated, the intricate details like foliage are not faithfully replicated; however, the hard surface elements comprising the floor and seating area adequately meet the desired level of detail standards.

2.5 Merging of different approaches

In our attempt to visualise the park's structure for an immersive audience experience, we drew inspiration from our previous VR project featuring the tropical Yunnan Garden (Seide et al. 2020). On one hand, with the park facing decay and the possibility of future refurbishment or even demolition, our aim was to preserve its cultural heritage virtually, capturing what remains at the time of recording. On the other hand, we sought to artistically convey the atmosphere of the park's ageing condition.

Reflecting on Kuchelmeister et al.'s (2017) “Parragirls Past, Present” project, which explores heritage sites through point-cloud representations, we grappled with the tension between preserving authenticity and artistic expression. This led us to explore combining realistic depiction with abstract representation in our approach.

To achieve this blend, we utilised point-cloud visualisation to outline the park's entirety, serving as the base structure, and incorporated architecturally significant segments rendered with a blend of photogrammetry and the gaussian splatting technique to create realistic representations within this abstract framework. The resulting experience invites audiences to explore the park, discovering pockets of detailed realism within the faded point-cloud landscape.



Figure 5: *Gaussian Splatting reconstruction of column with sufficient level of detail*

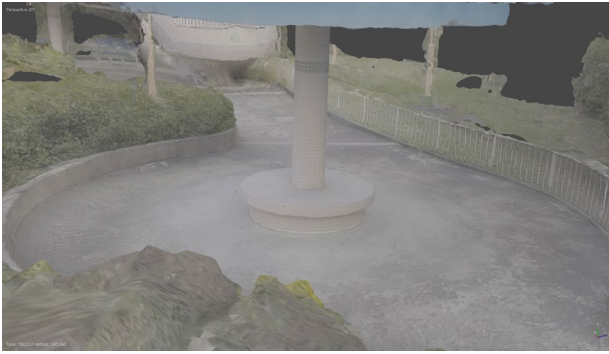


Figure 6: Photogrammetry reconstruction of column with sufficient level of detail

While our endeavour may seem modest, our observations reveal a curiosity to uncover these realistic “memories” within the abstract environment. This underscores the appeal of merging realism with abstraction, offering a nuanced perspective on preserving and interpreting cultural heritage in the face of change.

3. DISCUSSION AND CONCLUSION

To summarise our current technical endeavours: we briefly explored VR180, which confines the viewpoint to the camera's position yet delivers a photorealistic stereoscopic experience. Our use of Lidar to scan the entire park yielded valuable insights into its geometry and structural complexity. Photogrammetry, a well-established technique in virtual heritage reconstruction, consistently produces satisfactory outcomes for rigid surfaces.

However, Gaussian splatting, an innovative visualisation method, impresses with its exceptional fidelity in representing intricate details like foliage but encounters limitations in VR integration. This particular aspect merits further investigation due to its significance in advancing our understanding of immersive visualisation techniques.



Figure 7: Gaussian Splatting reconstruction merged with point-cloud structure

The subsequent steps will be to involve a comprehensive drone survey of the entire park and an additional ground-level handheld video survey. Although the project is still in its developmental stage, a notable aspect is the static nature of both the abstract and realistic representations. However, recognising that the park often exudes a vibrant atmosphere, our future plans entail integrating dynamic elements to enhance the immersive experience.

Specifically, we aim to introduce the subtle movement of park visitors, manifested as faded shadows traversing the scene. This addition not only injects a sense of life and activity into the virtual environment but also serves to further blur the boundaries between the digital realm and the real-world ambiance of the park. By meticulously orchestrating these nuanced details, we seek to deepen the audience's engagement and foster a heightened sense of presence within our evolving virtual landscape.

4. ACKNOWLEDGEMENT

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Please note that contribution between first and second authors on this paper is equal.

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LuYang–DOKU, Binary World: A networked live motion capture performance between Hong Kong and Sydney

Ashley Lee Wong
The Chinese University of Hong Kong
Flat A, 30F Heya Star, Tower 1,
368 Castle Peak Road,
Cheung Sha Wan, Kowloon, HKSAR
ashley@metaobjects.org

Andrew Crowe
MetaObjects
Flat A, 30F Heya Star, Tower 1,
368 Castle Peak Road,
Cheung Sha Wan, Kowloon, HKSAR
andrew@metaobjects.org

1. INTRODUCTION

This paper explores the iterative development of a live motion capture performance by the artist, LuYang. LuYang is an artist whose work crosses video, performance, installation exploring ideas across Buddhism, neuroscience and Chinese medicine through contemporary aesthetics of games, manga, and animation. As MetaObjects, a studio facilitating digital production with artists and cultural institutions based in Hong Kong and London, we have worked closely with LuYang since 2018 to develop the motion capture performances and game artworks.

Through numerous iterations of the performance, the project has evolved and grown with increasing complexity both technically and conceptually. The work presents novelty in the unique combination of motion capture and gaming technologies to explore live performance that explores concepts of Buddhist reincarnation, seeking to overcome notions of the self and binary conceptions of the world through contemporary aesthetics of contemporary culture and ACG ("Animation, Comics, and Games," referring to manga subcultures in East Asia).

2. BACKGROUND

LuYang is someone who resists identity by gender, ethnicity or even as an artist, despite existing in a world which continues to impose such categories. From around 2020, LuYang has been developing DOKU, a hyper-realistic androgynous digital human using the face scanning technologies. Their work exists independently from the self, where the digital avatar acts as a shell to be animated by different dancers in the real world. The name DOKU refers

to *Dokusho Dokushi* in Japanese meaning "we are born alone, and we die alone" as part of a personal spiritual journey in the continuous cycles of reincarnation. I connect this cyclic notion of suffering and learning to an iterative and expansive approach in the artistic practice of LuYang (Wong 2022). The digital realm for LuYang opens the possibility to transcend the self, and to exist in multiple realms of reincarnation (*samsāra*) represented in the different levels of a game. We describe the evolution of the work over several iterations in Hong Kong, Hangzhou, Shanghai, Moscow, Melbourne, Montreal and London as physical, online and hybrid events before, during and after the pandemic. The latest iteration of the performance extends the concepts of the self to resist binary thinking, resulting in a networked collaborative performance between a dancer in Hong Kong's Freespace, West Kowloon Cultural District, and the Sydney Opera House with a shared virtual body. While the use of motion capture for live performance is not new, we believe the dance collaboration across distance with live audiences in both cities with a single avatar as an expression of overcoming of binaries in Buddhist thought.

3. THE PERFORMANCE AND EVOLUTION

Technically, the performance involves a dancer on stage wearing a motion capture suit animating avatars of deities on a large LED screen on stage. A game controller is used to trigger visual effects, camera movements and scene and character changes live. A soundtrack of hi-energy dance music is played, where dancers are selected for their diverse urban dance styles.

3.1 Early iterations

The first version of the performance used HTC Vive Trackers with iKinema software, and a PC keyboard to trigger visual effects, camera movements and character arrangements live. As a proof of concept and small arts budgets, the project evolved, where each performance was taken as an opportunity to extend the possibilities further. The early versions involve avatars of four Buddhist deities representing the four elements of fire, wind, water and air. These deities are animated superheroes each with their own superpowers. The deities dance in different realms of experience from the city to the afterlife, to outer space. Following performances were upgraded using more robust motion capture technologies such as OptiTrack in collaboration with the China Academy of Art in Hangzhou and Chronus Art Centre in Shanghai, with performances at the Powerlong Art Centre and Rockbund Art Museum. For subsequent performances new avatars, environments and visual effects were added to enhance the performance.

In 2020, a performance was planned in Melbourne at Australian Centre for the Moving Image (ACMI) just as the pandemic emerged. Due to travel restrictions, the performance evolved to a live streamed event from Shanghai. A web interface was created for the live stream experience with chatroom enabling audience participation. The performance was followed by a live Q&A with the artist to demonstrate that performance was indeed live and real-time, rather than pre-recorded. The performance was well-received and created a captivating online experience during strict lockdowns in Australia. MetaObjects supported the development of the performance programme and motion capture, while the artist provided the character and environment designs and music, often in collaboration with other artists, designers and musicians. Dancers were also selected through shared communities and networks of artists in the cities. The performance was then presented in Moscow, Montreal and Melbourne as hybrid and in-person events between the waves of the pandemic each with their own local take on the performance.

3.2 A networked performance between cities

The latest iteration involves dancers in two cities interacting in a shared virtual environment, who at the end of the performance merge into a single virtual body. The performance is divided into six scenes representing the six realms of *samsāra*, including heaven, asura, the human realm, the animal realm, the hungry ghost realm, and hell. Working together with collaborators in Australia led by curator and producer Mat Spisbah and the

Sydney Opera House, MetaObjects worked with Freespace, West Kowloon Cultural District to stage the performance in Hong Kong. In the performance, the dancers would alternate, performing one of the six realms and avatars. The final scene features heaven (Sydney dancer, Taiga Kita-Leong) and hell (Hong Kong dancer, Kenny Leung) in a dance off. They then combine into the Binary God, where the upper half of the body is controlled in Sydney, and the bottom half of the body is controlled in Hong Kong (LuYang-DOKU 2023). The work addresses binaries not only of heaven/hell, but also self/other, human/animal, male/female, where Buddhism seeks to transcend divisions of the material world.



Figure 1: Photo from the Hong Kong performance of “Phygital D: Lu Yang–DOKU, The Binary World”. Photo: Eric Hong @ Moon 9 image. Courtesy of West Kowloon Cultural District Authority.

The performance posed unique challenges in presenting a hybrid networked performance including coordinating time zones, managing venue expectations, live streaming, choreography, streaming of motion data. The artist was not present in either city as the performance and DOKU took its own life through a network of collaborators. Technically, the performance streams only the motion data, where there is a copy of the performance program in each city, where the camera movements and visual effects are triggered live using a game controller. The performance was most recently presented at Zabludowicz Collection in London in February 2023 as part of LuYang’s solo exhibition *NetiNeti* with two dancers in a single location.

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From Ink to Pixels: A study on the fusion of traditional Chinese landscape painting and digital media art

Mingyong Cheng
University of California San Diego
Visual Arts Department
California, USA
m2cheng@ucsd.edu

This paper explores the intersection of traditional Chinese landscape painting, known as “Shan shui,” with new media art. It delves into how contemporary artists and technologists are reimagining Shan shui through digital media, blending ancient aesthetics with modern technologies such as digital image composition, animation, virtual reality (VR), artificial intelligence (AI), data visualization, and interactive installations. By examining various case studies, the paper highlights the evolution of Shan shui in the digital era, underscoring its artistic and cultural significance. The study also reflects on the transcultural and transtemporal nature of this fusion and examines how technology transforms visual engagement and methods of creation, offering insights into the new dimensions it brings to traditional Chinese art.

Digital media art. Shan shui. Traditional Chinese landscape painting. Art and technology intersection. Computational art.

1. INTRODUCTION

As we traverse the intersection of art and technology, the scholarly discourse surrounding traditional Chinese arts has been primarily concerned with themes of preservation, restoration, and classification. This study, however, charts a distinct course by examining an alternative aspect of this cultural convergence. It delves into the reinterpretation and reimagining of traditional Chinese landscape painting, known as Shan shui, through the prism of digital media arts, exploring how technology endows this venerable art form with new experiential dimensions.

The term “Shan shui”, a classical motif in Chinese art, represents a genre of traditional Chinese painting that encompasses natural landscapes, often highlighting mountainous and aquatic scenery. This artistic form is not merely a reflection of China’s rich aesthetic lineage but also a profound manifestation of its philosophical and spiritual fabric (Fong 1992). Ancient masters like Wang Wei infused their paintings with a profound interaction between spirit and matter, seeking to harmonize ink with nature’s vitality. This initiative stands in sharp contrast to the innovative explorations into digital

Shan shui artworks by contemporary media artists such as Weili Shi, Lu Yao, Victor Wong, among others, as well as the collaborative efforts of various museums and media collectives. Through the use of digital image composition, animation, virtual reality (VR), artificial intelligence (AI), data visualization, and interactive installation, these innovators not only reinterpret Shan shui aesthetics but also reflect contemporary ecological and philosophical discourses. Their digital works interrogate the coalescence of the natural and the technological, propelling the Shan shui tradition into the realm of global modernity and digital interconnectivity.

Through a meticulous analysis in related works, this paper aims to explore the intersection of tradition and modernity, illustrating how Shan shui has been re-envisioned through digital media. It navigates the complex dialogue between maintaining the essence of traditional art and embracing the creative possibilities afforded by modern technology. In doing so, it addresses critical questions about the evolution of cultural heritage, the boundaries of artistic innovation, and the transformative role of technology in art.

2. SHIFT IN VISUAL ENGAGEMENT

Digital media's incursion into traditional Shan shui has ushered in a transformative visual engagement, steering viewers from the "scattered perspective" characteristic of classical Chinese art (Yan, 2019) to novel, digitally mediated perspectives. This section scrutinizes two distinct digital reinterpretations of historical Chinese landscape paintings which utilize advanced technologies such as 3D animation and VR, redefining the conventional sensory and spatial experience of Shan shui.

2.1 From scattered to focused

The 3D experience at Huaqiang Fantawild Theme Park, "Flying through the vast land", elevates the transition from the traditional "scattered perspective" (Yan 2019) to a "focused perspective view" (Zou & Li 2021). As the audience embarks on a predestined flight path, they are enveloped in a narrative that unfolds seamlessly around them (Zi 2018). Following the ethereal cranes, viewers glide through a digitally reimagined landscape inspired by Wang Ximeng's "A Thousand Li of Rivers and Mountains" (see Figure 1). The journey commences in the imperial palace of Emperor Huizong of Song, surrounded by the ambient dialogue about the reclusive artist Ximeng Wang, before soaring into the expansive vistas of the Northern Song dynasty (Zi 2018). The meticulous design weaves together the historical context with the majestic beauty of the mountains and rivers, resulting in a coherent visual narrative. This digital immersion orchestrates a curated exploration, guiding viewers on an intimate journey that enhances the story-driven experience of the Song dynasty's splendor, drawing from the depths beyond the original two-dimensional artwork.



Figure 1: Snapshot from "Fly through the vast land."
Retrieved from Zi, 2018.

2.2 VR and the "Moving Viewpoint"

In the "Traveling Around the Fu-Chun River" (Hung, 2021), the VR technology allows the audience to explore "Dwelling in the Fu-Chun Mountains" (Huang, ca. 1350) with a "moving viewpoint" (Rahimi, Banigan, & Ragan 2020). Unlike the fixed trajectory in the 3D animation, this VR experience

gives the audience autonomy to look around freely in a full 360-degree space, thus recreating the multiple viewpoints and offering the potential to provide the non-linear narrative experience of traditional Shan shui (see Figure 2). The integration of eye-tracker technology further personalizes this experience. As the viewer's gaze directs the unfolding of scenes in harmony with the guqin's (an ancient Chinese musical instrument) rhythm, a unique redrawing of the landscape emerges, making each encounter with the painting an individual narrative (Hung, 2021). This shift not only pays homage to the original scattered perspective but also introduces a contemporary digital layer, allowing for a personal and exploratory interaction with the painting.



Figure 2: Snapshot from the video documentation of "Traveling Around the Fu-Chun River." Retrieved from Hung, 2021.

By examining the representative cases above, we see those digital reinterpretations, employing 3D experiences and interactive VR, have transformed the traditional Shan shui viewing experience. This transformation reveals a spectrum of engagement, ranging from the directed, narrative-driven journey of 3D animations to the exploratory freedom provided by VR technologies. These mediums not only modify the visual engagement with Shan shui but also redefine its spatial and narrative dimensions, blurring the lines between observer and participant.

3. TRANSCULTURAL SYNTHESIS

The evolution of digital art has ushered in an era of transcultural synthesis, erasing the confines of geographical and aesthetic boundaries (Schachtner 2015). In this section, we delve into Shan shui artworks that showcase a fusion of styles and philosophies across cultures, articulated through digital media that enables seamless integration of diverse artistic expressions. We explore two distinct facets of this phenomenon: Aesthetic Fusion, which intertwines Eastern and Western artistic styles, and Geological Fusion, which blends Shan shui philosophy with the Western urban experience.

3.1 Aesthetical fusion

The VR experience, “Traveling Around the Fu-Chun River” (Hung 2021), stands as a contemporary beacon of artistic fusion. In addition to the features mentioned in Section 1, this piece also incorporates real-time AI style transfer technology. Through AI style transfer, this digital medium breathes new life into the time-honored tradition of Shan shui, infusing it with the textures and tones of Western Impressionism (Hung 2021). It becomes a live painting, where the enduring structures of Eastern art dynamically meld with the fluid aesthetics of the West (see Figure 3). This transformative process, echoing the historical fusions of artists like Daqian Zhang, is now enhanced by the immediacy and interactivity of digital technology. Viewers are not mere spectators but active participants, navigating a transcultural landscape that is constantly reshaped by their movements, perspectives, and aesthetic preferences.

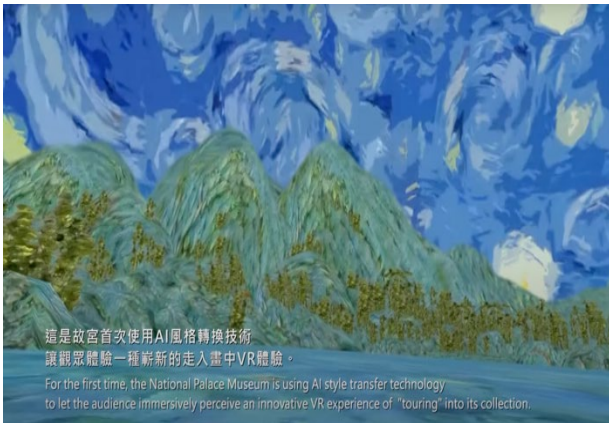


Figure 3: Snapshot from “Traveling Around the Fu-Chun River.” Retrieved from Hung, 2021.

This progression in digital artistry sets the stage for Wang Yi and Zhang Jun’s “Displaced Landscapes (错位山水)” (2022), which takes the concept of aesthetic fusion to a new dimension. In their work, the serene vistas of Chinese Shan shui are transposed onto the gritty backdrop of a cyberpunk metropolis, creating an immersive 3D experience that melds the quietude of the East with the vibrant chaos of the West (Wang & Zhang 2022). Here, the digital canvas becomes an expansive realm where the ancient and the ultramodern coexist, challenging the viewer to find balance amid the contrasting visual narratives (see Figure 4). “Displaced Landscapes” exemplifies the creative potential of transcultural dialogue in art, utilizing the digital space not just to blend but to reinvent and reimagine cultural identities and expressions.



Figure 4: Snapshot from “Displaced Landscapes.” Retrieved from Wang & Zhang, 2022.

3.2 Geological fusion

Weili Shi’s “Shan Shui in the World” (2016) is an exemplary case of transcultural creation where digital media is not just a tool but an alchemical medium that transmutes the steel and concrete of Manhattan into the silk and ink of traditional Chinese landscapes (Shi 2016). Through a sophisticated algorithmic process, Shi maps the dense urban geographical data of skyscrapers onto the rolling hills and flowing rivers of Shan shui (see Figure 5), thus crafting a series of images that are at once familiar and utterly transformative (Shi 2016). The artwork not only redefines the New York skyline but also imbues it with a sense of ancient tranquility, prompting a reflection on the relationship between our urban existence and the innate human longing for the tranquility of nature. Shi’s digital landscapes serve as a mirror, reflecting the complex interplay between the modern urban fabric and the timeless philosophical ideals of Shan shui—a fusion of the essence of two seemingly disparate worlds.

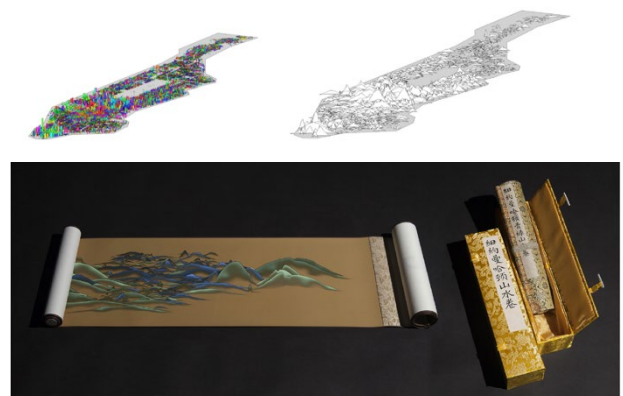


Figure 5: Up: Process of transferring the buildings information of height and range to the outline of the mountain from “Shan Shui in the World”; Down: Photo of the scroll of Blue-green Shan Shui in Manhattan, New York from “Shan Shui in the World”. Retrieved from Shi, 2016.

The transcultural synthesis evident in “Traveling Around the Fu-Chun River”, “Displaced Landscapes” and “Shan Shui in the World”, underscores the expansive potential of digital media to reinterpret and reframe traditional Shan shui. These works exemplify the merging of cultural aesthetics, forging a path for Shan shui in the digital era that respects its heritage while embracing a global narrative. As we conclude this exploration of transcultural creation, we prepare to delve into how such fusions not only connect disparate cultures but also allow for a conversation between different times — a dialogue between the past and the present that will be the focal point of the following section.

4. CONNECT PAST & PRESENT

Shan shui painting, traditionally a reflection of nature’s serenity, finds new resonance in the digital age, where it becomes a medium for exploring the dynamic interaction between the past and the present. Contemporary artists, through new media technology, re-envision this ancient art form, infusing it with current ecological and societal narratives, thus creating a meaningful mosaic that connects different eras. In this section, we examine how these artists articulate this fusion of temporalities and philosophies through their innovative works.

Lu Yao’s “New Landscape Series” (2008) is a profound commentary on the dichotomy of growth and preservation, framing the relentless pace of urbanization within the peaceful aesthetic of traditional Shan shui (Liu 2017). His photographs, digitally transformed and composited, reimagine construction sites as serene landscapes, infusing the imagery with metaphor and memory. Yao’s work captures the juxtaposition of development and destruction, with works like “Wine boat on pine creek” (see Figure 7) depicting a solitary figure on a boat beside a crumbling block of land, evoking the personal and collective loss felt amidst rapid urban change. Significantly, the character “拆” (demolish) is emblazoned on a wall, starkly symbolizing the ongoing removal of familiar structures and spaces (see Figure 6). This visual element serves not just as a poignant reminder of what is lost to progress but also as a call to reflect on the impact of our built environment. Through these layered narratives, Yao’s series invites a deeper contemplation of the balance between modern development and the preservation of both the natural world and human heritage.



Figure 6: Detail of “Wine boat on pine creek”. Retrieved from Yao, 2008.



Figure 7: Digital copy of “Wine boat on pine creek”. Retrieved from Yao, 2008.

Building on this thematic foundation, Yongliang Yang’s “Artificial Wonderland” (2010) series delves further into the intersection of urban expansion and ecological disturbance. Yang digitally composes sprawling cityscapes of Shanghai into images reminiscent of traditional Shan shui paintings that suggest harmony from a distance. Yet, upon closer inspection, they reveal a dystopian vision of development (Chu 2021). Additionally, Yongliang experiments with using video recordings of urban cities as material for creating Shan shui

compositions. For example, his work “Prevailing Winds” (2017) presents winding highways bustling with endless streams of vehicles (see Figure 8). In the entire scene, the motion of other objects is relatively slow or imperceptible, with only the mountain waterfalls and the flowing traffic moving dynamically. The natural landscapes juxtaposed with the surge of contemporary traffic reflect the congested and busy cityscapes of major Chinese metropolises. This contrast draws attention to the impact of human progress on natural environments, continuing the dialogue initiated by Lu Yao but from a more critical perspective on the costs of urbanization.



Figure 8: Snapshot from “Prevailing Winds.” Retrieved from Yang, 2017.

Yuxi Cao’s “The Vast Land” (2017) offers a poignant reflection on the enduring relevance of environmental stewardship by merging the classical Shan shui with the pressing realities of contemporary ecological concerns. Through the digital transformation of Wang Ximeng’s “A Thousand Li of Rivers and Mountains”, a masterpiece from 1113, Cao’s work visually communicates the distortions inflicted upon our natural landscapes by Beijing’s air pollution—a subject that has gained significant attention since 2013 (Cao 2017). The painting’s alteration in response to fluctuating PM2.5 levels (see Figure 9) not only highlights the tangible impact of modern pollution on historical beauty but also underscores a long-standing tradition of environmental consciousness that extends from the Song Dynasty to today’s discussions on sustainability. This fusion of art and data articulates a visual narrative that bridges centuries, urging a contemplative look at the ecological path we tread and the legacy we carry forward.

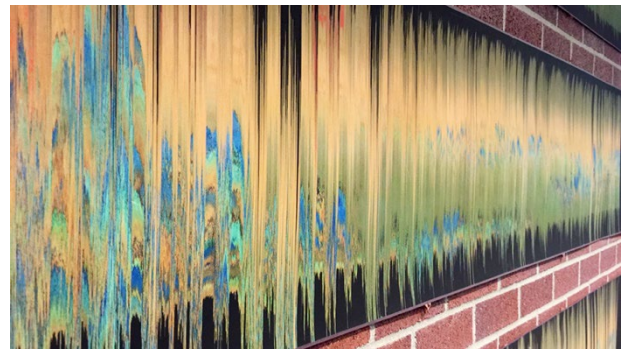


Figure 9: Photo of “The Vast Land”. Retrieved from Cao, 2017.

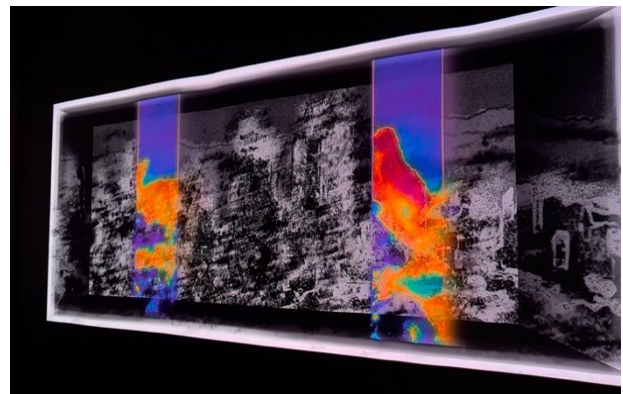


Figure 10: Photo of “Fusion: Landscape and Beyond 2.0”. Retrieved from Cheng, Dang, & Yu, 2023.

The interactive installation “Fusion: Landscape and Beyond 2.0” (Cheng, Dang, & Yu 2023) offers a nuanced exploration of the interplay between urban expansion and the contemplative essence of nature. Within this dialogue, the installation employs generative AI in conjunction with a real-time visual system to create a fluid canvas where the crisp, structured reality of urban skylines interlaces with the subtle mystique of Shan shui painting, now reimagined through thermal style that metaphorically evoke the heat and vibrancy of human life shaping our surroundings. This transformation is revealed by the movements of the viewers, whose presence triggers the emergence of these thermal landscapes, adding a layer of depth that reflects on the warmth and energy of our ecological footprint, often invisible yet fundamentally sculpting our environment (Cheng, Dang, & Yu 2023). Following this, the traditional “Cunfa” technique is reinterpreted in the digital domain, where AI replicates the textural strokes of nature, casting digital impressions that resonate with a painter’s touch against the backdrop of the city’s geometry (Cheng, Dang, & Yu 2023). The artwork thus guides the audience into a meditation on the dualities of visibility and obscurity in human impact on nature. It places the observer within the evolving story, their movements unraveling the complex layers of the digital environment, and emphasizing the interwoven nature of our existence with the

ecological shifts we drive, bridging past and present in a vivid tableau of interactive art.

These contemporary Shan shui creations, through the medium of new media technology, serve as a vital connective tissue between epochs, fostering a profound appreciation for the relevance of ancient principles in the scrutiny of modernity. In their innovative expressions, these artists do not merely replicate the aesthetics of a bygone era; they revitalize its ethos, challenging us to reflect on our environmental and urban realities. They compel us to consider our place in the ongoing narrative of nature and civilization, suggesting that our urban endeavors and ecological stewardship are not separate journeys but intertwined paths within the same landscape. The Shan shui tradition, therefore, emerges not just as a historical relic but as a living dialogue with the catalyst of digital media, urging us to contemplate the delicate balance of our coexistence with the earth—a theme that is timeless, yet acutely relevant to the present day.

5. SHIFTING AUTHORSHIP

The notion of authorship in art has traditionally been clear-cut in Shan shui paintings, with the artist as the sole creator. Yet, in the realm of digital Shan shui, the boundaries of authorship are expanding, giving rise to new forms of creative expression. Digital media has introduced collaborative creation processes where the roles of artist, audience, and even machine become intertwined.

5.1 Audience as co-creator

In the groundbreaking "Shanshui-DaDA" art project (Zhou et al. 2019), audiences are transformed from passive viewers to active co-creators, reshaping the concept of authorship in art. This interactive installation uses a Generative Adversarial Network (GAN) trained on traditional Shan shui paintings, allowing participants to sketch on a digital canvas, prompting the AI to generate landscapes infused with the ethereal essence of classical Chinese paintings (Zhou et al. 2019). The AI interprets each stroke, transforming them into the mountains, rivers, and mist characteristic of Shan shui (see Figure 11). This collaboration blends participants' ideas with age-old artistic principles, resulting in unique artworks that combine modern expression with the classic aesthetics of Shan shui. The resulting pieces are not just a visualization but also a fusion of the users' creative spirit and the AI's deep learning of Shan shui, echoing the tradition's spiritual core. "Shanshui-DaDA" thus redefines artistic creation, allowing a seamless integration of cultural heritage and modern technology. This project not only democratizes art but also offers a unique journey into artistic co-creation, reflecting the interconnected nature of our digital era.



Figure 11: Photo of a viewer interact with "Shanshui-DaDA." Retrieved from Zhou, Wang, Huang, & Lo, 2019.

5.2 Machine as co-creator

Victor Wong's artistic collaboration with AI Gemini represents a significant milestone in the evolution of creative authorship. Wong, drawing on his dual heritage of traditional Chinese art and a background in computer graphics, has nurtured AI Gemini (see Figure 12) not just to emulate Shan shui techniques but to innovate within them (Spicer 2019). The "Escapism" series, premiered in 2018, exemplifies this, showcasing a collection of ink paintings where the robot's unique style—marked by a pronounced three-dimensionality—comes to life. By integrating AI Gemini with live environmental data feeds, Wong instills variability into the robot's artistic process, mirroring the human artist's changing moods and environmental responses (Spicer 2019).



Figure 12: Photo of AI Gemini in action by Victor Wong. Retrieved from Spicer, 2019.

Pushing creative boundaries further, Wong's venture into depicting lunar landscapes with "Far Side of The Moon" sees AI Gemini interpreting 3D geographical information into traditional ink styles (see Figure 13), thereby expanding the scope of Shan shui from terrestrial to extraterrestrial realms (Spicer, 2019). This series not only challenges conventional perceptions of what constitutes a landscape but also celebrates the fusion of art, technology, and exploration. The works produced by Wong and AI Gemini stand as a testament to the transformative potential of AI in art, where technology becomes a co-creator, enriching the artistic narrative with its own distinct and evolving interpretation.



Figure 13: Photo of "Far Side of The Moon 0001" by Victor Wong & AI Gemini. Retrieved from Spicer, 2019.

"The Faded Landscape", from the "Fusion: Landscape and Beyond" series, presents a meditative digital animation confronting the environmental shifts impacting our view of Shan shui. Inspired by Wang Ximeng's "A Thousand Li of Rivers and Mountains," famed for its resilient mineral pigments, the work sets the timeless portrayal of verdant landscapes against today's diminishing natural splendor due to urbanization and climate change (see Figure 14). Here, generative AI and artists jointly craft a journey across time, illustrating the transition from historical greenery to modern "concrete jungles" (Cheng 2022). The animation leverages "Deform," a text-to-image AI tool powered by the Stable Diffusion model, pre-trained on diverse text-image pairings across history and cultures. AI transcends its role as a mere instrument, becoming a narrator that seamlessly weaves past artistry with current ecological narratives. AI as a creative collaborator, enhancing the story with a richness that fuses human sentiment with the broad "memory" of machine learning.

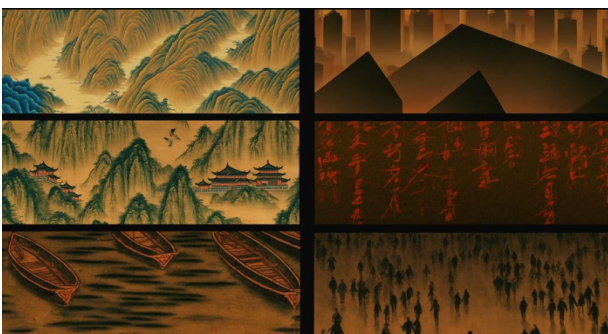


Figure 14: Snapshots from "The Faded Landscape." Retrieved from Cheng, 2022.

In these digital "Shan shui" artworks, authorship is no longer singular but shared among human, machine, and environment. This collaborative authorship reflects a broader shift in the art world, where the creative process is becoming more inclusive and interactive. These new forms of creation, enabled by digital and AI technologies, invite us to reconsider the traditional roles within artistic production and the ways in which we engage with art. As artists adapt Shan shui to incorporate collaborative and automated processes, they not only challenge the conventional notion of authorship but also prompt us to reflect on the evolution of artistic creation. This shift opens possibilities for a richer, more diverse artistic dialogue, where the boundaries between creator and creation become fluid, and where art itself becomes a shared journey of discovery.

6. CONCLUSION

The fusion of traditional Chinese landscape painting, Shan shui, with digital media art, as explored in this paper, symbolizes a significant cultural and artistic evolution. This merging not only signifies the adaptation of a time-honored art form to the modern technological landscape but also marks a renaissance that extends its philosophical and aesthetic values into the contemporary era. This evolution exemplifies a deep connection between the past and present, illustrating how traditional art forms can be reimagined and revitalized in the digital age.

Digital technologies like 3D animation, VR, and AI have enabled a renaissance in the portrayal and experience of Shan shui, preserving its aesthetic essence while infusing it with new vitality. This modern interpretation creates a bridge between ancient artistic traditions and contemporary sensibilities, offering a more immersive, interactive, and dynamic art experience. The case studies highlighted in this paper showcase the critical role of digital media as a catalyst in transforming the spatial and temporal dimensions of traditional Shan shui, thus reconnecting it with its historical roots in a modern context.

Furthermore, this fusion of Shan shui with digital art forms has facilitated a transcultural synthesis, blending Eastern and Western artistic philosophies. This integration is not merely a combination of styles but represents an active and meaningful dialogue between diverse cultural aesthetics. The resulting artworks serve as a testament to the universal appeal of art, transcending geographical and cultural barriers, and fostering a global appreciation of Chinese artistic heritage.

Significantly, the integration of new media technologies in Shan shui has induced a paradigm shift in the concept of art authorship. This shift acknowledges not just the artist but also the audience and technology as co-creators, promoting a more inclusive and participatory approach to art creation. This collaborative nature of art creation blurs the boundaries between the creator and the creation, embodying a journey of collective exploration and expression.

In essence, the fusion of traditional Chinese landscape painting with digital media art represents a profound transformation in the creation, perception, and experience of art. This fusion honors the historical and cultural significance of Shan shui while embracing the potentialities of the digital age. It answers the pivotal question of how traditional art can maintain its relevance in a modern, technologically advanced world. This research envisions a continuity where art naturally progresses to become more inclusive, interactive, and reflective of our multifaceted and interconnected global culture. Thus, the exploration of this integration is an observation of the ongoing transformation of art, providing insight into the wider consequences of technology for cultural heritage and the practice of artistic expression.

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Domy Reverie: A journey through real and AI-generated realities

Mingyong Cheng
University of California, San Diego
San Diego, CA, USA
m2cheng@ucsd.edu

Zetao Yu
Independent Researcher
San Diego, CA, USA
stevenyu0029@gmail.com

1. PROJECT DESCRIPTION

Domy Reverie is an immersive and interactive visual experience, manifesting as a microcosm that intertwines diverse realities and speculative futures. The installation presents two spherical domes, each containing a glowing core, orbiting each other over an interactive landscape. These cores are a kaleidoscope of satellite time-lapse images—one dome hosts authentic images, the other displays AI-generated counterparts (See Figure 1).

Each dome serves as a metaphorical window into a world—an exploration of the blurry boundary between utopia and dystopia. One reflects the visceral truth of our world, the raw beauty marred by human intervention. The other, AI's interpretation, mirrors either an idyllic haven untouched by humans or a further ravaged dystopia. This dual presentation offers an uncanny dichotomy between what is and what could be.

Beneath these orbiting domes, the landscape reacts in real-time to the images displayed in the real dome, an echo of our Earthly realm. It pulses with life or shivers in distress, reflecting the varying degrees of human impact on the environment.

This triadic structure, the two domes and the responsive landscape, creates an intricate Microcosm-Macrocosm analogy. It embodies three layers of reality: the 'Artificial/Synthetic Reality' of the AI-generated dome, the 'Historical Reality' of the real dome, and the 'Collective Reality' of the reactive landscape. Each layer offers its unique interpretation and response to our shared world, presenting a complex dialogue on our environmental footprint and its reverberations across realities.

Furthermore, the creation of an aurora-like illusion around each dome raises questions about the semblance of safety and isolation such structures propose. It serves as a visual metaphor for the illusionary comfort in ignoring the impending environmental crises and our uncertain future.

Through *Domy Reverie*, we aim to explore the interconnectedness of realities, the tension between preservation and decay, and our role within this cosmic dance. In this intersection of art, technology, and environmental consciousness, we are invited to reflect upon our responsibility towards our shared home and the uncertain paths that lie before us.

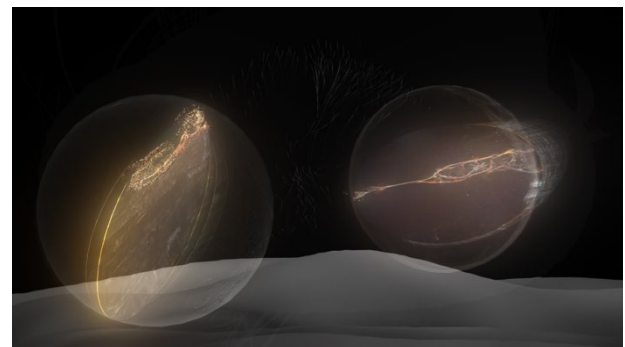


Figure 1: A frame from *Domy Reverie* (2023).

2. MOTIVATION AND CONCEPTS

The inspiration for *Domy Reverie* emerged from our collective exploration of Google Earth's time-lapse feature, which captures environmental transformations over a period of 38 years (Google Earth n.d.). As we ventured through this digital archive, we uncovered a plethora of pre-recorded time-lapse footage that vividly portrays various locations while underscoring the palpable human footprint on these landscapes. As artists with a keen

interest in environmental issues, these recordings initially struck us with their stark depiction of human encroachment and its adverse consequences, such as climate change, rising sea levels, and deforestation.

Nevertheless, as we delved deeper, it became evident that our perspective was seeing merely a fraction of a much broader narrative. This partial viewpoint was especially apparent when examining urban expansion through the time-lapses of Chengdu, prompting a reflection on the evolution of landscapes in our own countries (see Figure 2). We acknowledged the complexity in labelling the changes wrought by human activity as solely detrimental or misguided. Every species on Earth strives for prosperity and an enhanced quality of life. Humans, with our cognitive capabilities and evolutionary benefits, are no different.

This insight led us to consider the possibility of alternative realities. We contemplated how they might develop, how the environment would adapt over time, and how one might judge whether such alterations are beneficial or deleterious. The environmental impacts resulting from human intervention are multifaceted, encompassing both constructive and destructive elements. The world cannot be reduced to a binary of utopia and dystopia; our comprehension of it is intrinsically constrained and subject to the limits of our viewpoint.

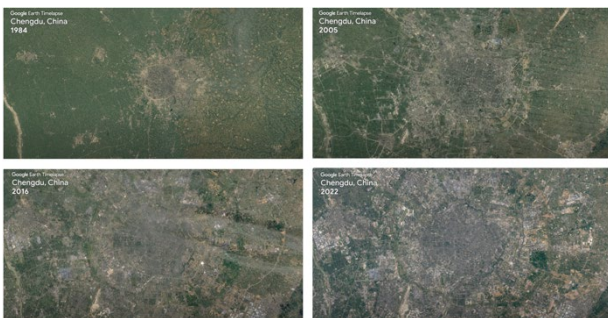


Figure 2: Four snapshots from the video 'Chengdu, China - Earth Timelapse'. Retrieved from Google, Landsat, & Copernicus.

The acknowledgment of complexity and diverse interpretations prompted us to reflect on the symbolism of the dome, traditionally seen as an emblem of utopian ideals (Lutolli 2022). Yet, from our perspective, the dome could represent a dystopia, or perhaps it transcends the binary classification of utopia and dystopia altogether. An iconic instance of dome architecture is Buckminster Fuller's Cloud Structures, a pioneering vision of human ingenuity and aspiration (see Figure 3). During that era, architects started to craft similar futuristic designs, one of the most ambitious being a proposed dome over the Arctic. This colossal

structure, spanning 2 kilometres, was envisioned to house between 15,000 and 45,000 people. It would feature a pneumatically sealed membrane to counteract the extreme weather, thus cultivating a habitable microclimate (Lutolli 2022).

Reflecting on the nuanced symbolism of domes and the intricate interplay between the natural world and human development, we have culminated our insights in the creation of *Domy Reverie*.



Figure 3: Buckminster Fuller, *Cloud Structures* (1962). Retrieved from Lutolli 2022.

3. METHODOLOGY

Utilizing the dynamic visual data from Google Earth's Timelapse videos alongside the generative capabilities of AI, we've re-envisioned Fuller's Cloud Structures (1962).

The dome for 'Artificial/Synthetic Reality' serves as a canvas for AI's creative force, where generative algorithms conceive timelapse patterns of fantastical places, unfettered by the physical or historical. Technically, this is achieved by fine-tuning a Stable Diffusion through LoRA method (Hu et al. 2021), refined with a dataset of satellite images (Ueberschär 2023), and Prompt Travel script (Kahsolt 2023), which, powered by the outputs of ChatGPT, dynamically generates these otherworldly landscapes.

The 'Historical Reality' dome offers a stark contrast, grounding us in the empirical. Utilizing Google Earth's Timelapse videos (Google, Landsat, & Copernicus n.d.), this dome chronicles the palpable alterations of our world, weaving a visual narrative of our planet's evolution. The technical underpinning here is the curation of time-lapse data, presenting an authentic record of temporal and spatial change.

The surrounding landscape represents 'Collective Reality', an active reflection of our contemporary moment. It reacts to viewer interaction, encapsulating shared experiences and societal flux. This real-time responsiveness is engineered through the visual programming in Touch Designer,

where motion capture technology translates viewer movements into changes within the landscape, manifesting as shifts in the visual elements.

The visual system, built in Touch Designer, features auroras that circle the domes and particles that fluctuate with time, symbolizing the delicate threshold between our present and possible futures. This aesthetic choice is intentional, designed to evoke the enigmatic vastness of the universe. The domes, suspended above the landscape, emanate particles to signify major environmental changes or transformations, a process enabled by optical flow technology that interpreted geographical pattern changes into a visual spectacle of time's passage.

The complete system, as illustrated in Figure 4, integrates the technical methodologies with the thematic elements, presenting a unified portrayal of a world undergoing constant evolution.

4. FUTURE DEVELOPMENT

In addition to the visual aspect, we will embark on further exploration to enrich the overall experience through sound. This entails integrating elements that evoke a meaningful auditory journey for viewers, which can dynamically interact with the current visual narrative. Specifically, leveraging data from Google Earth and AI-generated timelapses, corresponding soundtracks will be triggered in real-time. These soundtracks may originate from recordings, collaborations with musicians or AI-generated. Furthermore, an audio spatialization system, calibrated to the dome's position, will further deepen the immersive experience.

In addition to auditory enrichment, the installation will incorporate an interactive system that enables

the audience to engage directly with the dome's displays. This system will feature real-time text-to-image generation, allowing viewers to shape the synthetic world themselves. Moreover, it will provide the capability for audience members to uncover intricate real-time details by interacting with and zooming into specific world within the dome's presentation.

With the release of Apple's VisionOS, this experience has the potential to evolve into a mixed reality (MR) encounter, offering an even more immersive and engaging dimension for viewers.

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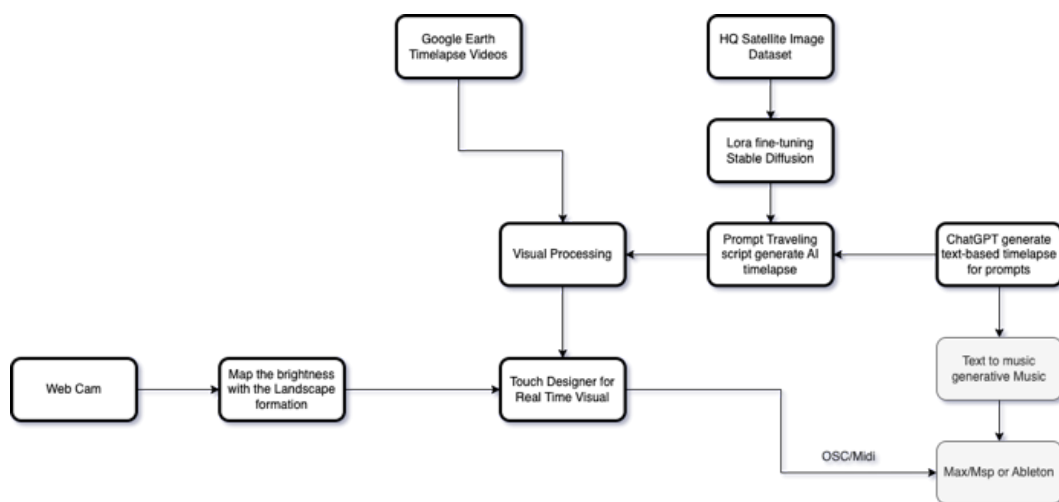


Figure 4: System Design for Domy Reverie.

Ruskin, Millais, and the Aclands: The colourful story of a painting, from oils to pixels

Jonathan P. Bowen
London South Bank University
School of Engineering
London, UK
<http://www.jpbowen.com>
jonathan.bowen@lsbu.ac.uk

John Everett Millais was a Pre-Raphaelite artist who painted the Victorian art critic and proponent of the group of Pre-Raphaelite artists, John Ruskin. The painting was given by John Ruskin to Henry Acland, Professor of Medicine at Oxford University. In turn, the painting became the property of Acland's daughter, Sarah Angelina Acland, who later became a pioneer of colour photography. Her collection of early colour photographs is now largely held by the History of Science Museum in Oxford and the painting of John Ruskin is on display at the Ashmolean Museum, also in Oxford. Acland took the earliest colour photograph of the Ruskin painting when it was hanging in her North Oxford home. Many of her photographs have been digitised and are now online. This paper tells the story of the painting to early colour photograph to the digital restoration of this photograph and the use of generative Artificial Intelligence (GenAI) for image colourisation and enhancement.

John Everett Millais. John Ruskin. Henry Acland. Sarah Angelina Acland. Pre-Raphaelite painting. Pioneer colour photography. Photographic digitisation. Generative Artificial Intelligence. Image colourisation.

1. INTRODUCTION

The Victorian Pre-Raphaelite Brotherhood, formed in 1848, was a group of British artists who believed that all art after the Italian Renaissance painter Raphael was a misdirection (Gaunt 1947; Hawksley 1999). They produced a highly realistic and detailed style of painting, sometimes almost photographic in their quality. This was at a time when monochrome photography was developing, but they had no competition in the domain of colour with their pictures. Despite what looks like rather traditional art to modern eyes, their style of art was not appreciated by Victorian society, at least initially. However, arguably the foremost British art critic of his day, John Ruskin (Batchelor 2000), became a proponent of their style of art, which significantly changed the fortunes of the leading Pre-Raphaelite artists during their lifetimes.

This paper covers the life of a painting of John Ruskin by the leading Pre-Raphaelite artist John Everett Millais, from its origination in oils to its

ownership by the Acland family, through to its early inclusion in photographs by the photographic pioneer Sarah Angelina Acland, including in colour. The paper continues in modern times with digital colour photograph restoration at the History of Science Museum in Oxford, as exhibited at an exhibition entitled *Colour Revolution* at the Ashmolean Museum in Oxford, covering colour in the arts during the Victorian era in Britain. In the age of generative Artificial Intelligence (GenAI), which has made rapid progress recently, some historic monochrome and faded images in this paper have been enhanced using the online DeepAI *Image Colorizer* (available under <https://deepai.org/machine-learning-model/colorizer>), which uses machine learning for its algorithm.

2. JOHN RUSKIN & JOHN EVERETT MILLAIS

John Ruskin (1819–1900) is considered the leading British art critic in Victorian times. He was a proponent of the Pre-Raphaelite Brotherhood group of Victorian artists (Ruskin 1853) as well as the importance of colour in art (Ruskin 1875). He

became friends with the Pre-Raphaelite artist John Everett Millais (1829–1896) in 1853 when Ruskin's Scottish wife Effie (formally Euphemia, 1828–1897) modelled for Millais' painting *The Order for Release, 1746*. (Tate 1984, pp. 115–117). In the summer of that year, John Ruskin with his wife, John Millais with his brother William, and the Professor of Medicine at Oxford, Henry Wentworth Acland (1815–1900) holidayed together in Scotland, staying at the New Trossachs Hotel, Callander (Gaunt 1943, pp. 52–54). They climbed the mountain Ben Ledi and did some fishing, although the weather was largely misty and damp. Ruskin and Millais both worked on artworks of the local area (e.g., see Figure 1 by Ruskin). During the holiday, John Millais and Effie fell in love. John Ruskin has the reputation of being very cold emotionally and was later accused by Effie of not consummating their marriage, leading to an annulment in April 1854 (Ashmolean 2013). John Millais and Effie subsequently married in July 1855, more happily for Effie this time.



Figure 1: *Study of Gneiss Rock*, 1853, by John Ruskin. Glenfinlas, Scotland. Pen, brown ink, ink wash, and body colour. Ashmolean Museum, Oxford. Colourised using DeepAI by J. P. Bowen.

During the holiday, Millais started work on a portrait of Ruskin standing on stepping stones at Glenfinlas in front of a waterfall. This remained unfinished for a while due to the personal situation between the two men. Despite this, Ruskin offered to continue sitting for the portrait and it was duly finished by Millais the following year (see Figure 2). That said, although Ruskin supported the Pre-Raphaelites, resulting in commercial as well as artistic success, his allegiance naturally moved from Millais to others, especially Dante Gabrielle Rossetti.



Figure 2: *John Ruskin, 1853–54*, by John Everett Millais (1829–1896) Oil on canvas. Allocated to the Ashmolean Museum, Oxford, 2013.

HENRY & SARAH ANGELINA ACLAND

Sarah Angelina Acland (1849–1930) was the daughter of Sir Henry Acland FRS (1815–1900), Regius Professor of Medicine at the University of Oxford (Gunther 1937, pp. 224–225), and Lady Sarah Acland (née Cotton, 1815–1878). Her father was friends with the likes of Henry Liddell (1811–1898), Dean of Christ Church, the largest college in Oxford, and father of Alice Liddell (1852–1934) of “Alice in Wonderland” fame, Charles Dodgson (aka Lewis Carroll, 1832–1898) a mathematics don at Christ Church and author of the 1865 book *Alice's Adventures in Wonderland* (Bakewell 1996), John Ruskin, first Slade Professor of Fine Art at Oxford, where he established the Ruskin School of Drawing, and so on.

The Acland family lived in a large house at 39–41 Broad Street, now the location of the Weston Library, part of Oxford University's extensive Bodleian Library. It was opposite the Clarendon Building, the Sheldonian Theatre, and the Old Ashmolean Museum building, now the History of Science Museum, all historic University buildings. With its location, the house was an important centre for the social life of the University at the time.

As a child, Sarah Acland was a friend of Lorina Liddell, daughter of Henry Liddell and elder sister of Alice (“in Wonderland”) Liddell. Sarah Acland was photographed by Charles Dodgson with her brothers (see Figure 3), Lorina Liddell (see Figure 4), and her parents (see Figure 5).



Figure 3: Sarah Acland (centre) with her brothers Theodore and Henry as children, 1856, photograph by Charles Dodgson (Lewis Carroll), albumen print (Hudson 2012, p. 8).



Figure 4: Alice Emily Donkin, Sarah Acland, and Lorina Liddell (sister of Alice Liddell), 1860, photograph by Charles Dodgson (Lewis Carroll), Deanery Gardens, Christchurch, Oxford (Taylor & Wakeling 2002, p. 160).



Figure 5: The Acland family (Sarah Angelina, Sir Henry and Lady Sarah, and Herbert), c.1860, cropped photograph by Charles Dodgson (Lewis Carroll), albumen print (Hudson 2012, p. 287).

Sarah Acland was tutored in art by John Ruskin and took up photography as a serious hobby (Hudson, 2012). She photographed many of the rooms in her family home, as well as notable people, scenes around Oxford, etc. The portrait of John Ruskin by

Millais was given to Henry Acland in 1871 after the falling out between Ruskin and Millais as mentioned earlier (Ashmolean 2013). Figure 6 shows a detail of a view in the drawing room of the family room, with the portrait of John Ruskin clearly visible through the doorway. The well-known 1867 photograph of the astronomer and polymath John Herschel (1792–1871) by the fellow-female photographer Julia Margaret Cameron (1815–1879) can also be seen to the left of the doorway, together with many other pictures covering the walls in the typical rather cluttered style to modern eyes.



Figure 6: Drawing room in the Acland family home in Broad Street, Oxford, with a detail of the *John Ruskin* portrait in the distance, 1892, cropped photograph by Sarah Acland, albumen print (Hudson 2012, p. 52).

No doubt Sarah Acland's interest in photography was influenced by her childhood experiences of being photographed by Charles Dodgson, and her awareness of Julia Cameron's photographs as well. One of Acland's most well-known photographs is of Ruskin and her father Henry Acland, taken in 1893 at Brantwood in the Lake District, Ruskin's country home overlooking Coniston Water (now open to the public as a historic house museum). A colourised version of the photograph can be seen in Figure 7.



Figure 7: John Ruskin and Henry Acland, 1893, photograph by Sarah Acland, Brantwood, Lake District. Colourised using DeepAI by J. P. Bowen.

Sarah Acland joined the Oxford Camera Club as its first female member in 1894 (Hewitson 2023). She published articles on photography, including one using Millais' *John Ruskin* portrait as an example (see Figure 8).



Figure 8: Article by Sarah Acland on photography, using the John Ruskin painting as an example (Acland 1900).

Henry Acland died in 1900, so was a true Victorian. By 1901, the John Ruskin portrait hung in pride of place above Sarah Acland's desk in her study at the family home (see Figure 9). It was obviously a favourite of hers.



Figure 9: Sarah Acland's study in the Acland family home in Broad Street, Oxford, with the John Ruskin portrait above her desk, 1901, photograph by Sarah Acland (Hudson 2012, p. 181).

In the early 20th century, Sarah Acland started to experiment with newly available colour photography processes such as the Sanger Shepherd three-filter method and Autochrome. Different technologies have had varying success in the long-term preservation of their colours, although Sarah Acland did not know this at the time. The next section explores these colour developments in the context of an exhibition at the Ashmolean Museum.

COLOUR REVOLUTION

Colour is an important aspect of art, especially painting (Winner 2019). In 2023, the Ashmolean Museum in Oxford (see Figure 10) organised a temporary exhibition entitled *Colour Revolution* on the arts during Victorian times in Britain (Ashmolean 2023; Riberyrol et al. 2023).



Figure 10: The main entrance of the Ashmolean Museum during the *Colour Revolution* exhibition.



Figure 11: The entrance of the *Colour Revolution* exhibition at the Ashmolean Museum.

The *Colour Revolution* exhibition on Victorian art, fashion, and design ran from 21 September 2023 to 18 February 2024 (see Figure 11). It illustrated that the Victorian period was in practice very colourful, with the invention of new vivid artificial dyes for clothing and so on, unlike the later view, clouded by monochrome photographs and Queen Victoria's extended mourning for the premature death of her husband Prince Albert.

The exhibition's information on John Ruskin stated the following:

Since the Renaissance, colour had been considered by many as secondary to composition and draftsmanship. Ruskin argued that colour was a divine gift from God and should be embraced just as it had been in medieval art. He believed the colours of the natural world could inspire and guide artists who should replicate them as truthfully as possible.

Sarah Acland studied with John Ruskin in Oxford. Ruskin wrote about observation for art:

Everything that you see in the world around you, presents itself to your eyes only as an arrangement of patches of different colours variously shaded.

Acland's 1877 watercolour of a fish in Figure 12 illustrates this in the fish scales, almost in a pointillist style with historical hindsight.



Figure 12: *Study of a Fish*, 1877, by Sarah Acland. Watercolour and opaque body colour over graphite on wove paper. Presumed to have been presented by John Ruskin to the Ruskin Drawing School in Oxford, where it was first recorded in 1906.

The exhibition describes Sarah Acland as a "pioneer of colour photography". She was an important practitioner of early colour photography, with a passion for art and science. She first started creating colour photographs using the Sanger Shepherd method, a complicated process involving three separate photographs taken through red, green, and blue-coloured filters, subsequently combined into a single image. She also used the French Autochrome process from 1907, taking many colour photographs in Oxford and further afield, especially on the island of Madeira where she used to holiday for health reasons. She experimented with different cameras, lenses, and processing methods, some more stable long-term than others. As a result, many of her original photographs are now too faded or fragile to be put on display.

From 1901 until the end of her life in 1930, Sarah Acland lived in Clevedon House in Park Town, North Oxford. She undertook most of her colour photography here, as well as during foreign trips to Gibraltar and Madeira, staying at Reid's Hotel on the outskirts of the Madeira capital, Funchal.

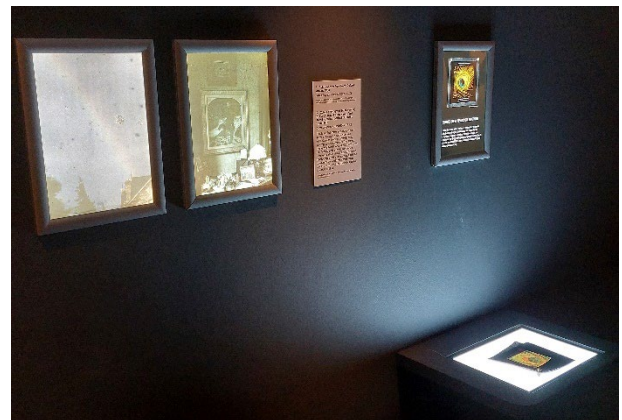


Figure 13: Display of photographs by Sarah Acland at the *Colour Revolution* exhibition. Sample Sanger Shepherd three-colour slides as used by Sarah Acland in 1900 can be seen on the right.

The *Colour Revolution* exhibition started with the *John Ruskin* portrait early in the galleries and ended with some of Sarah Acland's colour photographs (see Figure 13), most of which are now held in the collections of the History of Science Museum in the Old Ashmolean building, opposite where Acland lived for most of her life. Figure 14 shows an early colour photograph by Acland of a rainbow above Park Town and a similar modern equivalent, also taken in Oxford but using a modern smartphone digital camera.



Figure 14: Left: Rainbow over Park Town, Oxford, c.1908, by Sarah Acland. Right: Rainbow over Oxford with a modern smartphone, 2023, by J. P. Bowen.



Figure 15: Faded colour Autochrome photograph of the *John Ruskin* portrait by Millais, c.1917, taken by Sarah Acland in the study of her North Oxford home. Digitally restored by the History of Science Museum, Oxford.

Figure 15 shows the first-ever colour photograph of the Millais portrait of Ruskin, hanging in the study of her North Oxford home. Most colours apart from green have faded, even with digital restoration by the History of Science Museum. The original is too fragile to display. Figure 16 shows a version of this photograph with colours enhanced by the DeepAI *Image Colorizer*. The latter is not perfect, but an improvement. AI colourisation is highly likely to improve further in the years to come.



Figure 16: Image in Figure 15 enhanced by J. P. Bowen using the DeepAI *Image Colorizer*.

Sarah Acland died in 1930 and the John Ruskin portrait was sold privately. In 2013, it returned to the Ashmolean Museum in lieu of inheritance tax (Ashmolean 2013). In the same year, Sarah Acland was celebrated as a "pioneer of colour photography" with a Blue Plaque displayed on the front of her former North Oxford home by the Oxfordshire Blue Plaques Board (2013); see Figure 17.



Figure 17: The Blue Plaque for Sarah Acland on her North Oxford home in Park Town (Oxfordshire Blue Plaques Board 2013).

4. CONCLUSION

This paper has charted a path for a Pre-Raphaelite painting from its creation to early colour photograph reproduction through to modern digital colour restoration and enhancement. The original painting was produced when monochrome photography was still in its relative infancy. The first colour reproduction used colour photograph technology that was still novel, and its long-term stability was untested. Sadly, the process used was not one of the better ones but with digital processing now available, it is possible to restore the colour in such photographs. The original oil painting itself has fared much better and its colours are still remarkably vivid. The historical comparison of different image technologies may provide some lessons for the future, although long-term maintenance of digital images may have different issues (Diprose & Seaborne 2013; Diprose et al. 2018). While the digital image itself may not degrade, the storage medium and accessibility to it may do so as formats and technologies change. The copying of digital images to new formats and media will most likely remain an issue in the future to preserve such images for coming generations.

More generally, the arts are in the process of moving from analogue to digital approaches (Bowen & Giannini 2016), including and especially in photography (Bowen et al. 2023), as digital culture increasingly impinges on everyday life (Giannini & Bowen 2016; 2019; 2024; Bowen & Giannini 2024; 2021; 2023). Artificial Intelligence (AI) is an ever-developing and important part of these changes (Bowen et al. 2019) Generative AI now enables generative art for all (Giannini & Bowen 2023).

In the future, the use of AI is likely to be increasingly helpful in historical image preservation and conservation (Bowen 2017). Of course, the use of such technology should always be acknowledged for transparency. However, the author is optimistic that this will be a beneficial technology for conservators, making much more image conservation and preservation possible at decreased costs in the future. Most likely, a combination of automation with interactive checking and further improvement by experts will be the most effective approach.

Acknowledgements

Jonathan Bowen is grateful to Museophile Limited for financial support. This paper was partly inspired by the fact that my grandfather, the Oxford chemist E. J. Bowen, and his family moved to the house where Sarah Acland lived soon after her death, so I have known the room where the portrait of John Ruskin previously hung from my childhood onwards. Of course, I did not know the history presented in this paper until much more recently.

The paper was also inspired by the *Colour Revolution* exhibition at the Ashmolean Museum in Oxford, held during 2023–24. All modern photographs in this paper are by the author unless otherwise noted. Historic photographs originate from Wikimedia Commons (<https://commons.wikimedia.org>) under the Creative Commons licence unless otherwise referenced. All additional colourisation is by the author using the DeepAI *Image Colorizer* (<https://deepai.org/machine-learning-model/colorizer>).

Dedication

This paper is dedicated to my grandparents, Ted and Edith Bowen, and my grandson, Teddy Bowen.

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Understanding Our Relationship to the Other in the Car Park Image

Kenneth Feinstein
University of Leeds
School of Design
Leeds, UK
LS2 9JT
ken@kennethfeinstein.com

Within the act of photography, a relationship is created between the image maker, the object photographed and the subject of the image, which may not be depicted. In the case of the group photo, we create a relationship that involves the photographer, the people in the image to each other and the photographer and also a relation to the setting where the image is taken. The last one helps place us in time and establishes the idea of presence within the image as well as the act of photography itself. Within this act presence helps place us in a direct relationship with each other as what Lévinas would call a being-with. This is where we confront the other as present and real. It is within this confrontation of the other as real that we create a bond through our mutual obligation to each other, as we establish a moment of presence in this act. For Lévinas this can only happen in a literal face-to-face with another person. We will not only talk about how this is established through technologies based on presence, such as photography, but that they leave us with artefacts that help re-establish at least the trace of that moment. The specific form of photography we will be looking at is the carpark image. Those images we create so that we can remember where we parked. We will look at them as objects that create a relationship of presence between the photographer, the space and the car, which may not be depicted in the image. We will discuss the nature of that relationship and how it relates to ideas of time and presence. From there we will look at a proposed new immersive virtual reality project based on crowdsourcing images from a specific carpark in order to recreate the space solely through those pictures. We will see if such a work can be developed to help the viewer understand that nature of the relationship captured by the photograph. This project is still a work in progress.

Otherness. Spatial visualisation. Photography. Car park. VR.

1. OTHERNESS AND THE DEMAND OF MEDIA

To understand the appeal of media as a form of communication we have to first understand what it is that it engages in. We have a need to create various ways of placing ourselves in a world that is outside of ourselves. In Western philosophy we have tended to place the self as Being as the primary unit of existence. It is the syntagm of Being. Society emanates from the relationship of being to being. This is perceived as necessary but is not always treated as a positive thing. In *Leviathan* it is seen as a needed compromise. Even in Rousseau's *Social Contract* the idea of the autonomy of the self comes before society. In both cases society is understood a necessary compromise to being's will. This view makes sense in that there is an inherent conflict between an individual's consciousness and sense of will and a world that is not under its control. How do we understand how we can have a consciousness

of the world and not have control over it? How do we place ourselves into a world that is beyond the individual and their will and yet fit into the world of existence? Heidegger talks about the authenticity of the will and that any compromise of it is a move away from the authentic to the useful (Heidegger 1977). For him this is a moving away from one's truth towards a technologically efficient functionality. Effort and will are resources to be exploited for this function. In this way he continues the conflict between the societal and the individual. With media technology the efficient end is control of the individual. Because if the individual's will be objectified or limited by technology then their will is negated, and their freedom eliminated. Much like Burke or Rousseau he sees the world as made up of individuals uneasy with each other only entering into union because they lack the ability to exist on their own, the implied natural state. With this world view media can be seen as a tool for limiting the human will; that every development connecting us

together takes us away from our nature. For Heidegger our being-in-the-world is a complicated compromise with that world. One we enter into reluctantly even though it is necessary for the species to survive. And yet it is this idea of being-in-the-world that helps us understand an alternative way of seeing this situation.

In the 20th century an alternative understanding of the role of the self-emerged. Beginning with Martin Buber we see a philosophy where the self exists in direct relation to the other. Being-in-the-world is the act of encountering the other as an equal and not as something trying to limit our will. Encountering others ceases to be confronting objects in the world that compromises our will. Buber makes a distinction between what he calls the I-It relationship and the I-You. In the I-It we are engaging with things as objects that can be understood symbolically or are to be manipulated in a functional way. For Buber we do not encounter others in the world through the formulation of *I-It* instead it happens as, an encounter with an equal as equal, the *I-You* (Buber & Kaufmann 1970). The enactment of this relationship with the other is what he calls presence. For Heidegger and even Hobbes before him to communicate is to find a way for the self to navigate around and through a world that wants to compromise one's will. In such a formulation media becomes a method of either being able to express and enact one's will over others. While for Buber communication is the enhancing our ability to engage in direct relation to the other. Our direct relation with the other is not a necessary compromise of the will, but rather is the condition of our being-in-the-world. The promise of media is the ability to enhance and enact the I-You formula and enabling our being-in-the-world.

Communication is a means of presenting the self to a world that it belongs to. For Buber the I-You defines us in our presence in the world. We find this first in conversation, the address of one to the other. Emmanuel Lévinas brings this further as he states that the self exists not with the other but because of the Other. He calls this the preoriginal and because we owe our existence to the other this puts us under an obligation to the Other (Lévinas 1998). For him we experience this obligation when we see the face of the other (*autrui*). It puts us in relationship to *that* person. We are seeing *that* face, not an idea of otherness or a representation of an existential truth. We are in conversation with a being as real as we are and as we communicate with them, we are enacting our place in the world. We exist through our interactions (Lévinas 1987). In such a way of seeing our place in the world, this engagement becomes a fundamental to our existence. Our subjective self is defined by these encounters with the other (*autrui*) as much as we are defined by our obligation to the Other (*autre*) as our preoriginal. What does this

mean for the idea of communication and its technologies? First, they are subject to this demand to present the Other (*autre*) to us and act as a vehicle to encounter the other (*autrui*) as real, one who we can engage with as real, I-You. None of this is to deny or ignore the semiotic aspect of communication, but rather to say that this I-You comes first, and the semiotic structure of communication happens after. As we try to derive meaning from our interaction, we transform the encounter to a series of messages. Converting an I-You encounter into the I-It.

In his book, *Towards a Philosophy of Photography*, Vilém Flusser looks at the nature of photography as the starting point of our present media world. He talks about our engagement with the camera and the subject are an engaged in an interaction he calls play. The resulting artefact being the technical image (Flusser 2000). He states that this new apparatus changes how we encounter the world and each other. The forces that draw us to this apparatus (the camera) and entice us to play with it are the forces of the conversational. We play as long as there are new ways possible to be-with the apparatus and the photographic subject. The idea that we are drawn to these technologies because it presents a relationship to the other through play is developed later in *Into the Universe of Technical Images* (Flusser 2011). Here he more explicitly acknowledges that the draw of these technologies is their ability to present the other to us as a face-to-face encounter before sending us a programmed message.

It is because of the fact that in the technical image we see the literal face of the other in the same way that we do when we are in their presence, that allows it to transcend the metaphorical programmed message and have presence. This means that we have to confront what is before us as it is or what Lévinas calls unthematized (Lévinas 1998). We see that face before it becomes turned into a linguistic structure. It is what gives the technical image its power. It doesn't have to choose sides it's both literal and metaphorical, complicating our relationship to it. Within an image is a framing of a moment in reality. Much has been written about it as a moment in time. That it is an image from the past meant to be seen in the future. But it is also a map of the physical relationships that make up that image. Everyone, the subjects in the image and the photographer, were present not just in time but also in space. We tend to not think of the relationship of the various actors in this moment in spatial terms. This is because in doing so, in looking at the moment of photography as part of a greater moment in time and space is to turn away from the supremacy of the camera to define a world in Euclidian geometry and instead see the image as demarking a relational geometry where the image is just a single

perspective out of many. The former valorises the view of the image over any relationship between the participants, while the latter defines these participants as equals actors in the moment captured by the image. When we look at the image as solely the vision of the photographer, we take any agency away from the subjects and deny our relationship to them, instead we flatten out the space of the image into the two dimensions of the printed photograph. Here we valorise the image as print over the act of photography as enacting our being-with the other.

We understand that the media is a method of communication, and yet we forget that that means we must be talking to another. The need to reach out to establish our being-with the other is central to what we do with the technical image. It presents us to the other and demands a response. This is why Roland Barthes can rhapsodise on the image of Lewis Payne, one of the people convicted in the conspiracy to kill Abraham Lincoln (Barthes 1981). While he knows he is seeing the face of a man about to be executed a century earlier that experience of being-with the other through a face-to-face encounter comes first. It is where the feeling of presence and the real are derived from when he looks at the image. On top of this the pose of the subject is one that places us in a specific proximity to him. We are a meter or so in front of him nose to nose as it were. To see the image is to have a sense of place in relation to the subject.

2. HOW DOES THIS ENGAGEMENT RESIDE IN MEDIA?

We tend to ignore these relationships to otherness in the cases of journalistic or artistic images because the narrative or unique composition within the image becomes too powerful. We substitute the idea of the photographer's Point of View for an understanding of this relation of place demarked by the act of photography. This plays into the accompanying narrative of the artist and their vision being more important than the presence of being-in-the-world established by the act of photography. Again, the image is given priority over the act of photography and how it enacts our relationship with otherness.

The understanding of the image as representing a relationship with space can be seen in the movement called Rephotography. It is the creation of images where older images are placed inside new ones so that the older can be seen inside new photograph making a seamless image. This demands that the rephotographer must find the spot where the original image was taken, putting the spatial geometry that created the image front and centre.

This sense of place within the image is why car park photographs are so interesting. The narrative is very simple, almost to the point of being ignored. Yet this narrative is based on creating a record of a specific spatial relationship and answer the question, where is my car in this physical space. In the end they are images defining a location through a form of differential geometry. The image tells us where we are at that moment so that we can find our car later. What is interesting is that a successful image doesn't need to even have the car in it. The image is only about creating a reproducible moment in space. It shifts the centre of photography from the image to the spatial relationships defined in the act of photography.

2.1 The car park and photography

When one takes a photo in a car park what exactly is happening there? Why is the image needed and how does it operate as a functional object? One does not take photographs of where they park on the street. There are enough visual clues to remember where one is. The opposite is true in the car park. The car park is designed for maximum efficacy in relation to fitting a specific number of vehicles into its space. While the regularity of the space is best for storing cars, it is not helpful for human memory. Elements used to aid with memory are an afterthought at best. What the driver is confronted with is a very regular space, often underground and/or detached from views of the outside world, with continuing rows of parked cars and open spaces. Each row looks the same as the previous one. Every story of the car park follows the same design making it difficult to even know what level one is on. Where is the car located? It could just as easily be three stories above ground or three stories underground. Visually there is no difference. One of the only clues given is found in the form of provided signage giving a location code.

In Figure 1 we see an example of the type of signage added to the space so that one can remember where they have parked. It is placed on a loadbearing column; it has the relevant information on it, yet it even this signage is presented in such a regular fashion as to not distinguish itself from the rest of the car park. The signage appears to be functional as it carries the needed information, but following the logic of the car park design it is regular and has nothing to distinguish it enough for us to remember it. So, what people have found it the best way to remember where they have parked is photography. With the ubiquity of smart phones and the cameras built into them this would seem the most logical solution. While developers have tried to create their own ways of solving this problem nothing has taken the place of the photograph. This is because the relationship to place and photographer are already present within the image.



Figure 1: Image of carpark signage on a loadbearing column. Image courtesy of the author.

At first glance we can understand the car park image as yet another subset of the amateur photograph. When we look at amateur photos what we find is that they tend to fall into well understood conventions, the event or group photo, the image of discovery or the “me at” image, the portrait or selfie, the snapshot and the landscape (Feinstein 2010). While the car park image can be categorised as both me at and a snapshot, what is interesting for us about this hybrid is that it defies any specific visual convention. As an image it is more utilitarian than the other forms of amateur image. But this doesn’t change the importance of the being-with-the-other created by the image and how this is presented as presence through the resulting image. Quite the opposite it is because of this that the car park image has any meaning or reason to exist.

In this image we face the other (autrui) in their being of the world. The image has meaning only through how it places us with the other (autrui) seen and the other implied. A triangulation in space created by the act of photography is one that reinforces presence of the Other (autre) in the event of the photograph. We can only come back to the place of the image because the image places us in relation to each other. To be able to return to the car is to come back to another that we have made a promise to. To fulfil or responsibility to return to it. To be come back to it, re-establish our being-with it. In this sense the photograph is a promise to the car (autrui) to return.

To take care of and be responsible to it. It is through the photograph that this responsibility is forged. To park a car and walk away is to see the car as a thing, it is the I-It relationship, but by taking an image one is making the promise of return and that is what turns the relationship to be one of responsibility to the other, an I-You. While this may seem to be a rather subtle thing it is a profound change in how we relate to the object. It places us in the world by taking on this responsibility, even if we are not conscious of it as we do it. This relationship between the photographer and the photographed and the car, the invisible subject, this binding together created by the act of photography is brings us back to this act over and over again. Even if we are not aware of why. When Flusser talks about the taking of a photograph as a game between the apparatus and the operator to find a bond through creating new possibilities, he is leading us towards an understanding of the action as creating a being-with and how it draws us into this relationship (Flusser 2000). What he misses is how the subject of the image is also an active partner in this relationship.

3. MAKING THE PRESENCE OF THE IMAGE VISIBLE

We can see that the relationship to the other as described above is important to how we created the technology of communication. That the ability to bring presence to the communicative act is major change from what we experience with print or the drawn image. Still, it is a subtle relationship easily overlooked in the practical use of our technologies. Understanding this, the question I asked myself is, can we develop media experience that will make this relationship visible to the average person? Because the car park image is rather ubiquitous and we all have them on our smart phones, it seemed like a good starting point for creating such a work.

The idea is to present the spatial relationships created in the car park image. To depict where one is in space as they take the photo and reflect back on how the image itself captures this relationship in space. What is being described is a developing project and as such it may change greatly when it takes its final form. What will be discussed here is the reasoning behind the project, the choice of technology, the proposed design and experiential expectations of the work.

Conceptually if I want to be able to present the idea of presence through a photograph to an average or amateur photographer, I need to avoid certain types of images. My first concern was the relationship of photography to narrative. In 1994 the International Center of Photography had an exhibition called *Talking Pictures: People Speak about the Photographs That Speak to Them*. In this exhibition

people were asked to select images and explain why it had significance to them. I specifically remember the Reverend Jesse Jackson choosing an image by Charles Moore of children being pushed against a building by high pressure water hoses. Jackson's essay was about the effect of the image, what its value was as part of his political struggle (Heiferman et al. 1994). It is the narrative and the utility gained from it that is important to Jackson here. The image here is defined by its semiotic value, its I-It. This is what needs to be avoided. This is what can be expected from journalism and artistic images.

In a similar vein portraits and amateur images of discovery are not useful. When looking at the face of another a feeling of being-with the other is invoked as we saw in the earlier Roland Barthes example, but it is centred on the face of the other and not on the spatial relationship we are looking at. With such an image identification of the other becomes important and that separates the viewer from what is viewed. The same can be found in images of animals. We tend to anthropomorphise them in images, and this brings back to the same issue.

In order to emphasise the relationship between the photographer, the subject and the space it makes sense to use an image that is more spatially bound. The car park image makes sense because as mentioned earlier it doesn't have a defined visual convention. It doesn't have a visual history. Where, by contrast, a landscape does. With a landscape we are either referring back to the picturesque and landscape painting or we are tending towards the image of discovery which brings people back into the image. So, in the end the car park image is the ideal image to use because it is one that we possess but ignore when we discuss photography. It is a spatial image that we do not think of in those terms.

With this in mind then the question becomes how to develop a work that can present the relationship of the photograph to space and our place within it. In order to do this, photographs must be used, but the work cannot be based on established photographic displays that valorise the image as object, such as exhibitions, a photo albums or database sites like Flickr. A technology is needed that allows us to embed photos. One where the photograph as a printed image is presented but where the space it was taken in is featured. For this reason, I have chosen the project to be in VR. With VR we can be

engaged in the space while the images can appear or disappear as is needed. When one enters into the VR work, the viewer is conscious of their presence in a constructed space. While the user should move through the space as if it was as real as any other gaming or experiential VR space, here the viewer needs to be aware of their own relationship to the space that they are in.

In the prototype being developed the space of a specific car park is being created from car park photographs of that space. In the current prototype images of the Bangsar Village II car park in Kuala Lumpur, Malaysia are being used. From these images the entire space is being extrapolated and turned into a 3D space. The images used are being acquired through a crowd sourcing call. It is important that the image use are ones solely created for remembering where one is parked and not to map the space for the project or else the relationship of image, photographer and space is lost.

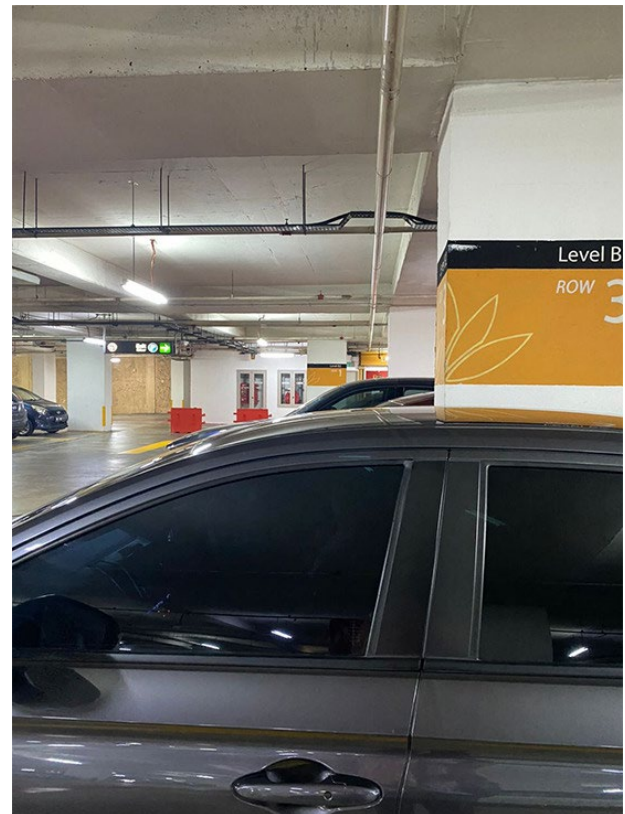


Figure 2: Image of carpark use for modeling. image drawn and courtesy of the author.



Figure 3: 3D rendition of Bangsar Village II car park derived from photograph. image drawn and courtesy of Ahmed Yaish.

Figures 2 and 3 show how a photograph is used as a source image to design the full car park space. The VR space created can be explored by the viewer. They can walk around look for an exist or try to find a specific car. Once the viewer moves close enough to the view of the original photograph, it will appear as an overlay. The image will appear or disappear in relation to the viewers proximity to the original image, see Figure 4. This will allow the viewer to see the image in the space as well as its functionality. As the viewer moves closer or farther away from the image, it will scale appropriately so the user can understand their physical position in relation to the image. At a certain point as the user moves out of



Figure 4: Rendered image of carp ark with original photograph over laid. Image drawn and courtesy of Ahmed Yaish.

range of the image it will disappear. It is hoped that by having the images appear and disappear from the VR space that the overall idea of the relationship between image, object and space will become understandable. The emphasis here is twofold. Firstly, the user will see a direct relationship through the image between the photographer and the space. This will allow them to see how the image as result of a spatial relationship. Secondly, because there will be a great number of such images, they will see how this is a common occurrence. That it has unique properties but happens all the time. It is hoped that the repetition found in having so many images will make the first point understandable. From this what is hoped to be presented through the work is not just the photograph as a static image in time, but rather that the act of photography is a dynamic event that puts enacts these relationships in real life.

4. CONCLUSION

This is still a work in progress and there are elements that will have to be play tested. Such as having the quality of the rendering of the overall VR site would be less photorealistic and the quality would increase as the photograph appears. How sound will play a part in the final work has not been determined yet. Further development of the project needs to be done once the final research /development team is in place.

As a final work it is believed that a VR environment can be developed to enable users to understand the photographic relationship to space. Once that has been accomplished deeper questions relating to understanding how photography presents us to the other and visa vera can be explored. These issues regarding the individual and the other can be seen with in the image relationships created by the image. It is just a matter of finding the correct visual language to make it understandable to general users. This will be accomplished through user testing and active design thinking. As the project is developed further it is hoped that these questions will become clearer. The focus here is to keep the project as one that communicates its ideas visually and not be dependent on text. Given these constraints the task is to see how far we can communicate such knowledge through experiential design.

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Twitchy Cells

Andy Lomas
Goldsmiths, University of London
London SE14 6NW, UK
a.lomas@gold.ac.uk

1. INTRODUCTION

Led by Professor Shankar Srinivas in the Department of Physiology, Anatomy and Genetics at the University of Oxford, The Srinivas Group (Srinivas 2024) is studying the emergence of patterning and morphogenesis of the early mammalian embryo. In particular, they are looking at how concentrations of calcium ions activate contractions in cells, how they generate structured waves of contractions, and how these rhythmic motions lead to the development of the heart (Tyler et al. 2016).

The author was invited to collaborate with the Srinivas Group to develop a digital artwork inspired by their research. The aim is to create a work based on simulation of biological processes that could help promote discussion of ideas within the research group as well as with other researchers and the public.

2. IMPLEMENTATION

Rather than directly visualising the specific patterns of cellular contraction observed in mammalian embryos, the aim of this project has been to explore the wider range of emergent patterns that might be achieved using a naive simulation of cells that can contract and interact with their neighbours.

The initial implementation used the codebase that the author previously developed for his Cellular Forms work (Lomas 2014). This work explored the emergence of organic structure through simulation of growth by cellular division. The simulation system allows dynamic interactions between cells through forces such as electrostatic repulsion as well as linear and torsion springs and simulates the generation and exchange of chemicals that can affect cell behaviour.

For this work the initial configuration for the cells are points randomly distributed on the surface of a sphere and connected together as triangles using Delaunay Triangulation (Renka 1997).

Cells are triggered to contract when the level of a simulated chemical (the 'potential level') exceeds a specified threshold. When they contract, the rest length that is used for calculating spring force connections is reduced causing a localised contraction. When a cell contracts, its potential level is reset to zero and it increases the potential level in its immediate neighbours so that they may also be induced to contract. The aim is to enable the generation of structured waves of contraction where each cell can trigger its neighbours.

After contracting, each cell gradually expands back to its rest size using a simple decay rate parameter. The potential level in each cell also increases back to a rest value using another decay rate.

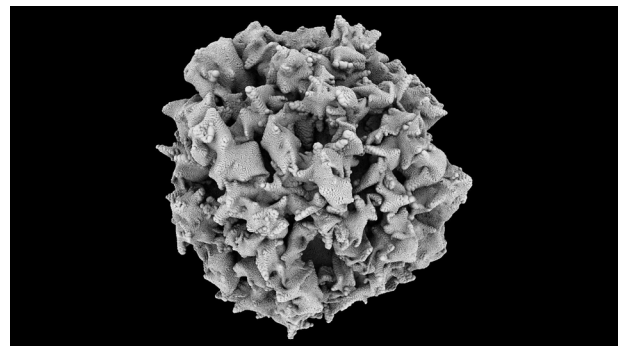


Figure 1: Example form generated by Twitchy Cells

The initial implementation using the Cellular Forms codebase was used to quickly develop a system that could be presented to the research group for discussion. This was enabled through the re-use of existing code for dynamic interactions between cells as well as for simulating chemical transfer between cells. However, the code is quite old and uses a GPU ray-tracer written by the author which is significantly slower than what can now be achieved using dedicated ray-tracing hardware, typically taking seconds to render each frame.

After reviewing the results with the research group, it was decided to implement a real-time version to

enable user interaction. This was achieved by re-implementing the system using CUDA for the simulation stages and NVIDIA's OptiX library (Parker et al. 2010) for optimised GPU ray-tracing using RTX hardware.



Figure 2: Testing the interactive system using a custom Wheatstone 3D stereo viewer and MIDI controllers.

To enhance user perception of how interactions affect the cells it was decided to explore sonification of the data generated by the simulation. Three different approaches to sonification were explored, which can be combined to create a richer structured sound:

- Mapping the potential levels in each cell to different frequency oscillators.
- Mapping the contraction level in each cell to different frequency oscillators.
- Physics-based sound synthesis using a damped spring system oscillator that is given an impulse every time a cell is triggered to contract.

3. RESULTS

Within the research group the work appears to be successfully generating discussion, in particular around what types of mechanism may be necessary for the emergence of patterns through cell movement, and what types of control are needed to guide those patterns to create desired structures.

One problem with the initial implementation was that a lot of fine tuning was necessary to create waves of contracting cells. The system appeared to have a critical threshold, below which a few cells would twitch randomly, and above which all cells would be over-stimulated in a storm of activity. To promote the generation of structured waves of activity it was decided to alter the system so that

after each cell contracts there is a short period of time during which it has a reduced response to taking up potential chemical generated by its neighbours. This appears to work well, allowing a much wider range of parameter settings to generate structured waves of contractions. The research group thinks cells having a variable response like this is biologically justifiable.

Initial tests appear to show that the inclusion of audio significantly enhances user interaction, particularly through frequency changes that reflect the rate of cell activity. Members of the research group have also expressed a preference for lower frequency drone-like sounds reminiscent of heart beats.

We are looking to explore different ways of presenting the simulation results, including use of auto-stereo displays such as the Looking Glass Portrait, and custom Wheatstone 3D stereo viewers.

Next steps include testing with users in a number of contexts, such as pop-ups at the Department of Physiology, Anatomy and Genetics at Oxford as well as other venues such as EVA and the Oxford Science & Ideas Festival. In particular, we wish to explore a variety of different physical arrangements for presenting the work, as well as exploring what features of the simulation should be exposed to allow meaningful user interaction.

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Emerging Trends in Online Learning

Mary-Joyce Arekion
MBCS, Beau-Bassin
Mauritius
jo_arekion@hotmail.com

1. INTRODUCTION

Online learning, a technology-based educational approach, has shown to be effective in maintaining class continuity during the Covid-19 disruptions (Olasile Babatunde Adedoyin et al. 2020). Indeed, it is possible for the classroom to spread beyond its four walls due to the ubiquitous nature of technology. Worldwide outreach to students is facilitated by the internet and World Wide Web (Means et al. 2009), generated scope for current online learning (Odili, et al. 2020) which has been enhanced by the massive transition to online platforms during the Covid-19 pandemic lockdowns. Online learning ecosystems is being enriched today by a leap forward in technology advancements, so redefining the way that education gets delivered (Kumar et al. 2017). These technology advancements are influencing how education is delivered online, but it is important to consider how they are impacting students because of the risk that education becomes too technocentric instead of being learner-centric.

2. THE EVOLUTION OF ONILNE INSTRUCTION

Online learning, a type of technology-based education, has a long and rich history. It originates from way back to the 1950's, consequently, there is an extensive amount of literature describing this topic (F. Gurcan et al. 2021). Novel ways of learning in avenues that could not be perceived five to ten years back now exist due to advancement in technology. Technology novelties is undeniably impacting the future of education. Online learning has been around for a while—online college degrees first surfaced in the 1980s, and it gained popularity in the 1990s and early 2000s; though it was considered to maintain continuity during the Covid-19 pandemic lockdowns, this is not the reason for which it came into the landscape of education (Ribeiro 2020). It has gain popularity due to technological advancement such as the world wide

web (Means et al. 2009) which made room for global outreach. The technological advancement relates to Artificial intelligence (AI) technologies, such as machine learning and deep learning, which have permeated every aspect of our lives, including education, in this technologically advanced digital age (Dogan et al. 2023). As a result, scholars from a range of fields have recently raised concerns about human control and management over Artificial Intelligence (AI) systems; these concerns are related to ethical, legal, and societal issues (Fanni et al. 2023).

2.1 New advances in online education and its impact on education

Today, technology-based education comprises, but is not exhaustive to the following: gamification, virtual assistants, virtual reality and artificial intelligence. Hence, the cornerstone of digital learning is acknowledging that new technologies alter how people learn at all ages (Kumar et al. 2017). For instance, new trends in online education management systems have been implemented as a result of the growing requirement for the development of creative teaching approaches (Nikkhoo et al. 2023). Futhermore, Nikkhoo and colleagues state that one trend growing in popularity is microlearning, which is the practice of delivering instruction using a short video (less than 10 minutes). Microlearning, relates to microlearning theory based on Hermann Ebbinghaus (1980) forgetting curve, enables learners to ingest instructions with reduced attention span. However, instructors have to strike a balance between providing students with appealing and easily accessible content and making sure that the content meets educational goals for complex and challenging topics. Consequently, it could be quite helpful to understand how all these technological improvements affect learners' motivation and engagement.

2.2 Student engagement and motivation in virtual environments

Learners do not share the enthusiasm of course developers regarding the ability of online ecosystems to offer an interactive and collaborative platform (Hampel and Pleines 2013). Consequently, research has been conducted in the aforementioned field concerning motivation and engagement in online learning settings (Beluce and Oliveira 2019). According to Topu and Goktas (2018), learning today necessitates recognizing any negative impact that might exist in any part of learners' interactions. So, while assessing students' engagement in virtual spaces, all behavioural, affective, and cognitive characteristics must be taken into consideration (Topu and Goktas 2019). Examining the learning theories that are fundamental to online ecosystems can help understand factors that drive learners' motivation and engagement.

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2.4 CONCLUSION

To this effect learners can be asked to reflect on their motivation and participation while using online learning platforms, then contribute to online diaries, blog posts and discussion prompts which will provide invaluable qualitative data; quantitative data on the other hand can be obtained through learning analytics which would provide data related to time spent on course, participation rates, completion rates for assignments to name but a few indicators of learners' engagement. Hence, a mixed-method inquiry is to be conducted to help investigate how emerging technologies influence the learner motivation and engagement in online ecosystems. In order to provide learners with a stimulating and

encouraging online learning environment, a proposal for best practices and approaches for implementing developing technologies in online settings would be made.

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The Allure of Immersive Technologies: Unveiling motivations, societal implications, and responsible design

Caitriona McAllister

CMcA

London, UK

Caitriona.mcallister1@gmail.com

Immersive technologies have captured the collective imagination, with their ability to transport us to extraordinary realms and create captivating experiences. While visual aesthetics play a role, there are deeper motivations that drive human and societal fascination with immersive tech. This paper explores the underlying reasons behind the widespread desire for immersive experiences, moving beyond surface-level aesthetics, commercialisation and social media. By delving into the psychological, emotional, and societal aspects, I aim to uncover the true motivations behind our longing for immersive technologies and the potential implications they hold for individuals and society. I want to uncover the true essence of our connection to immersive technologies and understand the profound impact they have on our perceptions, emotions, and social dynamics as a creative technologist working within the realm of immersive experiences.

Immersive technology. Immersive experience. Escapism. Societal implications.

1. INTRODUCTION

Immersive art represents a unique form of creative expression, captivating participants through multi-sensory experiences that transcend conventional artistic boundaries. These installations often occupy physical space, incorporating technology and various sensory elements to envelop participants in dynamic and interactive environments. The roots of immersive art can be traced back to humanity's earliest expressions of creativity, such as cave drawings illuminated by flickering lights (Zhang 2020). Across millennia, the evolution of immersive art has paralleled advancements in human culture and technology. From ancient civilizations utilising architectural spaces for ceremonial rituals to Renaissance-era frescoes inviting viewers into illusionary landscapes, the impulse to transcend the two-dimensional and immerse oneself in art has endured (Zhang 2020).

In the contemporary context, technology serves as a powerful ally in expanding the horizons of artistic immersion. Virtual reality (VR), augmented reality (AR), and interactive installations offer artists unprecedented tools to craft environments that not only envelop but actively engage participants. These modern incarnations of immersive art build upon the

primal connection between light, space, and human perception, providing a canvas for artists to explore new dimensions of narrative, sensory experience, and audience interaction (DeSalle 2018). As we traverse the diverse landscape of immersive artistic expression, from ancient cave drawings to cutting-edge digital installations, it becomes evident that the human impulse to be absorbed in artistic expression transcends time and medium. Immersive art remains a testament to humanity's innate need for connection, storytelling, and the exploration of boundless possibilities. Modern technology has ushered in a new era where artists, fuelled by technological innovation, seek to transcend traditional artistic forms and transport audiences into previously unimaginable realms (Zhang 2020).

At its core, immersive technology incorporates sensory stimuli that engage individuals in simulated environments, blurring the lines between the physical and the digital. However, in recent years, particularly over the past decade, there has been a remarkable surge in the popularity of immersive technologies. The COVID-19 pandemic has played a pivotal role in accelerating their widespread adoption (Steed et al. 2020). The global health crisis, marked by lockdowns, social distancing measures, and a profound sense of isolation, has influenced

people's lifestyles and perspectives. As individuals grapple with the limitations imposed by the pandemic, the longing for tangible, sensory experiences intensify to counter feelings of global isolation (Steed et al. 2020). Concurrently, the rise of social media has transformed the nature of these experiences, linking the pursuit of immersive encounters with the desire for online validation and visibility. This shift has led to a commercialisation of immersive experiences, where the emphasis on creating shareable content sometimes overshadows the authenticity and depth of the personal encounter (Scholz & Smith 2016). The intertwining forces of personal fulfilment, social connectivity, and the commercialisation of these technologies pose challenges in maintaining a balance between meaningful experiences and curated online representations.

The term "immersive experience" transcends the mere consumption of digital content; it encapsulates a profound engagement that transports individuals to extraordinary realms, allowing them to escape the confines of reality (Zhang 2020). It is essential to understand why immersive technologies have become a focal point of technological evolution. What is the magnetic pull that propels individuals towards these simulated realities, and why has their popularity surged, particularly in the last ten years? The answers lie not only in the technological advancements that enable more realistic and engaging experiences but also in the broader shifts in societal needs, preferences, and challenges.

2. MOTIVATIONS FOR IMMERSIVE EXPERIENCES

Immersion provides an avenue for escapism, allowing us to transcend everyday boundaries and explore realms of wonder. It taps into innate curiosity and the yearning for novel experiences, broadening perspectives and enriching emotional well-being. Additionally, immersive technologies have the transformative potential to foster empathy and connection, breaking down barriers of geography, culture, and social status (Zhang 2020).

The exploration into the motivations and societal implications behind the allure of immersive technologies reveals a complex tapestry of human desires. While visual aesthetics and social media capture initial attention, there are deeper reasons driving our longing for immersive experiences.

2.1 Escapism and Curiosity

Immersive experiences act as powerful avenues for psychological escapism, providing a brief respite from the challenges of daily life. Within a world often defined by routine, the allure of entering alternate

realities captures our imagination, offering a much-needed departure from the ordinary (Jackson and Campbell).

At its core, immersion satisfies our innate curiosity by presenting boundless possibilities beyond the confines of reality. It's not merely a distraction but a deliberate exploration into uncharted territories, where individuals suspend their usual surroundings to engage with narratives that transcend conventional boundaries such as mobile devices and digital screens (Steed et al. 2020). This active engagement within immersive environments not only heightens the sense of escapism but also deepens the connection between individuals and the virtual world. Users take on the role of protagonists, shaping their own stories and interacting with environments that respond to their actions (Jackson and Campbell). The allure of escapism, coupled with curiosity, drives individuals towards immersive realms, providing an escape from the mundane and satisfying the human need for experiences that ignite the imagination.

2.2 Broadening Perspectives and Emotional Enrichment

Immersive experiences serve as vehicles for expanding perspectives and enhancing emotional well-being by offering unique encounters with diverse narratives and viewpoints. Through active participation, users cultivate empathy and understanding, contributing to the fabric of a more interconnected society (Jackson & Campbell).

In these immersive environments, emotional depth is elicited, fostering a profound engagement with the content. Users move beyond passive observation to actively engage with narratives, allowing them to feel, understand, and connect with the experiences of others. This empathetic immersion, facilitated by technological advancements, reinforces the nuances of human emotions and complex societies. It becomes a tool for building bridges between individuals, transcending geographical, cultural, and social barriers. Immersive experiences not only broaden perspectives but also enrich emotional experiences, creating empathy, understanding, and connection in a society where human interaction extends beyond physical boundaries (DeSalle 2018).

The ability to simulate experiences that bridge gaps in our communities, position these technologies as powerful tools for dismantling societal boundaries. As we delve into the motivations behind the allure of immersive technologies, it becomes evident that the psychological underpinnings go far beyond mere aesthetic appeal or the influence of social media. The desire for escapism, the quest for novel experiences, and the transformative potential for

human connection form the core motivations that drive our longing for authentic encounters (DeSalle 2018). Understanding these psychological drivers is crucial for unravelling the profound impact immersive technologies hold for individuals and society at large.

2.3 Market Forces and Consumer Appeal

Alongside the profound psychological motivations behind immersive technologies lies a notable aspect intertwined with commercialisation, marketing strategies, and profit-driven endeavours. While personal fulfilment and societal connectivity drive the adoption of immersive technologies, their integration into the commercial sphere significantly influences the landscape (Scholz & Smith). As immersive technologies become more sophisticated and accessible, a demanding market has emerged, catering to a variety of experiences designed not only to captivate audiences but also to generate revenue. It's essential to acknowledge the influential capacity of immersive experiences and commercial entities to captivate, leverage and engage consumers in unprecedented ways.

Immersive experiences have evolved into marketing phenomena, offering dynamic platforms for brand engagement. They allow companies not only to showcase products but also to immerse consumers in narratives aligned with their brand identities, fostering deeper connections and brand loyalty. Balancing commercial viability with authentic engagement presents challenges. As experiences become commodified for financial gain, there is a risk of diluting the depth and sincerity of the immersive encounter (Scholz & Smith 2016). Navigating this delicate balance is crucial to ensure that immersive technologies continue to offer authentic, enriching experiences that resonate with users on a personal level.

Innovation within the immersive technology landscape often follows profit motives, with creators aiming to produce experiences that captivate while yielding financial returns (Scholz & Smith 2016). This profit-driven approach has led to the emergence of a wide array of immersive content, each striving for consumer attention and financial success but often lacking quality and substance (Scholz & Smith 2016). The integration of immersive technologies into marketing strategies raises questions about the preservation of authenticity and meaningful engagement. While immersive experiences offer unparalleled opportunities for brand engagement, maintaining a balance between commercial interests and genuine user experiences remains paramount.

3. REDEFINING NARRATIVE AND STORYTELLING

Beyond aesthetics, immersive experiences redefine the very nature of narrative and storytelling. They empower us as active participants, blurring the line between creator and audience, and enable us to shape and be shaped by the stories we encounter (Jackson & Campbell). This engagement with narratives not only entertains but also holds the potential for personal growth and emotional resonance.

Immersive technologies introduce a paradigm shift, transforming audiences from passive spectators into integral participants within narratives. Placing the audience at the core, immersive experiences encourage exploration, interaction, and influence over the story's trajectory. This dynamic blur the lines between creator and audience, generating a shared authorship of narratives. In immersive environments, the traditional hierarchy between storyteller and audience dissolves. Creators encourage participants to collaboratively shape narratives through their choices and interactions, promoting a more intimate and collaborative connection. By relinquishing some control, creators invite participants to actively contribute to and shape the narrative. This symbiotic relationship challenges conventional storytelling norms, nurturing a closer and more cooperative bond between storytellers and their audience as they navigate the narrative together (Jackson & Campbell).

These reciprocal interactions transform storytelling into a shared journey, where the audience not only shapes the narrative but is, in turn, shaped by their own choices and actions throughout the experience. The fluidity of storytelling in immersive environments mirrors the unpredictability and richness of real-life narratives, creating a more authentic and immersive connection with the content. The transformative potential of immersive narratives extends beyond entertainment as storytelling becomes a vehicle for self-reflection, empathy, and understanding (DeSalle 2018). Individuals can navigate diverse scenarios, confront challenges, and make choices that impact the unfolding narrative. In essence, redefining storytelling within immersive experiences transcends the boundaries of traditional narration, transforming it into a participatory and transformative venture. The blurring of roles between creator and audience, and the dynamic shaping of narratives, mark a compelling evolution in the art of storytelling within the immersive realm (DeSalle 2018). This unique approach encourages audiences to not only consider choices within orchestrated experiences but also beyond them.

4. THE FUTURE OF MULTI-SENSORY EXPERIENCES AND EDUCATION

The appeal of immersive technologies goes further than visuals, embracing multisensory experiences. Integration of haptic feedback, soundscapes, and olfactory stimuli offers a richer connection to virtual and augmented realities, heightening our sense of presence and immersion (DeSalle 2018). The capacity of immersive technologies to reshape narratives extends far beyond the confines of storytelling, design, entertainment and art, branching into realms of science, communication, accessibility, and myriad other fields. Recognising and harnessing this potential is crucial for ushering in a new era where immersive experiences become indispensable tools for education and societal progress.

Immersive technologies have the potential to revolutionise scientific understanding by enabling users to step into the intricate details of complex theories or historical scientific breakthroughs. From exploring the microscopic world within a cell to witnessing the cosmos unfold in three dimensions, these experiences offer an unprecedented level of engagement, making academic concepts tangible and accessible to wider audiences (Zhang 2020). These technologies have the power to democratise access to experiences and knowledge. Whether it's virtually exploring cultural heritage sites for those unable to travel, offering immersive educational content to remote areas, or providing inclusive experiences for individuals with varying abilities, the potential for accessibility and inclusivity is vast. Immersive technologies can break down barriers, ensuring that transformative educational experiences are available to a diverse and global audience (Jackson & Campbell 2011).

In the realm of medicine, immersive technologies offer revolutionary applications, from training medical professionals in realistic simulated environments to providing therapeutic interventions for mental health. Virtual reality, for instance, can simulate medical procedures, allowing practitioners to refine their skills in a risk-free environment, while immersive experiences can offer therapeutic benefits by transporting individuals to calming and supportive virtual spaces (DeSalle 2018).

Beyond the field of medicine, immersive technologies become powerful tools for cultural preservation. They enable the recreation and documentation of historical sites, traditions, and languages, offering users the unique opportunity to virtually step into ancient civilizations, explore endangered ecosystems, or witness cultural practices on the verge of extinction. This preservation effort extends beyond conventional methods, providing an immersive and authentic

encounter with cultural heritage that transcends traditional documentation (DeSalle 2018). The possibilities within multiple sectors are endless as immersive experiences serve as a catalyst for experiential learning that transcends traditional classroom and physical boundaries.

5. DESIGNING FOR POSITIVE AND RESPONSIBLE CHANGE

As we delve deeper into immersive technologies, addressing ethical considerations and societal impacts is paramount. Responsible design, usage, and awareness of potential addictive tendencies and privacy concerns are essential to ensure immersive technologies serve as tools for growth and empowerment rather than sources of harm or exploitation (DeSalle 2018). Designers have a unique opportunity to leverage immersive technologies for positive change, promoting environmental causes and shaping perspectives while maintaining transparency, ethical considerations, and respect for individual autonomy. These spaces can be utilised for those who need it most, benefiting the disabled, minorities, and raising awareness. Designers can recreate history, events, experiences, and memories, aligning the power of technology with ethical considerations (Clarke 2022).

The spectrum between shaping and manipulating perspectives is nuanced, demanding ongoing dialogue, interdisciplinary collaboration, and a commitment to responsible design. Recent incidents, such as sexual assault regulations in the metaverse, underscore the need for critical reflection among designers (Clarke 2022).

6. CONCLUSION

Embracing the transformative power of immersive experiences, allows us to cultivate a world where technology and human connection coexist harmoniously, enriching lives and deepening our understanding of ourselves and others. Responsible design allows us to navigate the ethical complexities and harness the potential of immersive technologies for a more empathetic, informed, and inclusive society (Slater et al. 2009).

The impact of immersive technologies on storytelling transcends mere engagement—it revolutionises the very essence of narrative construction. Narratives within immersive experiences become fluid, responding to user decisions and actions. This interactive storytelling model breaks free from the constraints of a predetermined plot, allowing for a more organic and participatory narrative evolution. Immersive experiences are not confined to presenting a singular, fixed narrative; instead, they

offer a spectrum of possibilities. Users become explorers of storyworlds, making choices that branch into divergent narrative arcs (Slater et al. 2009). The convergence of technology and storytelling creates a medium that invites users to navigate narrative landscapes that are rich, diverse, and profoundly engaging.

The transformative potential of immersive technologies extends beyond the realms of storytelling, art and entertainment. They offer a multidimensional realm that can reshape scientific exploration, communication, accessibility, health, and cultural preservation (Jackson & Campbell 2011). Immersive experiences can redefine communication by allowing individuals to share spaces, even when physically separated. This form of communication has the potential to bridge geographical gaps, break down barriers to entry and foster collaboration on a global scale (Jackson & Campbell 2011). By recognising and embracing this insane potential, we pave the way for a future where immersive experiences become integral components of education, empathy-building, and societal advancement. The challenge lies in leveraging these technologies responsibly and innovatively to unlock their full potential for the benefit of humanity.

In conclusion, the exploration of the motivations and societal implications behind the allure of immersive technologies reveals a complex tapestry of human desires and aspirations. While visual aesthetics and social media may initially capture our attention, there are deeper and more profound reasons why we seek immersive experiences.

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Looking at Wilson's Paintings of the Antarctic

Lindsay W. MacDonald
University College London, UK
lindsay.macdonald@ucl.ac.uk

Elizabeth I. Watkins
University of Leeds, UK
E.I.Watkins@leeds.ac.uk

Dr Edward A. Wilson was a member of the 'Discovery' expedition to the Antarctic in 1901–04 and the 'Terra Nova' expedition 1910–13, both of which were led by Captain Robert Falcon Scott. He made a visual record of what he saw, by sketching in daylight and painting in watercolour at night in the winter base hut illuminated by the light of acetylene gas lamps. The paintings have survived, but when viewed under daylight now they may look quite different from what Wilson saw. We have measured the spectrum of the gas lighting and digitised the paintings with a hyperspectral image scanner to investigate the effects of chromatic adaptation.

Antarctic expedition, Painting, Acetylene illumination, Hyperspectral scanner, Chromatic adaptation

1. WILSON'S ANTARCTIC PAINTINGS

Scientific expeditions of the early 1900s into the hitherto unseen interior regions of Antarctica utilised established and emergent technologies to document the environment, its wildlife and meteorological phenomena. Multiple media – pencil sketches, watercolours, journals and photographic materials – were employed to record the scientific work of the expedition, to illustrate official expedition narratives. They also sought to recuperate the costs of exploration through public exhibition in art galleries and as lantern slides and cinematograph lectures (Watkins 2018).

Two Antarctic expeditions were led by Captain Robert Scott: the British National Antarctic Expedition on the 'Discovery' 1901–04 and the ill-fated British Antarctic Expedition on the 'Terra Nova' 1910–13. The explorers overwintered in different locations, the 'Discovery' on board the ship which was trapped in ice 1902–04 and Scott's second expedition at Cape Evans. In each case, an acetylene gas plant was built to produce acetylene gas by dripping water onto calcium carbide. In May 1903 Scott recorded in his diary: 'our acetylene plant is now in full swing and gives us light for twelve hours at an expenditure of about 3lbs of carbide' (Scott 1907).

Dr Edward Wilson was a member of the scientific staff on both expeditions. He was a physician, fellow of the Zoological Society, ornithologist, and artist who had illustrated several books about wildlife. He died in March 1912 on the return journey from the South Pole, along with Scott, Oates, Bowers and

Edgar Evans. His pencil sketches, watercolours and original manuscripts are kept at the Scott Polar Research Institute (SPRI), Cambridge. Wilson's pencil sketches of shifting coastlines, ice formations and geographical features contributed to the cartography of the region. As a skilled colourist, his black and white pencil sketches were annotated with notes regarding the hues of his subjects (Fig. 1). Colour could assist the identification of wildlife and geology of the region and studies of Aurora Australis, paraselena and other optical effects of light refracted by the ice. Colour offered a multifaceted yet often elusive topic for study, utterly dependent on light conditions in a region characterised by extremes of temperature and months of darkness in winter; as spectacle, moreover, colour enhanced the potential for public exhibition.

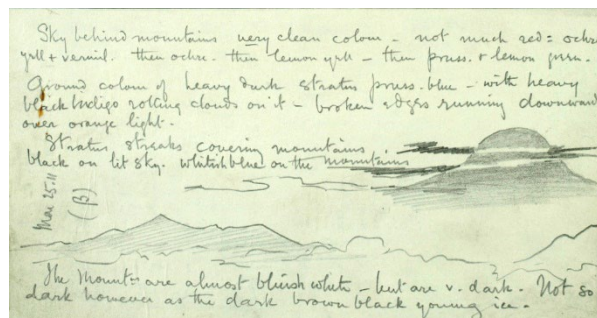


Figure 1: Pencil sketch by Wilson of mountain in clouds, with colour notes, 25 March 1911. SPRI Cat. N1802/4

Wilson's notebooks include numerous references to issues encountered in the study of colour. In sketching from direct observation he found chalks

impracticable for the accumulation of dirt, whilst watercolours froze to the page. Experiments with colour photography were lost or deemed unsuccessful, such as those of Reginald Koettlitz on the 'Discovery' expedition. Wilson developed a working process of 'colour note sketches' – black and white pencil drawings annotated with generic colour names (red, yellow) – which he would subsequently use to inform the painting of watercolours (Savours 1966).

Evening work in the Winter Base Hut necessitated the use of artificial light sources, particularly during the three months of darkness that characterise Polar winter. Wilson commented that oil lamps and candles provided insufficient illumination for substantial work, until the introduction of acetylene gas as a source of light (Fig. 2). His diary for 1903 includes the following entries:

Friday 10th April: 'Acetylene gas is being tried now, and gives an excellent light, if only the machine making it will not succumb to the cold in the lobby, as water has to be used.' (p.254)

Thursday 23rd April: 'Calm clear day, perfect weather. Colour everywhere. Went up the Harbour Hills. Erebus' smoke was lit up with a fiery orange light by the set sun. The blue on the southern and western horizon rising into lilac and rose pink was exactly what one sees in the Swiss winter. Here, now that the sun is below the horizon, one sees the shadow of the slopes of Erebus thrown against the sky in a pure blue on the south-west horizon. Afternoon drawing, evening painting by acetylene.' (p.255)

Tuesday 2nd June: 'In the afternoon one can get in about 2½ hours at the table and in the evening, from 7.30 till about 11 when the acetylene gas is turned off and only those who have candles to spare can go on working.' (pp.262-263)



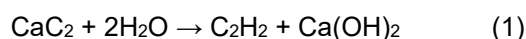
Figure 2: Herbert G. Ponting's flashlight photograph, printed from a black-and-white orthochromatic glass negative, shows E.A. Wilson painting under acetylene light in the Winter base hut at Cape Evans, 20th May 1911. The table lamp has a conical shade with white enamel on the underside. SPRI Cat: P2005/5/402

Both Captain Scott and Wilson directly linked the availability of artificial light, such as the rationing of candles, to work and morale. Sources of fuel, for heat and light, included oil lamps, candles, paraffin, acetylene gas, coal, and a wind turbine to generate electricity. Electricity was available on the 'Discovery' expedition until May 1902 when the turbine was damaged in a gale, but was more consistent throughout the 'Terra Nova' expedition. The practicalities of work in the Antarctic, including the peculiarities of acetylene gas light and innovations in electric lighting, often formed the basis of newspaper and journal articles appealing to readers in the modern metropolis.

An exhibition of Wilson's work at the New Archaeological Museum Cambridge in May 1914 included watercolours from the 'Discovery' and 'Terra Nova' expeditions. A review in *The Cambridge Independent Press* describes 'works painted for the most part in the snow hut, lit by a smoky acetylene lamp, with a number of men around doing anything from trimming the blubber lamp to mending harness'. Wilson 'would make a copy of his note sketch, filling in the colours in the places indicated. It is a method that requires a retentive memory of colour effects and an eye unaffected by a light that is eternally altering colour values.' The presence of contaminants, such as coal dust and soot, is visible in the finger prints at the edges of the lampshade in Ponting's 1911 photograph (Fig. 2), further complicating the perception of colour in Wilson's work. The pencil note sketches record scientific observations of wildlife, glaciers, paraselene, Aurora Australis and the colours of light refracted by the ice at sunrise and sunset. The watercolour paintings set scientific observations in a composition that was both cautious and constructed for exhibition and sale to recoup the costs of the expedition.

2. SPECTRUM OF ACETYLENE GAS LIGHT

What did Wilson see when painting his pictures under acetylene gas light? Both the rendering of his colour paints and the adaptation state of his vision depended on the spectral power distribution of the illumination. The method for production of calcium carbide in an electric arc furnace had been discovered in 1892 and quickly became important industrially, using great quantities of power from hydro-electric generators. Calcium carbide reacts with water to produce acetylene gas and calcium hydroxide:



Calcium carbide found widespread use in carbide lamps, burning the acetylene gas to produce light. Though subject to variations in the purity of calcium

carbide, these lamps gave steadier and brighter light than candles, and were employed in mining and caving, and extensively as headlights in early automobiles, motorcycles and bicycles, until improvements in battery technology led to their replacement by electric lamps in the 1920s.

No data on the spectral power distribution of light from an acetylene flame could be found in the literature, so it was measured empirically. A vintage Calcia Major bicycle lamp was purchased, together with a quantity of calcium carbide, and restored to working condition. After reaching stability the flame spectrum was measured with a PhotoResearch PR-650 telespectroradiometer (Fig. 3).



Figure 3: Measurement of flame spectrum with PR-650

The data gives the intensity at wavelength intervals of 4 nm over the range 380–780 nm. Three measurements were normalised at 600 nm. The plot of power vs wavelength shows a continuous distribution with a correlated colour temperature (CCT) of 2510K, as expected for the combustion of a hydrocarbon (Fig. 4). Relative to standard Illuminant A (tungsten filament lamp, CCT = 2856K), the spectrum has a little less power in the shorter wavelengths (blue to green) and more power in the longer wavelengths (red into infrared). The calculated CIE general colour rendering index R_a of the acetylene flame spectrum is 99.85, similar to that of Illuminant A.

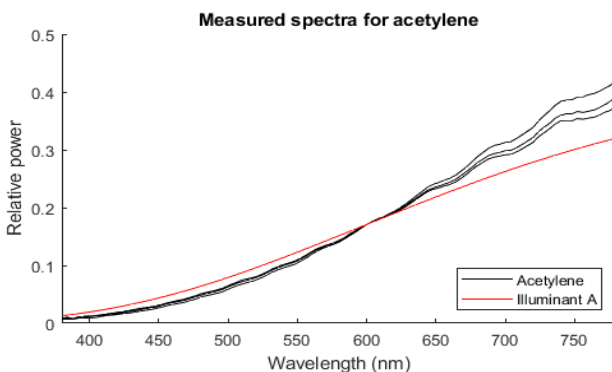


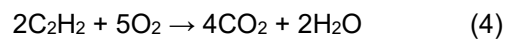
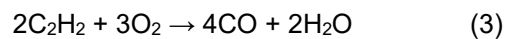
Figure 4: Measured spectral power distribution of acetylene flame vs Illuminant A

The yellowish light emitted by the flame and its associated low CCT is caused by the limited amount of atmospheric oxygen available for normal combustion in air. The predominant process is the breakup of acetylene molecules into carbon and hydrogen, with excess carbon deposited as soot:



If the temperature of the luminous zone is above 1200°C, the light emitted is due mainly to incandescent particles of carbon, and not to incandescent hydrocarbon vapours (Lewes 1894).

Suppose that more oxygen could be introduced into the combustion process? As increasing oxygen becomes available, the main reactions produce carbon monoxide or carbon dioxide and water:



Further experimental measurements were made on the flame from a cutting torch attached to an industrial oxy-acetylene rig in an engineering workshop. The PR-650 was focused on a spot at the centre of the flame (Fig. 5) and the room lights were switched off to make the measurements.



Figure 5: Measurement of an oxy-acetylene flame

Turning on the acetylene gas initially produced an unfocused yellow-orange flame and a shower of soot. As the proportion of oxygen was increased, the flame became hotter and bluer causing the emission spectrum to change shape, with greater power at shorter wavelengths. Fig. 6 shows the family of curves, normalised at 620 nm, plotted for 45 spectral measurements. The baseline curve, for acetylene burning in air without additional oxygen, is similar to that for the cycle lamp in Fig. 4, but with an even lower CCT of 1756K. As oxygen is introduced the chemical reactions of first Eq. 3 and then Eq. 4 become dominant, and the spectrum shifts toward blue, with strong line spectra for C_2 combustion at 473.7, 516.5 and 563.5 nm. The final spectrum in the

sequence has the greatest power at short wavelengths (blue to violet) with a CCT of 22844K.

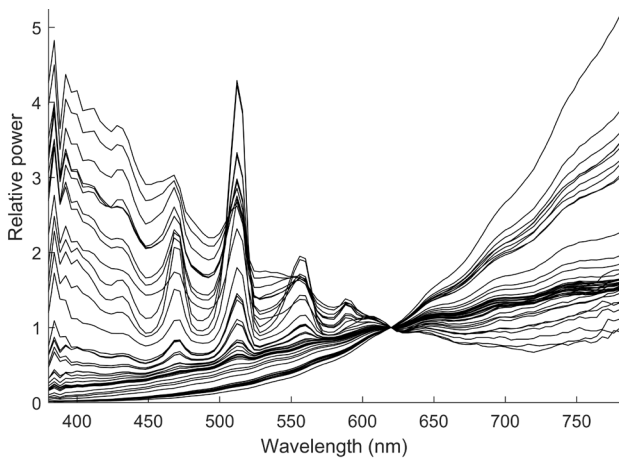


Figure 6: Relative power vs wavelength for varying proportions of oxygen and acetylene

3. HYPERSPECTRAL IMAGE PROCESSING

In order to make colorimetric calculations for the paintings under various illumination spectra, it is necessary to know the reflectance spectra of the paintings at every point. Selected paintings by Wilson were scanned at SPRI by a Headwall Hyperspec III scanner (Fig. 7). This produced an image array of 1168 vertical lines of 640 samples, in 270 spectral bands, at intervals of approximately 2.24 nm over the wavelength range 400–1000 nm.



Figure 7: Dr Francesco Beccari with the Headwall hyperspectral scanner in operation at SPRI

The image files were stored in ENVI format, each of size 769 Mbyte, with data in single-precision floating point representing the reflectance factor in the range 0-1, calibrated by reference to a spectralon white tile. The spatial resolution on the surface of the

painting was 4.5 pixels/mm, i.e. a pixel size of 0.22 mm.

Eight watercolour paintings were scanned, representing Wilson's work in both expeditions. The hyperspectral image sets were processed in Matlab. Colorimetric calculations used the CIE standard 2° observer over the range 380–780 nm, interpolated to the same wavelength intervals as the image data (vector of 170 values). Using CIE standard D65 as the illuminant, the X,Y,Z tristimulus values were calculated and converted to the sRGB colour space for display. For this paper one painting *Earth Shadows* is used as an example (Fig. 8). It is outstanding for the delicacy of colour gradations in the sky, and carefully observed coloration of foreground shadows.



Figure 8: Watercolour painting 'Earth Shadows' by E.A. Wilson, 24 April 1903 (SPRI Cat. N1288), 200x120 mm

The tristimulus values were recalculated, using instead the spectrum of the acetylene flame as the illumination source, then converted to sRGB with the D65 white reference. The resulting image has a horribly yellow cast (Fig. 9). This is what an observer fully adapted to D65 would see if viewing the painting illuminated by the acetylene lamp, for example when looking from a room illuminated by D65 through an aperture into a chamber illuminated by acetylene flame. Because there is so little power in the acetylene illumination at short wavelengths, the blues disappear completely.



Figure 9: Watercolour painting 'Earth shadows' illuminated by light from an acetylene flame

4. CHROMATIC ADAPTATION

Wilson, when painting at night in the hut, would have been completely adapted to the prevailing illumination, i.e. the light emitted by the gas lamp on his desk and other sources in the room. He noted the effects of this illumination on his perception of colour whilst painting, commenting on the uncertainty of yellows and blues (Savours 1966):

'Discovery' Expedition, 12 April 1903: 'Had a game of hockey in the afternoon, otherwise spent the day at the S.P.T. drawings. We had acetylene gas today and I find one can paint by it, though in yellows and blues one cannot tell what one is doing.'

'Terra Nova' Expedition, 27 Oct 1911: 'Packed up my sketches, I am sending home ... In looking at them you must remember they were all done by artificial light – acetylene – and so they look queer by daylight – the blues and yellows are apt to go wrong.'

Wilson's task was to render in watercolour paints the scene he had viewed and committed to memory during the Antarctic daylight, aided by his sketches and notes. At night in the Winter Base Hut, his colour vision must have been fully adapted to the spectrum and luminance level of the ambient lighting, which included candles and oil lamps in addition to acetylene lamps. He therefore had to choose his colours according to both his chromatic adaptation state and the rendering of the pigments by the acetylene light.



Figure 10: Painting illuminated by light from an acetylene flame, adapted by CIELAB

Knowing the illumination spectrum and reflectance spectrum of the painting enables the tristimulus values at every point to be calculated precisely. But Wilson's adapted colour vision can be estimated only by applying a transformation that models human chromatic adaptation. A first attempt was by means of the CIELAB formula, using the inbuilt Von Kries correction for the white point (Hunt and Pointer 2011). Thus the X, Y, Z image pixel values calculated using acetylene illumination were converted to L^*, a^*, b^* values using the acetylene white point $X_{WA}, Y_{WA}, Z_{WA} = 115.15, 100, 26.72$, and thence to sRGB using the standard D65 white reference $X_{W65}, Y_{W65}, Z_{W65} = 95.04, 100, 108.86$. The resulting image (Fig. 10), when compared with the basic D65

rendering (Fig. 8), shows an overall pink cast and greater colour saturation, particularly in the blue sky and foreground shadow patches.

The next chromatic adaptation transform applied was CAT02, the first stage of the CIECAM02 colour appearance model (Li *et al* 2017), again taking as input the tristimulus values computed from the reflectance spectra when illuminated by acetylene light. Chromatic adaptation was assumed to be complete, so the adaptation factor D was set equal to 1.0. The first (input) illumination source was acetylene and the second (output) illuminant was D65. The adapted (output) tristimulus values (X_A, Y_A, Z_A) were converted directly to sRGB with D65 white point. The resulting image (Fig. 11) has a slightly pink cast but lower contrast and colour saturation than for the CIELAB rendering.



Figure 11: Painting illuminated by light from an acetylene flame, fully adapted by CAT02

The image was then processed by the recent CAT16 chromatic adaptation transform (Li *et al* 2017), using the same parameter values as for CAT02. In addition to a change in the cone sharpening matrix \mathbf{M} , adaptation factors D_r, D_g, D_b for the three channels are calculated differently:

$$\text{CAT02} \quad D_r = \left(\frac{Y_{WA}}{Y_{WB}} \right) D \left(\frac{R_{WB}}{R_{WA}} \right) + 1 - D$$

$$\text{CAT16} \quad D_r = D \left(\frac{Y_W}{R_W} \right) + 1 - D$$

and similarly for D_g and D_b .



Figure 12: Painting illuminated by light from an acetylene flame, fully adapted by CAT16

The resulting image (Fig. 12) still has a pink cast in comparison with the reference D65 image (Fig. 8) and lower contrast that reduces the visibility of details in the distant hills. Also the blues in the sky and foreground ice sheets (lower left) are significantly reduced in colour saturation.

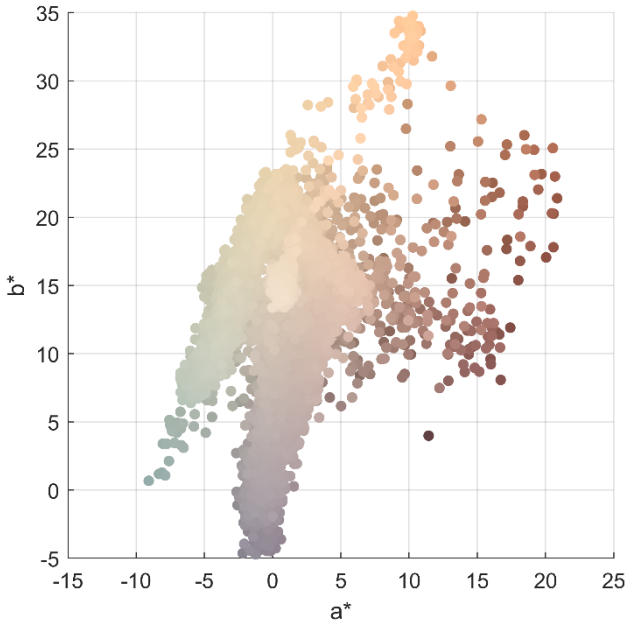


Figure 13: Distribution of 10,000 pixels in a^*-b^* plane

The distribution of colours in the D65 image (Fig. 8) is shown by scatter-plotting 10,000 randomly selected pixels within the rectangular area of the painting (i.e. excluding the mount). Fig. 13 shows that the colour gamut is rather small, with the majority of colours lying within the bounds $56 < L^* < 91$, $-7 < a^* < +8$, $-5 < b^* < +24$. The effect of the three chromatic adaptation algorithms on the mean colour of the image is compared in Table 1.

Table 1: Image mean after chromatic adaptation

	L^*	a^*	b^*	ΔE^*_{ab}
D65 (ref)	78.53	-0.05	12.32	0
CIELAB	79.39	4.28	12.18	4.42
CAT02	78.85	2.43	10.59	3.05
CAT16	79.39	2.27	10.68	2.97

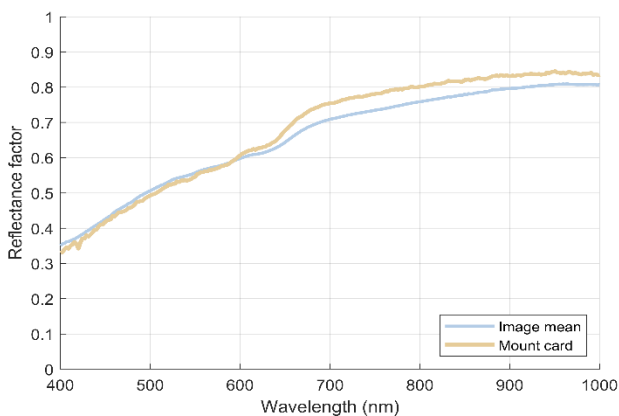


Figure 14: Reflectance spectra of image mean and mount card over all hyperspectral image bands

For comparison, the card in which the painting is mounted is not neutral but rather yellowish-beige, with CIELAB coordinates $L^*, a^*, b^* = 79.4, 1.8, 14.3$. Taking the mean over an 11×11 pixel region in the mount and plotting for all 270 hyperspectral bands shows the reflectance factor increasing steadily with wavelength (Fig. 14). In this case the reflectance spectrum of the mount is quite close to the mean image spectrum, and hence the effect of the chromatic adaptation algorithms is similar. The mount is important visually because it surrounds the picture and so contributes significantly to the observer's perception of its colour appearance.

5. DISCUSSION

This study commenced with the question: What did Wilson see when painting his pictures under acetylene gas light? There is no simple answer because it depends on two unknowns: his colour vision and the spectrum of the illumination.

First we may suppose that Wilson had normal colour vision, meaning that he was not colour deficient. But everyone is slightly different in colour sensitivity; the so-called Standard Observer is an average across the population of normal observers and is a convenience for computation and standardisation. So we may adopt either the older CIE 1931 Observer or the recent CIE 2015 Observer and use the corresponding colour matching functions for calculation, but there is no guarantee that either would apply exactly to Wilson.



Figure 15: Remains of acetylene table lamp (top right) on the biology bench in the winter base hut at Cape Evans. NZ Antarctic Heritage Trust ref AHT2018-19_LM

Second we cannot be certain about the physical construction of the acetylene desk lamps in the winter hut and the spectrum of the light they produced. We have some idea from photographs of the hut and components that survive. For example, the remains of the shade and base of the table lamp shown in Fig. 2 are still there amongst all the scientific apparatus (Fig. 15).

The lamps in the winter hut were supplied by the communal acetylene gas generator. They had no additional oxygen supply, and so they were burning with only the oxygen available in the Antarctic atmosphere at the ambient temperature within the hut. The flame depended primarily on the pressure of the gas supply and the type of burner used.

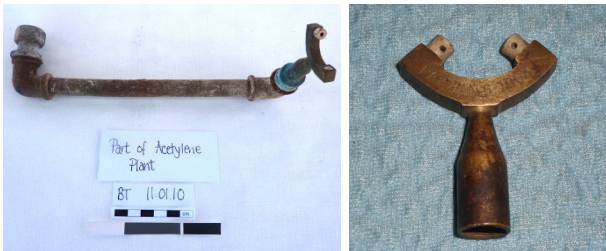


Figure 16: (left) Remains of gas pipe and acetylene burner from the winter base hut at Cape Evans, NZ Antarctic Heritage Trust ref. AHT6509.9; (right) Bray 'Luta' gas burner

Photographs of the apparatus give an indication of the burner (Fig. 16), which appears to be of the patented 'Luta' design (Bray 1903) with two arms arranged so that the flames from the inward-pointing jets coalesce to form a single brighter flame. The arms have tips made from steatite (soapstone) which has low thermal conductivity and remains unaffected by the heat of the flame.

Despite the uncertainty about the spectrum of the illumination, however, we do have Wilson's superb paintings, and the ability to inspect and measure them. Hyperspectral imaging enables us to obtain an accurate reflectance spectrum at every point of the painting, and hence provides the basis for more precise spectral computation, instead of the conventional trichromatic calculation.

What remains less certain is the nature of the visual adaptation of a human observer under a change of illumination. Wilson viewed the outdoor scenes under the Antarctic daylight conditions, then later he painted indoors under acetylene gas light. He was relying not only on his memory and notes but also on his perception of the pigment colours to match the coloration of the scene.

The provenance of the watercolour paints is similarly complicated. Although Winsor & Newton were official suppliers of artists materials to both of Scott's Antarctic expeditions, various watercolour manufacturers have been connected to the work of E.A. Wilson. The current location (March 2024) of the paint box visible in Ponting's flashlight photograph of Wilson working on a watercolour in 1911 (Fig. 2) is uncertain. Furthermore, 'the small selection of paint tubes, paint mixing dishes, paint brushes, and a box of coloured pastels', which remain at Cape Evans, are 'highly likely [...] Ross Sea Party items (1915-17).'

Following Wilson's death in 1912, his belongings were returned to his family. In 2009, the Canterbury Museum in New Zealand acquired a wooden paint box from the estate of Wilson's sister and fellow artist, Ida Elinor Wilson. The box is marked 'Ackermann & Co. Manufacturers of Superfine Water Colours to Her Majesty' in reference to Queen Victoria who died in 1901, which places its manufacture prior to departure of the 'Discovery'. However, the pans of watercolour paint are loose in the box and made by different companies, indicating a process of continual use as a working set of artist's paints. The box includes numerous blocks of yellow, red, and blue paint, which use a variety of recipes and pigments from different geographical locations:

- Three pans of yellow paint, including: Chenel Paris, R. Ackermann 'Indian yellow'; Newton 'Chrome yellow' and numerous pans of 'Raw sienna' by R. Ackermann and Reeves & Sons.
- Two types of blue: R. Ackermann 'Antwerp blue' and 'Indigo'.
- Nine variations of red paint: Winsor & Newton 'Venetian red', 'Indian red' and 'Rose madder'; Sherborn & Tillyer 'Crimson lake'; R. Ackermann 'Crimson lake', 'Saturn red', 'Vermillion' and 'Light red'; Reeves & Woodyer 'Red chalk'.

The watercolour paintings, completed by Wilson on board the 'Discovery' 1901–03 and at Cape Evans 1910–12, were influenced by both a global trade in pigments and the connection noted by Scott between labour, light and morale. Viewed under the light of the acetylene gas lamp, with the colours filtered through layers of coal dust and soot, Wilson's paintings carry the traces of industrial processes and empire, which can also be noted in the colour names of the paints used to negotiate the 'seemingly endless white dullness' of the Arctic coastlines that were considered problematic to the public presentation of expedition photography (Iversen 2018). Wilson had planned to exhibit his watercolours alongside Ponting's black-and-white photographs as a way of conveying the hues of refraction by ice to a viewing public on his return to Britain (Wilson 1911).

Wilson was working in multiple media through profoundly harsh conditions and he left a vivid visual record documenting the polar environment. How might we address the complexity of materials and environmental conditions that he encountered in Antarctica in the early 1900s? If he had been using combinations of similar-coloured pigments from different manufacturers, or even different batches from the same manufacturer, there might have been differences in their absorption spectra. This could have resulted in metamerism, i.e. the phenomenon whereby an observer may see two pigments as appearing the same under one source of light but different under another with a different spectrum. For

example, working under the acetylene lamp Wilson might have seen 'Madder rose' and 'Madder lake' as being identical, but when the paintings are later viewed under daylight the two pigments may look different. A recent study of madder entries of the company's book P1 in the Winsor & Newton 19th Century Archive found systematic differences in pigment colour, depending on the extraction process (Fig. 17). The successful preparation of a historically accurate rose madder pigment was analytically validated against a 19th-century oil paint tube of W&N Rose Madder (Veiga *et al* 2023).

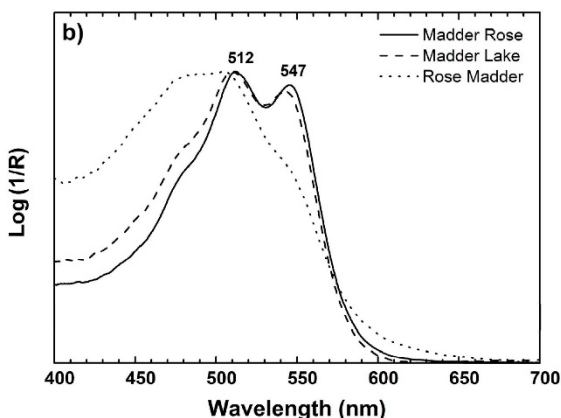


Figure 17: Measured absorbance spectra for three W&N madder pigments (from Veiga *et al* 2023)

Chromatic adaptation transforms (CATs) attempt to model the effect of a change in tristimulus values from a scene viewed under a source illuminant to those under a destination illuminant. But despite more than a century of investigation, chromatic adaptation remains an unsolved research problem. In this study three common transforms were tested and produced somewhat different results. Who can say which might be nearest to what Wilson saw? The most recent model, CAT16, does reduce the distinction between blues and yellows (Fig. 12), albeit with the underlying complexity of a variety of pigments, perhaps explaining Wilson's comment that "the blues and yellows are apt to go wrong".

Finally it is worth noting that, for a professional artist, the colour memory of actual live scenes might compensate for chromatic bias due to lighting systems. Colour is a psychological affect, as shown by many chromatic optical illusions, and the colour perception of experienced professionals may be well away from average responses of the Standard Observer. Because the artist had a fixed supply of paint with known characteristics, it is quite possible that when viewing the live scene the colours of the landscapes (or snowscapes?) were remembered as pigment shades, and that memory was later applied to guide the painting process. This is a topic for further research.

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Hyperhumanism in the Age of Generative AI: The impact on human creativity and identity

Carl Hayden Smith
School of Arts and Creative Industries
University of East London
University Way, London, UK
csmith7@uel.ac.uk

Filip Lundström
Dark Renaissance Productions
Beväringsgatan
Gothenburg, Sweden
filip.lundstrm@gmail.com

Recent developments in generative artificial intelligence have made it once again important to investigate our relationship to emerging and disruptive technologies. A core question being asked is what it now means to be a human being, when we are no longer the sole creators. What is the role of the human when the creative act is being outsourced and externalised to our machines? Hyperhumanism offers an alternative path when conceiving our relationships with these powerful tools, by defining concepts that help us to rethink human-technology interaction. This is a follow-up paper to Techno-Hyperhumanism (Smith and Castaneda 2020) addressing the future work suggested, namely hyperhumanism's impact on human identity, comparing transhumanist and hyperhuman approaches and relationships to modern and future technologies, as well as developing the ethics of human improvement through a hyperhuman lens. Our main conclusion is that new technologies can give us new creative roles instead of eliminating them. Hyperhumanism is enabled through ontological design where we focus on context rather than content creation. We believe it is important to continue this work and develop hyperhumanism further due to the nature of our technological moment.

Hyperhumanism. Ontological design. Ethics. Imagination.

1. INTRODUCTION

Since the "Techno-hyperhumanism" paper (Smith & Castaneda 2020) huge advances have been made in machine learning which is widely referred to as AI, especially generative AI with tools such as ChatGPT, Midjourney and Dall-E. This has already affected the creative industries, with 70% of jobs lost in some instances (Zhang 2023) and this trajectory will most likely continue. This is not only affecting economies, but we argue it is affecting human identity as well.

Human beings have seen themselves as sole creators with the capacity of both depicting and shaping the world according to their will, but what happens when machines themselves begin to take on this creator role? A transhuman response would be to encourage the outsourcing of this capacity to the machines, sit back and enjoy the endless stream of AI generated content, especially if the machines can eventually become better creators than humans. The question is what will happen to us as human beings if we adopt and encourage this perspective? Here, we believe hyperhumanism can offer a cognitive reframing of the relationship

between man and machine and the creative act in the meeting with generative AI.

We regard the transhumanist narrative of human augmentation as a negation of the human condition and will demonstrate how this affects our thinking and, in turn, our (well)being with machines. We will then offer a hyperhuman approach and framework that is an affirmation of the human condition by outlining the central concepts of hyperhumanism that can help us to cultivate creative and ethical human-technology relationships.

2. GENERATIVE AI

The Artificial Intelligence field is a vast and branching field of research that has undergone a lot of development in recent years with several breakthroughs, the latest (and the one which is of main interest for this paper) is generative AI. Generative AI is a subfield within the field of deep learning and refers to systems that can generate content based on training data and not only classify data (Feuerriegel et al. 2024). Tools such as ChatGPT, Midjourney and Dall-E had their breakthrough in the last two years and generative AI

was chosen as one of the top ten emerging technologies likely to transform society by the world economic forum (Fink and Weissenberg 2023). fixed. Therefore, we endeavour capturing the large structure digitally with its charm of slow decay and transferring it through an artistic interpretation into an immersive experience.



Figure 1: The Hyperhuman according to GenAI

3. TECHNOLOGY: DREAMS AND REALITIES

We need to understand that our stories have a tendency to become our realities. The transhuman versus hyperhuman dialectic is therefore designed to fuel design thinking regarding the development and implementation of future technology. The importance of the discourse lies precisely in how we dream about human-technology interaction, consciously and unconsciously, for it is how we dream that will determine how we face our realities. The hyperhuman narrative is therefore a cognitive reframing of the human being and, more importantly, it's becoming in relation to future technology.

A transhumanist vision of the future of dreaming can be encapsulated by a device called HALO (Prophetic AI 2024). HALO is built by 'Prophetic AI' which is a non-invasive (tFUS) neurotech company. HALO is a device designed to induce and stabilise lucid dreams. It is rare to have a lucid dream. There is a technique, which is hard to learn, but you can learn it. This is the hyperhuman approach to do the work, to learn the technique. The transhuman approach, once you use this device and maybe it is successful, maybe it will allow you to lucid dream, but then there is a chance that you will never have a lucid dream without the device, dependency becomes the problem. And what happens if

everyone's lucid dreaming? What happens if this is the last place of agency we have, where we are now forced to work in our dreams, precisely because dreams now a stable place to interact in? A new economy will arise, especially, as the technology that will enable us to record our dreams is also being developed in parallel.

4. HOW TRANSHUMAN IDEAS AFFECT THE WAY WE THINK ABOUT TECHNOLOGIES

We understand transhumanism to be a negation of the human condition, a perspective in which limitations of human nature (body and mind) are viewed as bugs rather than features, such as death, ageing, and disease, and that therefore the process of transcendence to transhumanism is a debugging of the human condition (Bostrom 2003).

Transhumanists are right, however, that "human nature" is not a fixed condition but is, like most complex systems in nature, adaptive. What makes human beings special in this case is the degree to which the human condition is shaped by our use of technology. However, humans are not the most resilient and adaptive beings on earth. The tardigrade has survived five mass extinctions whilst humans are currently causing the sixth (Banerji 2020).

Transhumanism operates under a technocentric or "technology first" principle and is correct that our technology shapes our thinking and being. An insight which Marshall McLuhan built into his philosophy and explored in his ground-breaking work "Media the extensions of man" (McLuhan 1964) describes human augmentation as auto-amputation, "every augmentation is an auto-amputation" (McLuhan 1964). Technology shapes our thinking and our thinking about technology shapes the development and implementation of technology, making this a potentially vicious feedback loop for human beings if the dominating narratives about future technology are about human replacement, where human features become bugs to be removed.

There are several popular narratives that stem from Transhumanist discourse; they are examples of "technology first" narratives as they use existing or emerging technology as a metaphor or sometimes direct explanation of how the nature of the universe actually is. These narratives often have a pseudoscientific character, they seem to be the result of hard science but are widely speculative and lack grounding in existing or sometimes even probable emerging realities. The clearest example is "The simulation hypothesis" (Bostrom 2003) meaning that the entire universe is a computer simulation we are living in. Although the argument is a probability argument and not a mechanistic one it

is a narrative that has had major influence in contemporary philosophy and tech-culture. Another narrative that also utilises the computer as a metaphor is consciousness uploading, the idea that consciousness is a form of code that could be copied and stored on a hard drive or uploaded into the cloud so we could live forever. The hard problem of consciousness is that we still don't know what it is, and therefore the idea that it can be stored in a computer is (from all available neuroscience sources) far-fetched. This post biological narrative has led some thinkers down dangerous paths such as Cerullo (2015) who reaches the conclusion that if consciousness can be uploaded that would be the superior mode of being and it is therefore an ethical act to upload your consciousness and dispose of the physical body.

David Pearce's (Pearce 2019) philosophical project paradise engineering, sometimes known as 'The Hedonistic Imperative', argues that suffering could be eliminated in all sentient life, using biotechnology. This is based on the principles that it is now possible (using technology) to engineer gradients of bliss and that it is desirable to eliminate all pain, suffering and malaise. Pearce says genetic engineering, nanotechnology and neuropharmacology will open the door to redesigning the biological substrates of consciousness. With such enhancements, we could do away with the physical and emotional forms of suffering, replacing them with genetically pre-programmed hedonia, or states of well-being more intense than most people experience today. What are the implications of this hypothesis for personal autonomy? Happiness and wellbeing can have many meanings, as clearly attested by the diversity in human life.

Along these lines transhumanist principles are now being applied to drug development. DMTx or DMT extended is a new technology being developed at Imperial College London and around the world that aims to prolong the peak of the DMT state, from hours to months and potentially indefinitely. Andrew Gallimore states that...

"You will learn how your brain constructs your subjective world and how psychedelic drugs alter the structure of this world; how DMT switches the reality channel by allowing the brain to access information from normally hidden orthogonal dimensions of reality. And, finally, you will learn how DMT provides the secret to exiting our Universe permanently — to complete the cosmic game to become interdimensional citizens of hyperspace." (Gallimore 2019).

The key question with this proposed technologising of DMT is that are we not here to have a human experience? This intervention presents another form of the transhuman 'ready player one' scenario where we sidetrack the 'jackpot win' of being human for the

short period of time that we have the privilege to be here.

5. HYPERHUMANISM

Hyperhumanism (HH) represents an affirmation of the human condition and of our central importance in the current technological moment. The human being is not something that we want to move beyond and be "on the other side of" (transhumanism) or something that we no longer are (post), but as stated earlier, the first tenet of HH is that we are not human yet, making the human being "pre-human." HH requires a shift from thinking about human beings as an essence to a process; a human being is therefore defined as a being participating in the process of becoming human. Hyperhumanism is the insight that a human birth is a jackpot win, "the best of all possible worlds" and that one who is lucky enough to be born a human should not miss the opportunity to be human; one should seek to thrive in their human body for the short time it is still here. We will now explore the definition of Hyperhumanism through some key concepts:

5.1 The "hyper" prefix in hyperhumanism

Before outlining the characteristics of hyperhumanism as a response to transhumanism in the GenAI question, an explanation of the choice of the "hyper" prefix is required. There are several prefixes indicating a state of being "beyond", "over", or "after" a certain concept, such as "post", "meta", "trans" and "hyper". While these prefixes have distinct meanings, the way they are used to delineate a certain realm of discourse is often arbitrary and can lead to more confusion than clarity. Humanism has been combined with all the said prefixes; "posthumanism" and "transhumanism" are established and well-known terms in the field; and "meta-humanism" is also of some significance as well (del Val 2010).

This leads to the question of why we have chosen the prefix "hyper" and what we aim to say with it. Hyper can mean two distinct but different things, the first being beyond or above, meaning hyperhumanism is beyond a "human-centric" view of life and acknowledges multiple kingdoms and intelligences that are not human but remain valuable, such as the fungi kingdom but also potentially the emerging machine intelligences. The first premise of hyperhumanism is that 'human beings may not be fully human yet', meaning we are still very much in our infancy as humans, in a constant state of becoming. Hyperhumanism is also "hyper" as the hyperhuman strives to be fully human and live a life where the intensity of living a transitory human life is celebrated, sought after and thoroughly explored. In contrast to transhumanism, the hyperhuman does not seek to get rid of the

limitations of the physical body but enjoys them and thrives within those constraints.

5.2 Dividual identity

A foundational assumption of hyperhumanism is that humans are not coherent individual beings with solid identities but dividuals in a process of becoming, participating in several networks and flows simultaneously, and having no clear-cut boundaries but using membranes to filter the flows and utilising multiple identities. This is true of both the physical body and consciousness itself (Saey 2016).

5.3 Double consciousness

Double consciousness (DC) (Smith 2020) is another key concept for hyperhumanism. Double consciousness is the state of being that gives access, at one and the same time, to two distinctly different fields of experience. The basis of DC is that perception is something that we are actively involved in, reality itself is under construction and we are (to a certain extent) agents in constructing our own reality. The key question therefore is, if we know our reality primarily through our first-hand experience then how should we understand the production of that experience?

The objective is that through understanding the mechanisms of DC we may be able to explore the production of exactly that, our own experience. As a result, DC also relates to the field of Ontological Design, which is a method of context engineering the human experience itself. Double Consciousness (DC) is a framework that is being stress tested through a number of emerging application areas. Can adopting these forms of DC help us to see ourselves from other perspectives and how can a literacy of pluralism help us to become more hyperhuman?

5.4 Interbeing

The interbeing (Hanh 2020) is a crucial bridge towards hyperhumanism. Interbeing enriches interconnectedness, compassion, and mindfulness. It encourages us to extend our awareness beyond ourselves in order to foster a greater sense of responsibility and engagement with the world and all living beings. Interbeing also refers to the ability of thriving in the liminal state, the 'liminality of being human' but also utilises the liminal states such as the hypnagogic and hypnopompic for creative insight (Dumpeert 2019). Exploring the notion of 'sleeping on it' to ensure the dreaming state can do its work.

5.5 Umwelt hacking

Umwelt Hacking is the active questioning of whether we can sense like a forest, a mycelium network, or

an octopus (Smith and Wakely 2022). Each of these is their own 'kingdom', so how do we build sensory bridges between these kingdoms? This emphasises and affirms the liminality of the human condition, the ability humans have to shift states of mind. The hyperhuman seeks to master this ability and use it as a source of knowledge and wisdom.

5.6 Learning and the creative act

Another central tenet of hyperhumanism is to learn and be devoted to lifelong learning and realise that this learning is dependent on the long-term mediation of knowledge and integrating experience, which means working through information thoroughly and avoiding shortcuts (outsourcing) and copy-and-paste reasoning. This has implications for the creative act as well, where "long-term mediation" is translated to the more poetic concept "the creative struggle," meaning that the creative act cannot be replaced with quick prompts but is dependent on the careful consideration and attentiveness of the artist. This is closely linked to the hyperhuman approach to aim for altered traits rather than altered states. This means that instead of trying to attain a new mental state through shortcuts and bypassing, the way to go is to work through an experience and grow from it. As stated by songwriter Nick Cave in 2023 in response to the popularity of ChatGPT:

"Songs arise out of suffering, by which I mean they are predicated upon the complex, internal human struggle of creation, and, well, as far as I know, algorithms don't feel. Data doesn't suffer. ChatGPT has no inner being; it has been nowhere; it has endured nothing; it has not had the audacity to reach beyond its limitations; and hence, it doesn't have the capacity for a shared transcendent experience, as it has no limitations from which to transcend. ChatGPT's melancholy role is that it is destined to imitate and can never have an authentic human experience, no matter how devalued and inconsequential the human experience may in time become. ChatGPT is fast-tracking the commodification of the human spirit by mechanising the imagination. It renders our participation in the act of creation as valueless and unnecessary." (Cave 2023)

5.7 context over content

Participation rather than Consumption: Contextology (Smith 2016) is the study of context, or the science of 'Context Engineering' (CE). CE focuses less on engineering content and instead attempts to manipulate and create context directly. This is achieved when we are enabled (via CE tools) to reconfigure our own perception and cognitive abilities directly. We can now adopt radically different visual or auditory systems or spend time out of body (through body swapping or gender swapping) to achieve novel cognitive and creative insights. CE gives us new abilities, control over our

senses, and the corresponding ability to develop new forms of perception, providing us with a new type of self and societal exploration.

6. CONTENT SATURATION AND MODEL COLLAPSE

Content saturation is one of the dangers of generative AI and relates to the speed that these systems generate content, not necessarily the quality. As these systems have lowered the bar of entry for creating poetry or digital paintings more people can create and upload content using the same models giving similar results. The result of this process is an internet saturated with mediocre content without a personal human touch. This could lead to a drying up of content platforms and loss of engagement, in other words a more boring internet for us humans. It has been suggested this could be harmful for the machines as well since these systems are trained on data scraped from the internet and the model is only as good as the data it has been trained on. This could lead to “model collapse”, when a model starts to perform worse with every iteration as it is trained on lower quality data (Shumailov 2023). This is a positive news story for the central importance of human interaction and creativity since it seems to be needed to keep the machines sane.

7. CONCLUSION

Hyperhumanism enables the resistance that we need to hold on to our humanity and become detectives in our own life worlds. Hyperhumanism is about discovering what it means to be human. We believe the creative act is a central characteristic of becoming human; a characteristic that we cannot afford to fully outsource to generative AI systems, even if it proves itself a worthy artist. We should not replace our human imagination with computer animation. However these technologies have a place when they instead act as a scaffold, assisting us to go further into our zone of proximal development where the ‘zone’ focuses on the relation between content (instruction) and the context (personal development) (Chaiklin 2003).

We need to rethink our relationship to these emerging technologies and know that we as humans possess something the machine does not, a will to transcendence with its inherent struggles that gives us a unique perspective, presence and participation. We can become context engineers and space holders for machine generated content and in that way we become participating co-creators with the machines. Or as said beautifully by songwriter Nick Cave:

“This is what we humble humans can offer, that AI can only mimic the transcendent journey of the artist that forever grapples with his or her own shortcomings. This is where human genius resides, deeply embedded within, yet reaching beyond, those limitations.” (Cave 2023)

8 FUTURE WORK

8.1 Developing literacies

A major part of the hyperhuman project in the coming years that will influence our relationships with technology is the mapping of the human experience with the development of several novel literacies. Literacy in the hyperhuman sense is a domain of knowledge that is not confined to propositional knowledge (facts, concepts, and arguments) but also involves developing skills (altered traits) and integrating lived experience to grapple with a certain human domain such as embodiment, sex, mimetics, and death. One of the most important literacies to develop today for our society is a “digital literacy”, meaning knowledge about the digital sphere, how it affects us, how we should use it and how it affects our experience. This paper has laid the philosophical groundwork for such a work. What is missing now is a clear mapping of practices that can successfully deal with these issues.

8.2 Mapping technologies - transhuman or hyperhuman

Connected to the task of developing digital literacy is the task of mapping and analysing existing and emerging technologies and evaluating their hyperhuman potential. We believe that the hyperhuman potential of a technology lies firmly in the use and application of a certain technology, not in the technology as such. For example, Virtual Reality (VR) and Augmented Reality (AR) could be seen both as hyperhuman or transhumanist technologies depending on how they are used. VR can be used in exposure therapy to treat phobias and anxiety disorders; it can also be used to immerse a user in pleasurable fictional worlds that connect the user to their body and their surroundings. A clear case of using the same technology for altered traits (hyperhumanism) or altered states (transhumanism).

8.3 The Hyperhuman Institute

The Hyperhuman Institute was formed in 2024 by Carl Hayden Smith as a container for Hyperhuman research and experimentation to develop Hyperhumanism further and facilitate physical and hybrid events in the future. The Institute’s guiding mantra is: *we cannot predict the future, but we can invent it.*

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A Sign in Space: Global collaboration as cosmic theatre

Daniela de Paulis
Artist in Residence
SETI Institute 339 N Bernardo Ave Suite 200, Mountain View, CA 94043
USA
selavyrose@gmail.com

On May 24, 2023, a simulated extraterrestrial message was transmitted towards Earth by the Trace Gas Orbiter, a spacecraft of the European Space Agency orbiting Mars. The radio signal was received by the Green Bank Telescope and the Allen Telescope Array in the USA and by the Medicina Radio Antenna in Italy. The event was part of the interdisciplinary project A Sign in Space and was streamed live by the SETI Institute, with thousands of people watching in real time. A Sign in Space is a visionary art project involving the worldwide search for extraterrestrial intelligence (SETI), professionals from different fields and the broader public in the reception, decoding and interpretation of the message. The project is a combination of theatre, live performance art, electronic literature, ARG (Alternate Reality Game), science, including radio astronomy and SETI. It also crosses disciplines such as space studies, anthropology, philosophy, semiotics, computer science, poetry and several others. After one week following the reception of the signal, several participants on Discord managed to extract the message from the raw data of the radio signal received by the various observatories. The message extracted has been represented by the Discord community as an enigmatic image with a black background dotted by groups of white pixels. Since then, the community has continued further decoding the message, experimenting with hundreds of possible interpretations, however until now there has been no conclusive interpretation of the message. The project aims at questioning human communication through one of the possibly most radical scenarios, in which humankind attempts to create meanings around a message crafted by an extraterrestrial intelligence.

Search for extraterrestrial intelligence. Radio astronomy. Live performance art.

1. INTRODUCTION

On 24 May 2023 a simulated extraterrestrial radio signal was transmitted towards Earth by the Trace Gas Orbiter (TGO), a spacecraft of the European Space Agency (ESA) orbiting Mars. The signal was received by the Green Bank Telescope (GBT), the Allen Telescope Array (ATA) and by the Medicina Radio Antenna. The event was part of the interdisciplinary project “A Sign in Space” and was streamed live by the Search for Extraterrestrial Intelligence (SETI) Institute, with thousands of people watching in real time.

2. DESCRIPTION OF THE PROJECT

I started “A Sign in Space” in late 2018 and developed the project in collaboration with researchers at the Green Bank Observatory (GBO), the Italian National Institute for Astrophysics (INAF),

the SETI Institute, and the European Space Agency over a period of four years. I also gathered a team of specialists from various fields and cultural backgrounds for feedback and guidance in accomplishing the full cultural and scientific potential of the project.

The title of the project is borrowed from a short novel by Italian writer Italo Calvino, published in his book “Cosmicomics”. In the novel, the very first living being in the entire universe, decides to draw a sign in the vastness of the cosmos as a way of affirming its own existence. After many rotations of the galaxies and after many million years, the mysterious being finds out that more life forms started drawing signs in the universe. In the novel, Calvino seems to hint at the search for extraterrestrial life through whimsy and surrealism.

“A Sign in Space” is a visionary art work involving professionals from different fields and the broader

public in the reception, decoding and interpretation of a simulated extraterrestrial message designed for the project.

“A Sign in Space” simulates one of the possible scenarios following the reception of a confirmed signal from an extraterrestrial civilization. In the scenario envisioned and implemented in the project, scientists release the data of the signal in the public domain so that people with different skills and expertise can attempt to decode and interpret the message contained within it. The project aims at questioning human communication through one of the possibly most radical events, in which humankind attempts to create meanings around a message crafted by an extraterrestrial intelligence.

“A Sign in Space” is a combination of theatre, live performance art, electronic literature, Alternate Reality Game (ARG), space sciences, radio astronomy and SETI. It crosses disciplines such as anthropology, philosophy, semiotics, computer science.”

“A Sign in Space” extends the space of the performance stage to the Martian orbit, by using an ESA spacecraft as celestial source for transmitting a radio signal towards Earth. The signal transmitted by the spacecraft as part of the project on 24 May 2023, was received by six radio telescopes: the Green Bank Telescope and the Allen Telescope Array in the United States, the Medicina Radio Antenna in Italy, as well as three other radio telescopes that received the signal by their own initiative: the Raega Radio Telescope in Yebes, Spain, the Raega Radio Telescope in the Santa Maria Island in the Azores and the Bochum Radio Antenna in Germany. This was an unprecedented event in both the live performance art and the science outreach fields. The data of the signal received by the radio telescopes collaborating in the project were released in the public domain shortly after the live event, simulating a desirable first contact scenario between humans and an extraterrestrial intelligence. This event is innovative as it presented to the global public a first contact scenario very different from that portrayed by mainstream media: the scenario presented in “A Sign in Space” identifies citizen scientists, artists and people from all walks of life as key contributors in the decoding of a signal from an extraterrestrial intelligence. “A Sign in Space” aims to provide SETI scientists with a more concrete scenario to test their hypothesis in decoding an extraterrestrial signal received from space. SETI researchers might find resourceful material in the knowledge produced by citizen scientists experimenting with both existing and innovative decoding methodologies and data analysis procedures.

3. COLLABORATIVE STRUCTURE

The team collaborating in “A Sign in Space” started gathering around my project proposal in 2019, when I brought together scientists and science outreach specialists at INAF and at the Italian satellite company D-Orbit. On 30 July 2021, D-Orbit transmitted towards Earth the iconic Arecibo message – conceived by a team of scientists led by American astronomer Frank Drake in 1974 – using one of their satellites orbiting at 500 Kilometre. The message was successfully received by the Sardinia Radio Observatory and the Medicina Radio Antenna in Italy. Following this first successful test, the collaboration extended to scientists and outreach specialists at ESA, to scientists and outreach specialists at the SETI Institute, at the SETI Artist in Residency programme and at the Green Bank Observatory. These specialists are the core team of the project. For “A Sign in Space”, I formed and led several working groups. One group brought together radio astronomers at INAF, GBO, ATA and the SETI Institute with space scientists and engineers at ESA. This group tackled the challenges of calibrating the radio transmission from the TGO, while orbiting Mars, with the individual reception capabilities of the three radio telescopes. The group worked together for more than a year, conducting three tests before the live event in May 2023. A second group gathered science communication specialists to help define the public outreach programme, through a process that lasted one year. At the same time, I led an international and interdisciplinary group, composed of artists and academics, who met once a month for more than two years, brainstorming ideas around the message composition. Topics raised during the meetings questioned human culture, the concept of intelligence, anthropocentrism, ethical concerns related to the project, and current research topics in SETI and astrobiology. The meetings greatly helped identify the possible concepts to be included in the final simulated extraterrestrial message. The message was finalised with the crucial support of Italian computer scientist Giacomo Miceli and Dutch astronomer Roy Smits. The live event on 24 May 2023 was the official launch of the project. The event was presented by the SETI Institute in collaboration with ESA, INAF and GBO. The event featured some of the researchers collaborating in the project, including the specialists who worked in the message composition process. During the live event, scientists and other collaborators presented their role and experience of the project, providing technical, scientific, cultural and artistic insights into the work and collaboration. The live event successfully conveyed that the project was the result of a global collaboration, with many experts involved. The event was streamed and recorded by the SETI Institute and has been watched by more than 87,000 people from around the world since 24 May 2023. After the live event, the raw data of the

signal received at the three radio telescopes was published in the public domain. Shortly after, an international group of citizen scientists gathered to work on the decoding process on Discord. At this stage, the public became the crucial collaborator in the project. After only one week following the reception of the signal, a group of citizen scientists on Discord managed to extract the message from the raw data of the signal received by the three radio telescopes. This was a ground breaking achievement by the citizen scientist community who accomplished this feat by collaborating with each other. The data of the message extracted from the radio signal was visualised by the citizen scientists on Discord as an image composed by a black background and white dots. This image, named by the Discord community "The Star Map", has been the object of hundreds of interpretations by many people who are trying to further decode the data and give them scientific and cultural meanings.

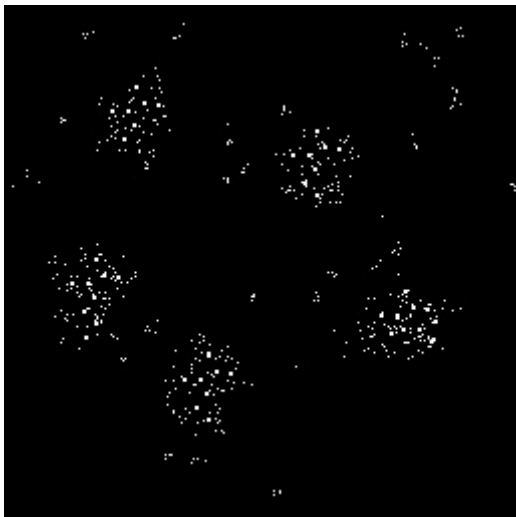


Figure 1: The message extracted from the raw data of the signal has been visualised as a black and white image, named by the Discord community "The Star Map"

In connection with the project, I organised a series of interdisciplinary workshops, hosted by the SETI Institute. Since the launch event in May, the workshops have been running on a monthly basis, and are led by specialists in philosophy, art, literature, astronomy, poetry, art. The workshops have been actively engaging the international public in the open discussion of scientific and philosophical topics around the field of SETI. The workshops are participatory as the audience can directly ask questions and interact with the specialists. These global events have been covering SETI research from the perspective of Aboriginal Australians, of Amazonian communities, of members of the Electronic Literature community, of international poets, of Muslim cultures, of religious communities, of the blind and visually impaired, of Chinese artists and scientists.

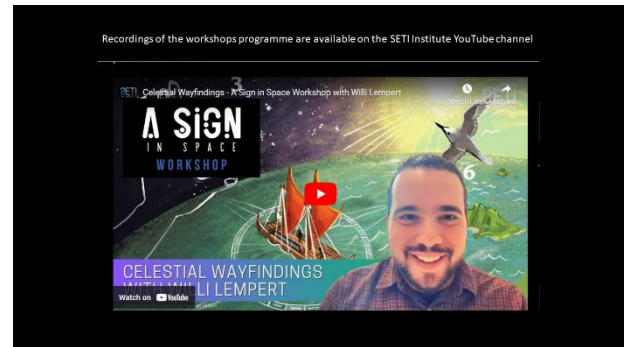


Figure 1: The workshops series of the project has been presenting diverse perspectives on SETI throughout the world. Image credits: SETI Institute.

The collaborative structure of the project is flexible and open ended, as new people start gravitating around the decoding process, and as the media keep reporting on its progress. It is expected that the collaborative structure will further expand thanks to the involvement of additional researchers and members of the public in the near future, generating new initiatives, either in collaboration with me and the project's core team or independently. In the near future some members of the Discord community, scientists and artists might further develop some of the leads birthed as part of the project through their own initiatives.

"A Sign in Space" has been reaching a broad public since its early stages. The project, designed as a work of global theatre, has created an imaginary event to be experienced both subjectively and collectively by people from various cultures and geographical locations. In "A Sign in Space", people active in the decoding process are members of a micro-society, engaged in the process of meaning making. Citizen scientists in the project are participating primarily as human actors, regardless of their technical, scientific or cultural knowledge. This approach allows participants to find their own voice within the project, with each voice being equally interesting and important. The decoding process has been fostering a collaborative approach, over a competitive one. Thanks to the process, several citizen scientists have been discovering their specific area of interest within SETI research, proposing new approaches to SETI, with the possibility of furthering and broadening the field in the near future. Collaborations have been emerging within the citizen scientists themselves to start new SETI related initiatives. The decoding process has been evolving through critical thinking, promoting in depth reasoning and peer feedback. In "A Sign in Space" citizen scientists are equally motivated by the possibility of a successful outcome and by the decoding process itself.

4. COMMUNITY ENGAGEMENT & GLOBAL REACH

"A Sign in Space" for the first time in the history of SETI research staged a concrete "first-contact scenario", simulating the societal, scientific and cultural impact of the first detection of a signal from an extraterrestrial intelligence.

"A Sign in Space" stages a socially innovative event, for which citizen scientists are asked to decode a potential extraterrestrial message, harvesting collective intelligence and skills. In the project, citizen scientists are given full freedom of scientific, cultural, artistic exploration, with the possibility of working independently or in groups. The project presents a socially innovative scenario, in which citizen scientists from around the world become the primary investigators of a scientific and cultural quest. This approach allows for the participants to become highly engaged with the process. Also, the ongoing challenges of the decoding process have been promoting community building. It is expected that the decoding process will continue to engage students, artists, scientists, other specialists and the general public. The community engagement promoted by the decoding process, with citizen scientists from various countries collaborating with fellow decoders from around the world, has been enhancing a vision of global cooperation, while advocating for a socially transformative use of science and digital technologies.

The engagement of citizen scientists is fostered through regular community meetings with people active in the decoding process on Discord, and through plans for international exhibitions showcasing the work of active decoders. Citizen scientists are also being involved in the making of the book that will cover some of the interpretations of the simulated extraterrestrial message presented by the global community.

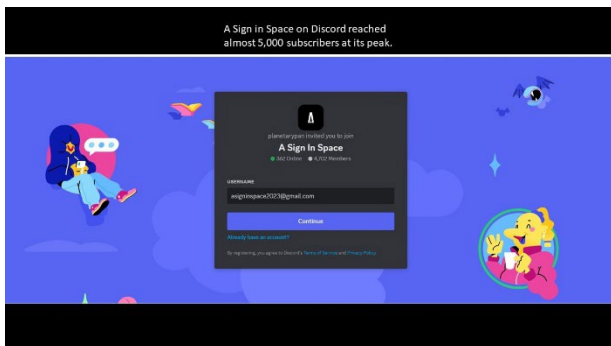


Figure 1: "A Sign in Space" Discord channel. Image credits: Discord.

"A Sign in Space" managed to reach the global public and facilitate collaboration amongst citizen scientists also thanks to its global mediatic resonance. The launch event was widely covered by the international media, including radio and

television programmes. According to a statistical analysis conducted by the Green Bank Observatory, the project reached more than 145 million people worldwide just during the first week, after its launch. The event was presented as a work of global theatre, simulating a first contact scenario, and this scenario lived in the mind of millions of people during the first week. This is an interesting outcome for an experimental, interdisciplinary project, based on conceptual art reasonings.

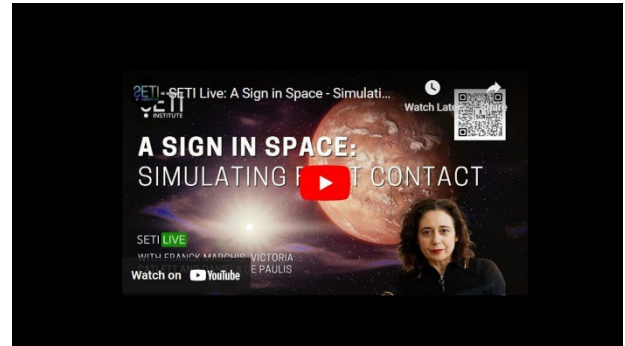


Figure 2: A Sign in Space was presented as a live event on YouTube by the SETI Institute and was widely covered by the international media

The global media coverage of "A Sign in Space" established the project as a very recognizable work in the field of SETI and Art.

5. ARTISTIC BACKGROUND

"A Sign in Space" asks how do we, as humans and as a complex multitude of societies with very diverse cultural backgrounds, have been assigning meanings to concepts, events, phenomena, throughout our evolutionary history. How does the process of meaning-making unravel and evolve? "A Sign in Space" asks these questions, using one of the possibly most radical scenarios that we might experience as humankind: attempting to assign meaning to a message from an extraterrestrial intelligence. How can we possibly assign meanings to something so detached from our terrestrial experience? What would that signify for humankind? How can we attribute meaning to something that is possibly beyond our cognitive abilities?

Although in "A Sign in Space" it is desirable that participants will eventually discover the actual content of the message designed for the project, the many interpretations presented by the global public are an incredible display of human creativity, intelligence, inquisitive abilities. The decoding process has been allowing participants to experiment with existing technologies in innovative ways, to explore scientific and artistic concepts and to reinterpret those in a multitude of forms. Besides participating in the exploration around the possible content of the simulated extraterrestrial message through scientific and creative reasoning and by

applying various visual and acoustic tools, citizen scientists engaging with the project on Discord have been discussing with each other fundamental topics about human and non-human intelligence, about the emergence of life on Earth and beyond, about the limits of human knowledge and abilities, while self-reflecting through philosophical and existential questions.

“A Sign in Space” is a project rooted in the artistic tradition of live network art, connecting various people and communities through cyberspace, and in this case also through radio, space technologies and citizen science. The project is the development of my previous works from 2009 to 2022, exploring the medium of radio transmissions in live performance art, in collaboration with the global public and with international radio telescopes. The project is also informed by my background as a contemporary dancer working with free improvisation: “A Sign in Space” is in fact conceived as an open and flexible theatrical space, encompassing the entire planet, and reaching as far as the Mars orbit.

The interdisciplinary science of SETI very effectively lends itself to this planetary thought experiment by focusing humankind’s bewilderment towards an extraterrestrial entity.

“A Sign in Space” creates a vivid imaginary event that lives for an indeterminate period of time in the mind of people from around the world. Each active participant in the project – whether a collaborating scientist or a member of the public – is also a performer.

The project shows the process of meaning-making as a fluid global narrative, through which meanings are continuously shaped and restructured. As societies become more and more interconnected, the process of meaning-making is becoming increasingly challenging and diversified.

Besides providing some interesting insights into the societal response and cultural impact of the discovery of an extraterrestrial intelligent signal, the material that is being produced as part of the decoding process for “A Sign in Space” is providing relevant material for researchers from various fields, including statistics, music, arts, literature, sociology, anthropology, philosophy. It is possible that researchers in the near future will study this material as part of their work.

6. ACKNOWLEDGEMENTS

“A Sign in Space” was made possible by a well-orchestrated collaboration of nearly 80 specialists from around the world. The project would not have been possible without the crucial collaboration and

intellectual generosity of each single contributor. A special thanks and acknowledgment go to the scientists at the European Space Agency, the Green Bank Observatory, the SETI Institute, and the Italian Institute for Astrophysics. A special recognition goes also to radio engineer Daniel Estevez; to scientists and science communicators Franck Marchis, Rebecca McDonald, Claudia Mignone, Angela Damery, Victoria Catlett; to the director of the SETI Artist in Residency programme, artist and curator Bettina Forget, for welcoming the project into the programme and for the extraordinary support in making it happen; to astronomer Roy Smits and computer scientist Giacomo Miceli for helping with the crucial steps of the message composition; to all specialists who supported the message composition process, especially physicist and space lawyer Mukesh Bhatt, philosopher of ethics Chelsea Haramia and anthropologist Kathryn Denning; to all workshops hosts and panellists for presenting SETI perspectives from around the world; a special thanks and acknowledgement go also to the international Discord community that is attempting to decode the message, and to people from all over the world who keep engaging with the project. Thank you to every single collaborator and participant for supporting a vision of global and constructive engagement, uniting cultures in these tormented historical times.

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Can Brain-Computer Interface Predict Change in Anxiety During an Art Experience?

Preliminary data from the ASBA project

Raffaella Folgieri
Università degli
Studi di Milano
Milan, Italy

[raffaella.folgieri@uni
mi.it](mailto:raffaella.folgieri@uni
mi.it)

Annalisa Banzi
Università di Milano-
Bicocca
Milan, Italy

[annalisa.banzi@uni
mib.it](mailto:annalisa.banzi@uni
mib.it)

Maria E. Vanutelli
Università di Milano-
Bicocca
Milan, Italy

[maria.vanutelli@uni
mi.it](mailto:maria.vanutelli@uni
mi.it)

Vincenza Ferrara
Università La Sapienza
Rome
Italy

[vincenza.ferrara@uniro
ma1.it](mailto:vincenza.ferrara@uniro
ma1.it)

Claudio Lucchiari
Università degli Studi
di Milano
Milan, Italy

[claudio.lucchiari@uni
mi.it](mailto:claudio.lucchiari@uni
mi.it)

1. INTRODUCTION

Museums and the arts can have a significant positive impact on people's health and wellbeing. But it's important to assess the real impact that artifacts and museum areas can have. Numerous studies have demonstrated that the psycho-physical impact of art is dependent on the visitor's unique qualities as well as the piece itself. Personality, artistic inclination, prior museum visits, stress and anxiety levels, and other factors can all have a big impact on how beneficial art actually is. Standardized scales have long been used in psychology to assess psychological factors like stress and anxiety levels. In controlled studies, this is simple to accomplish, but in field investigations, it is far more challenging.

The use of psychometric measures (e.g. scales and questionnaires) in real-world contexts is very complicated. In our case, museums themselves would have to implement measurements on their visitors. To make the measurement of the effects of museums' spaces on perceived well-being simple and feasible, it is, therefore, possible to use a combination of visual-analog tools, which are very quick to perform and immediately understandable (e.g. through the use of emoticons or other visual forms), and advanced, wearable and inexpensive technological tools. One such tool is the BCI (Brain-computer interface), an easy-to-wear tool that can provide easy-to-process biometric data. In addition, various low-priced BCI devices are available on the market, which allows their purchase even in certain quantities. BCIs offer a potential solution by providing objective measures of brain activity related

to emotional and cognitive states (Torres et al. 2020). Previous research has explored the use of BCIs for artistic expression (see. Vanutelli, Salvatore, and Lucchiari 2023) and studying affective states (Nijholt et al. 2018), as well as for training and intervention in various contexts (Cao 2020).

However, before these technologies can be concretely used to effectively measure the effect of any experience or treatment on well-being, their operation needs to be validated. In our study, we administered before and after the experience in the museum both a standardized scale for anxiety (the State-Trait Anxiety Inventory, STAI; Spielberger et al. 1971) and at the same time measured through BCI the basal EEG for two minutes (one minute with eyes open and one minute with eyes closed), again before and after the experience. We then sought to assess whether a significant change in state anxiety measured through STAI corresponded to a significant change in some EEG parameters. Currently, we have collected data on 30 people engaged in various experiences in some museums. The data from the initial data analysis show that indeed some EEG parameters seem to be able to signal a significant increase in well-being. In particular, the power of prefrontal alpha rhythm seems to be a good candidate to play this role.

This study is part of the ASBA project (Anxiety, stress, Brain-friendly museum approach; Banzi et al. 2023), which aims to investigate the effect of museum experience on individual wellbeing using a variety of elicitation methods, such as Mindfulness, Art therapy and Visual thinking strategies. In this

paper we focus on potential use of BCI to predict changes in anxiety levels in museum settings. Specifically, we aim to validate the use of BCIs by comparing changes in electroencephalogram (EEG) parameters with changes in self-reported anxiety levels, as measured by STAI and visual-analogical scales.

2. METHODS

2.1 Participants

The study included 30 participants (age range: 18-65 years) who engaged in various guided and well-structured experiences at a museum. Participants were recruited through dedicated websites, social media and local advertisement. Exclusion criteria included history of neurological or psychiatric disorders, and use of medications that could affect cognitive or emotional functioning. The study was approved by the ethical board of University of Milan-Bicocca, Italy.

2.2 Procedure

Participants completed the STAI and underwent a two-minute baseline EEG recording (one minute with eyes open and one minute with eyes closed) before and after the museum experience. EEG data were collected using a commercially available, wearable BCI device (the Muse headband) with dry electrodes placed on the forehead and temporal regions.

2.3 Data analysis

Changes in STAI scores (state anxiety) and EEG parameters (e.g. prefrontal alpha power) were analysed using paired t-tests or non-parametric equivalents, depending on the distribution of the data. Correlations between changes in STAI scores and EEG parameters were also examined.

3. RESULTS

Preliminary data analysis showed a significant decrease in STAI scores (indicating reduced state anxiety) after the museum experience ($p < 0.05$). Additionally, there was a significant increase in prefrontal low alpha power, a marker of relaxation (Sharma & Singh 2015), after the experience ($p < 0.05$). Changes in STAI scores were positively correlated with changes in prefrontal alpha power ($r = 0.42$, $p < 0.05$).

4. DISCUSSION

The findings suggest that BCIs can be used to predict changes in anxiety levels during art experiences in museum settings. The observed

increase in prefrontal alpha power and its correlation with reduced state anxiety align with previous research on the relaxing effects of art (Belkofer et al. 2014) and museum experiences.

This preliminary study demonstrates the potential of BCIs for predicting changes in anxiety levels during art experiences in museum settings. By combining self-report measures with objective EEG data, BCIs offer a promising tool for evaluating the psychological and physiological effects of cultural experiences.

However, this study is limited by its small sample size and lack of a control group.

Future research with larger samples and control conditions is needed to validate the use of BCIs for assessing the impact of art experiences on mental well-being. Additionally, exploring the potential of BCIs for real-time monitoring and personalized interventions in museum settings could further enhance the visitor experience and promote well-being.

Further research is needed to establish the validity and practical applications of this approach that promise to enhance the feasibility of those applications aimed to extend the missions of museums from cultural heritage conservation to cultural well-being, such as the ASBA project.

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The Gamified Gamelan: A new approach to educational outreach using pose detection

Gaetan Boisson & Jan Mrazek
National University
of Singapore
gaetan@nus.edu.sg

1. INTRODUCTION

Gamelan is a music genre native to Southeast Asia, and particularly Indonesia. It has had and still has an important influence worldwide, having influenced composers such as Claude Debussy as early as 1903. Global music audiences, however, are still mostly familiar with Western conventions of music.

To address this, museums and cultural institutions usually highlight the instruments, sometimes along audio or video or recordings, and in rare cases performances.

While the refinement and beauty of the instruments as an artefact and the music they produce cannot be understated, our preliminary research shows that to learn, people need to be exposed to theory but more importantly practice.

2. OVERVIEW OF EXISTING APPROACHES

Due to the sheer size of the instruments (see Figure 1) a relatively easy way of introducing audiences to them has long been museum displays. An actual performance will require flying 20 or so musicians and their instruments from Indonesia, a financial and logistical challenge that only large festivals or institutions will be able to undertake.

Additionally qualified instructors to teach the music are rare to find in most places, and organising workshops or even classes will prove equally challenging.

Nevertheless, amateur gamelan ensembles have been flourishing around the world and many institutions (such as the Cité de la Musique in Paris) offer a more practice based educational approach.



Figure 1: A display of Javanese Gamelan instruments at the Asian Civilizations Museum, Singapore.

Previous projects have addressed these difficulties to facilitate access to the music itself and educate about it. New media and online experiences have been an avenue of interest. Beyond the simple wow factor of digital media, they can break down some of the barriers encountered as they bypass the requirement for the instruments and an educator, even when they rely on less commonly available hardware such as VR headsets.

One noteworthy such example is the Gamelan Mécanique available on the Cité de la Musique website. This colourful interactive experience works on a simple web browser and introduces the viewer to several genres of gamelan from both Java and Bali. It allows users to explore several structures and even create their own sequences.

Other relevant projects include efforts from Universitas Dian Nuswantoro (Semarang, Indonesia) to create a gamelan metaverse and VR based games.

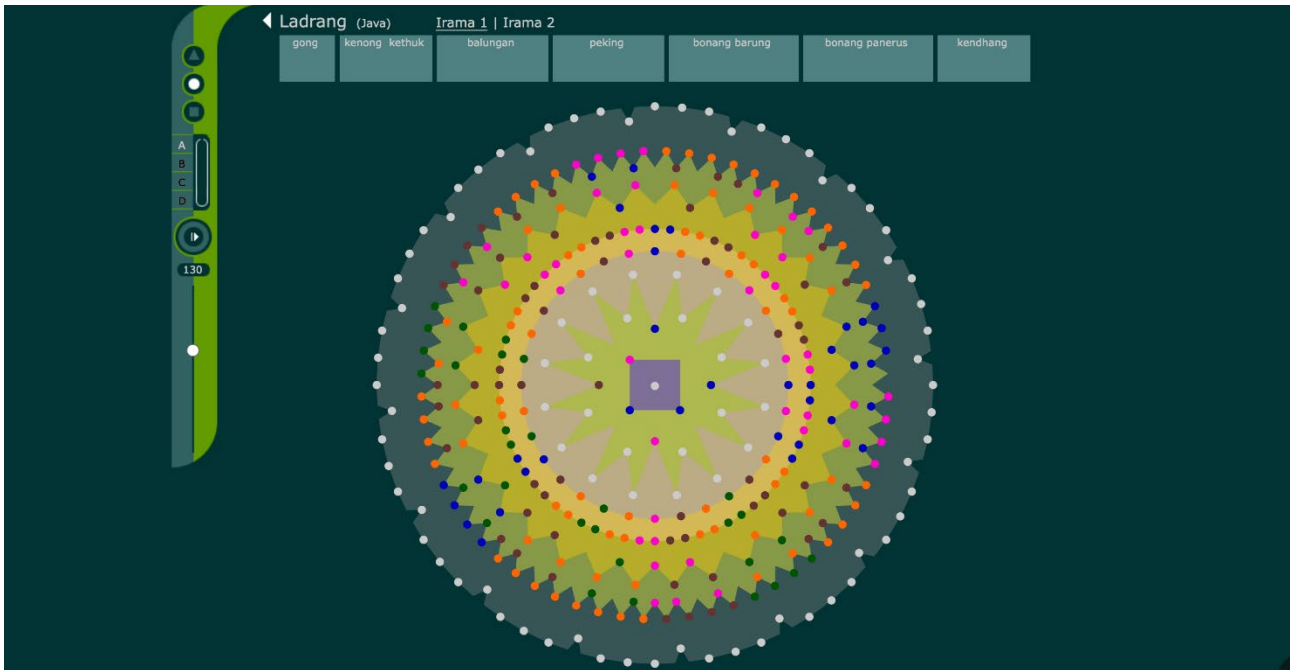


Figure 2: Screenshot of the Gamelan Mécanique website at Cité de la Musique.

3. DETAILS OF OUR APPROACH

This project proposes to create a motion-based game to facilitate the learning of the scales, grammar, and general aesthetic of gamelan. Leveraging the knowledge of the Singa Nglaras ensemble at the National University of Singapore as well as the teaching expertise of professors from our department of Southeast Asian studies, we are developing an experience that will guide users with no, or little knowledge, of gamelan, to a basic understanding of the scale and structure of the music.

We really on web standards to make the experience easy to access and deploy, as such an up-to-date web browser and a web cam will be the only requirements to run the experience.

We have conducted a research process following the UX methodology to guide the design of our experience. Users from a variety of backgrounds,

based in Singapore or the USA with diverse levels of familiarity with the practice of music were invited to answer our questions and provide their input through the design of the experience. One salient fact that surfaced during interviews was the necessity of practice in the learning process. The experience was therefore designed as incremental steps of learning, which will all involve user motion to reinforce learning.

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Software on the Spotlight and its Eventual Cloistering

Marta Pérez—Campos
UPV/EHU: University of the Basque Country
Bilbao, Spain
mperez272@ikasle.ehu.eus

This paper presents an analysis of the presence, influence and nature of software from a humanist perspective. To this end, Software studies and Software art are taken as references. The former analyses software as a phenomenon that goes beyond computer science and the latter is the artistic movement or trend that claims a reflection on software specifically within the art world. The approach taken by Software studies allows for an analysis of the source code that makes up coded objects, mainly from their political, social and cultural influence, which goes beyond understanding programming languages as mere intermediaries between computers and people. To be able to talk about Software art, it has been necessary to investigate its definition, which has been considered necessary to adapt to include those manifestations that currently continue to place software and programming languages at the centre. It also analyses the defining characteristics that allow these projects to be grouped under certain labels such as Net art or Browser art. In this analysis it is possible to see how in the beginning the aim was to unveil, to show the interior and functioning of the machine, and how nowadays, with applications based on machine learning and neural networks (NN), the software remains inside a *black box* system that hides it. This last part allows us to reflect on the idea of generativity and creativity in relation to this type of manifestations: is it possible to speak of co—creation with the machine or are we simply dealing with tools whose output is often uncontrollable and to which, therefore, we assign creative capacities that, in reality, they lack? This approach to AI is completed with the analysis of two projects that attempt to open up the black box by showing us how it works and all the human work and exploitation of resources required.

Exploratory research. Software studies. Software art. Critical AI.

1. INTRODUCTION

Placing code at the centre is inevitable when it is itself responsible for shaping the spaces in which we live our daily lives. If we transfer these coded objects to the artistic world, we find manifestations in both the virtual and the real world: installations, web pages or publications of computer poetry whose code is executable.

Although it is true that the creation of artistic projects involving computers, microcontrollers or any other device of a digital nature is not something recent, the idea of showing and making the real artistic aspect of the work the software itself did not appear until 2001 with the birth of the concept of Software art.

In opposition to these manifestations, the idea of placing the software at the centre disappears in those projects that make use of artificial intelligence (AI) and which have become so important in recent years. In these projects, the inner workings are completely out of the user's reach, in what is known as a black box system.

As a starting point for analysing not only these artistic manifestations, but also the influence of software beyond its usefulness as a tool for giving instructions to a computer, the approach proposed by Software studies will be taken.

2. THE BIRTH OF SOFTWARE STUDIES AND SOFTWARE ART

One of the first appearances of this term can be found in Lev Manovich's *The Language of New Media*. In the introduction, he proposes the creation of a theory of media in which the main purpose is to analyse the foundations of both software and

hardware (Manovich 2002). This interest in analysing the inner workings of the machine from the humanities materialised in a series of publications, within the MIT Press platform, some of the main authors being: Geoff Cox, Annette Vee, Mark Marino, Florian Cramer, Wendy Hui Kyong Chun, Warren Sack and Nick Montfort.

In 2011, in the book *Code/Space*, a manifesto was published that advocated the need for Software studies. The manifesto is conceived as something unfinished, open to modification, as an algorithm created by a group of programmers, ready to receive contributions, and in which we are invited to modify and rewrite. Two of the ideas defended and still relevant today are, on the one hand, that by opening the black boxes of algorithms, we will be able to understand software as a means to automate society and, on the other hand, that the act of designing software involves representing an idea in a certain way: it is decided what is included and what is left out of that representation.

Although the AI boom that we begin to face in 2022, with all the problems of bias and discrimination that have emerged, had not yet happened in 2011, Kitchin and Dodge were already anticipating the dangers of neglecting the study of software itself:

What are the implications of reducing the world to a small ontological subset and a sequence of algorithms? Does the sensibility of a relatively small cadre of programmers become the overriding blueprint for future everyday social relations? Will defaults in code become the defaults for living? (Kitchin and Dodge 2011, p.247)

Almost contemporaneous to Software studies is the artistic current known as Software art. In 2001, Florian Cramer and Ulrike Gabriel wrote an article after being selected as jurors for the *Artistic Software* category at Transmediale Festival in which they coined the term. In the projects considered as Software art, there had been a leap from art that was displayed on screens to art that was itself a creator of a system (Cramer and Gabriel 2001) and that, in some cases, as in Generative art, it was in continuous change.

Another idea that has helped to generate a reflection on software — and which was also defended by Cramer and Gabriel — was its consideration as a literary object, whose influence went beyond being the system that allows us to interact with a computer. This placing of software at the center contributed to the generation of a reflection on the particular aesthetics presented by these projects, which has intensified in the last fifteen years.

2.1 Software studies as a starting point for analysing the political, social and cultural influence of software

Software studies consider that programming languages, and the applications created with them, are an essential part of the current configuration of the world and that, therefore, it is necessary to reflect on this fact. In this section I will focus on three publications that analyze software from its political, social and cultural influence.

2.1.1 Speaking Code and Critical Code Studies: an analysis of the political and social influence

Written in 2013, it mainly analyses the political and social implications of code writing. In the first two of the four blocks into which the book is divided, Geoff Cox discusses the nature of code by comparing it in the first block with the spoken word (speech) and in the second by making the inverse comparison, looking at how our discourse resembles code from a political dimension. In the third and fourth sections of the book, he analyses our relationship with and through code, and in turn comments on various projects that use code to critique the very structures that have arisen thanks to it.

Speaking Code proposes new forms of criticism and practices that combine natural and artificial languages, calling for the creation of a starting point for writing from a recombination of both. Cox chose the Italian philosopher Franco 'Bifo' Berardi as his preface. Bifo had written in the same year *The Uprising: On Poetry and Finance* in which he calls for a linguistic revolution, taking poetry as its protagonist.

If language has become an automated system that can be escaped through poetic use: what exactly does 'Bifo' mean when he uses the word *poetic*? In the prologue to *Speaking Code* he speaks of movements based on a poetic use not of natural languages, but of software. A use that moves away from perpetuating a system in which language is relegated to being the structure on which corporate conglomerates, such as Wikileaks or Linux, are sustained. In these cases, software is conceived as a political expression, thus relating to the idea of discourse (*speech*) and adopting the orality that this word entails. There are also other practices, perhaps not as well known, such as the use of improvised scripts or esoteric programmes as ways of recomposing collective action. In all of them, code is perceived as a place from which to express a diversity of voices.

Returning to the properties of code, one of the concepts enunciated by Cox and which is of particular interest for this article as it relates to the political and economic dimension is that of code

working. Cox uses this term to emphasise both the work that goes into the code itself when it is executed, and the work behind the writing of the code. The idea of *code working* poses an exploration of the relationship between code and labour, as a starting point for examining how the practice of code writing is embedded within the capitalist system. A reflection on how code works within today's society.

If code working is based on the exploitation of the workers who generate the code, this occurs when the software produced is proprietary, copyrighted and making it public would be actionable by the company to which it belongs. The alternative that emerged in response to this situation were movements that tried to move away from this idea of ownership –such as Creative Commons, Copyleft or Copyfarleft– although not all of them share comparable principles.

Regarding the influence of software within the social imaginary, we find the 2020 publication *Critical Code Studies (CCS)* by Mark C. Marino in which the author uses examples in which software comes out of the computer to be read by people who are not necessarily programmers. It explores the meaning of writing an algorithm today and emphasises the context in which the algorithm was written. Something interesting about the proposal made by the CCS is that the code readings are not to be done alone, but in groups, to discover different perspectives and to be able to debate the interpretations of the software, which do not always have to match.

This need to analyse and rethink software from a critical perspective is currently represented in the art world by names such as American Artist. This artist decided to legally change his name in 2013 which, apart from making him an anonymous person with a name, makes it hard to find him on the internet, serving as a critique of the invisibility of black people in areas such as art and technology over time (Tareke 2021). Within his *Black Gooney Universe* [Figure 1] he developed a line of research in which he discusses how the origins and development of software –mainly in Silicon Valley– are linked to cisgender and straight white men and with it the birth of the GUI or Gooney. He argues that before the appearance of the first GUI, the screens –where interacting with the computer required command line typing– were black, and that after the appearance of the GUI, the background space changed from black to white. It seeks to create an interface that represents the opposite values to what is sought with any current functional GUI and proposes a conceptual interface with which, from its lack of functioning, we can rethink what the GUI is and for whom it has been created.



Figure 1: American Artist, Mother of All Demos II (2021), part of Black Gooney Universe.

Therefore, the software ends up configuring, shaping, an ideology and a specific imaginary that we take for granted because, until relatively recently, we accepted it directly as it was given to us.

2.1.2 10 PRINT CHR\$(205.5+RND(1));:GOTO 10 (10 PRINT) and the cultural influence

This third publication looks exclusively at a one—liner program and all that it means. This program, written in BASIC, corresponds to a typology that was very common in the 1980s, although in this publication it is not analysed for its popularity, but for the cultural load it has: 10 PRINT tries to demonstrate the cultural load that a single line of code, apparently simple, can represent.

It is the result of research carried out by ten authors that seeks to demonstrate that the code is a cultural text that reflects the history and social context of its creation.

It is interesting that the first thing to be analysed is each of the tokens that compose it, making it understandable for a person who does not know how to program and justifying the use and presence of each one of them, including the spaces. Here we find an interest in opening up the code and making it easier for someone who is not used to working with it to understand it. This first approach, which only analyses the way in which the code is written –using structures such as *goto*, the BASIC programming language and the output it generates– already speaks of the moment in which it was written, providing us with more information than we might think at a first glance.

We can say that these publications are the result of an interest in analysing to what extent software influences and is influenced by the society in which it is created and what social, political and cultural impact it exerts, as well as its links with disciplines that at first might have been considered as alien to

it. It can be affirmed that this interest in the nature of software, code and the influence it exerts today is the central nucleus of software studies and is capable of providing us with the keys to propose an aesthetic—pedagogical use that helps us to look at software in a different way.

Inside the world of art, the artistic current that has been and continues to be concerned with considering software itself as a means of expression is known as Software art.

2.2 Software art: Searching for a definition

Although talking about software art in the current context may be perceived as an anachronism, since this artistic movement began to develop in the 1990s, publications analysing the influence of software have used this type of artistic manifestation to present examples from the art world. In 2001, just a year before Manovich published *The Language of New Media*, Florian Cramer and Ulrike Gabriel wrote an article – already mentioned at the beginning of this second section– directly entitled "Software Art". They tried to find a definition for those projects that, due to their digital nature, could be grouped under this label and which, they argued, it was wrong to consider as a derivation of Video art (Cramer and Gabriel 2001).

The definition they proposed for this category was: "We would like to define Software art as art of which the material is software" (Cramer and Gabriel 2001). It was proposed as an analogy to Henry Flynt's 1961 proposal for Conceptual art, which he called Concept art. With this label he sought to speak about an art whose material is concepts, establishing in an evident way a relationship between Software and Conceptual art.

Following this link with conceptual art, nine years later, Geoff Cox, in *Antithesis: The Dialectics of Software Art*, Cox rescued the idea that software art proposes 'software as artwork' (Cox 2010) and emphasised the importance of the process over the final result. However, Cox argues that Software art includes projects where the source code is the main part of the project, as well as those where the result of those instructions is more important.

Without getting into the more conceptual component, another approach to Software Art that is more focused on the medium itself is that presented by Christiane Paul, in her book *Digital Art*. In it, she includes this artistic movement in the chapter in which she presents artistic manifestations that make use of digital technologies (Digital Technologies as a Medium) such as Cinema, Video, Virtual Reality or Internet/Network art. In the case of Software art, we

would be dealing with the only case in which it is in itself a medium capable of generating coded objects, thus fulfilling McLuhan's thesis in which the medium coincides with the message: the software is the result but at the same time the medium in which it is executed.

Thus, we could assume that Software art includes those *artistic manifestations whose main characteristic is that they are made up of a set of instructions executable by a computer and their execution*. Whereas such execution can take place either inside a computer or inside the head of the person reading them.

2.3 Software art: derived and related movements

If, once the definition of Software art has been clarified, we stop to analyse related trends, the first thing to do is to try to shed light on the debate surrounding the distinction between software and generative art; while both have been linked to digital art, there are notable differences.

One of the main differences stated by new media art researcher Inke Arns is that Software art itself does not necessarily have to be generative, while for Generative art it is a requirement. (Arns 2007). We can therefore consider that the fact that Generative art is always based on software in order to exist will lead us to consider it as a trend derived from Software art.

Apart from Generative art, within the movements related to Software art, we find Net art, which originated in the 1990s, in the early days of the internet. Some of the artists belonging to this movement developed their projects along the lines of what is known as netactivism, in which they used the ability to disseminate information and make copies of files intrinsic to the internet. (Paul 2015).

This article will focus on projects that are explicitly critical in nature and explore the characteristics and limits of the medium in which they take place, in this case the internet. This is due to the fact that, in spite of the different drifts that Net art has taken, it emerged as a reflection on the medium itself and, in most cases, it had a highly critical component.

Net Art has been linked to provocation since its beginnings. In 1994, Natalie Bookchin and Alexei Shulgin, both members of the net.art group, wrote a manifesto that, apart from making it available online, they decided to carve in stone, thus emphasising the medium used and confronting instability with the perdurability, intangibility, and presence of one and the other.

Alongside Bookchin and Shulgin, one of the pioneers is the artist Olia Lialina, whose extensive work and contribution to net art will not be analysed in depth in this paper, but who we feel it necessary to mention because of the way she currently presents her work on the art.teleportacia.org website. Lialina adopts an aesthetic close to that of the web pages of the 1990s, thus maintaining the initial spirit of the first net art creations. This aesthetic is also shared by Shulgin, who does the same on his website easylife.org. In both cases, we find that their portfolios differ from other artist's ones in that the name of the website does not coincide with that of the artist. This fact entails the loss of the importance of authorship, since in cases such as Shulgin's, his name does not even appear on the homepage.

Along the same lines, we find the homepage of the Jodi collective composed of the artists Joan Heemskerk and Dirk Paesmans. Their website, <https://jodi.org/>, is a black background with green characters; imitating the aesthetics of the first CLI and chaotic in appearance [Figure 2]. It all makes sense if we inspect its source code, where the text appears with the spaces formatted correctly and where those same characters correspond to the outline of various types of bombs, appealing to the idea of how something apparently chaotic and innocent can hide something dangerous and better assembled than it might seem at first glance.

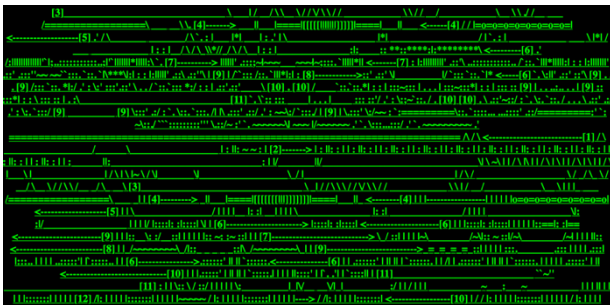


Figure 2: Home of Jodi Collective

Although Net art had its heyday in the 1990s, Net art projects are still being developed today. Two examples can be found in projects by the artist Jonas Lund. Using the browser as a performance space, in 2011, he created the project *I'm Here and There*. During the time the performance took place, if the visitor accessed <https://imhereandthere.com/> he could see in real time the URL that the artist was visiting at that moment. In this sense, it makes us put ourselves in the shoes of the algorithms that track our online activity. The browser is stripped of all its characteristic elements and becomes a screen that shows you which web page someone else's browser is on. It relegates the user to the role of spectator, a completely passive position, in

which, without being able to interact with the content shown, he or she acts as a *voyeur*.

More focused on the browser itself is *What You Get Is What You See*, [Figure 3] which is based on 2012 *What You See is What You Get* [Figure 4]. They show the different window sizes of previous visitors to the website hosting the project, creating an amalgam of squares by overlapping one on top of the other. In both cases, if we read the source code of the page, we find a description of the project [Figure 3], which indicates that it is meant to be displayed, to be read by the visitor.

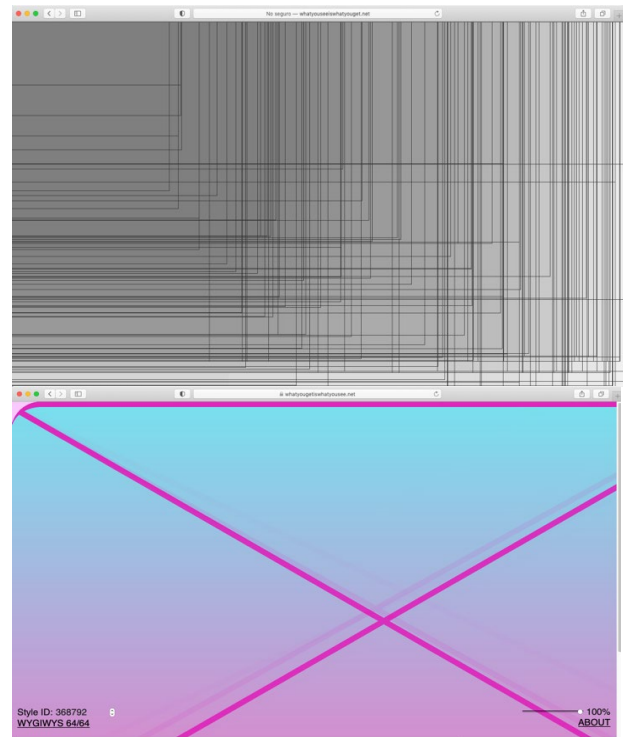


Figure 3 and 4: Jonas Lund, *What You See Is What You Get* and *What You Get Is What You See* (2012 and 2022)

Obviously, none of these Net art or Browser art projects would make sense outside the computer, since an essential part is the visual component of their execution. What they all share is an attempt to question our relationship with the internet, with the interfaces we use to navigate it, and to highlight the problems that arise from this, such as the lack of privacy.

This paper shares the three characteristics of Net art pieces defended by the researcher Annet Dekker: the importance of ambiguity, process and the need for the idea of a network. (Dekker 2018).

Firstly, ambiguity can translate into a reluctance to find solutions and a tendency towards playfulness. It is possible to assert that in the very ambiguity and futility a political and social critique emerges:

the ambiguity of these proposals, the failure to find a clear purpose can also have a critical effect. This interest in playfulness, in provocation, means that Net art pieces are not interested in the spectacle offered by technology, in creating something visually powerful, but without content.

Secondly, the importance of process in all Net art projects is to prioritise it over the end result. Their content may evolve over time, may no longer operate, often responds to the dynamics of the community, etc. All of this means that being a spectator of this type of project is complicated due to its instability.

This emphasis on process and mutability is connected to the third point, the need for the network idea. Net art is found within networks other than the internet, such as political or economic ones, which are related to the internet but not strictly part of it. The Internet is the main network, but not the exclusive one. This awareness of belonging to a network is related to the importance of process, of uncontrollable mutability and at the same time to the idea of ambiguity, to the volatility of meanings that can emerge in pieces developed and hosted in an unstable medium such as the internet.

However, we find that, when software is used within an artistic piece, there is also a tendency to hide its inner workings, to preserve the magic of not knowing how the phenomenon we are witnessing occurs. Today, with the rise of AI—based projects, the inner workings are once again being hidden inside the *black box*.

3. THE CONCEALMENT OF SOFTWARE

Although this paper focuses on those manifestations in which the source code is explicitly part of the work, it is considered necessary to mention those software—based artistic manifestations that are currently being developed. For this reason, it was impossible to leave aside those framed in the field of AI, although, normally, in these, the software is inscrutable. This inscrutability and the need for execution and intercession of the machine are what give it an autonomy, a creative power, which increases when we do not know the processes that take place within it.

The fact that most AI—based applications encourage us to interact with them using our voice and natural languages directly adds a layer of abstraction on top of the GUI and takes us one step further away from the inner workings of the machine. This also seems to move us away from adopting a critical stance towards them, on the

grounds that they are systems and applications that are too complex to operate.

Florian Cramer argues that it makes no sense to try to open the *black box* or to approach such systems from the poetic point of view of Software art because studying and understanding all the relationships created and criteria used by the AI would be too much work. (F. Cramer personal communication, 1st November 2023).

Although this position is shared in this paper, it will also be shown in section 3.2 that, even if we do not get to analyse the whole process, those projects that show how AI works help to understand its internal mechanisms, our role in the whole process and its impact, for example with the amount of hardware and resources involved in its training and maintenance.

3.1 AI and creativity: the idea of co—creation

The debate about creativity in Art projects involving a computer has existed since the first manifestations of Computer—Generated art emerged in the 1960s and speculation began as to whether the artist was subordinated to the machine or whether she would be replaced by it. This debate would continue until the 1980s, when Vilém Flusser reflected on the image and the photographic camera, presenting it, as in AI, as a *black box* (Flusser 1990). From this perspective, the NN, the camera and the computer are presented as systems to whose interior the artist has no access and, therefore, bearers of a certain creativity.

In the case of AI, it is considered necessary to qualify that the fact that it generates something aesthetically significant is still related to the person who has designed it, so that, although we consider that the system has acted creatively, we cannot stop talking about co—creation. This necessary presence of the creator of the system and/or the artist who uses it means that in this paper AI is considered as *a tool whose exploratory, combinatorial and transformational capacities can give rise to a result that we can consider as the consequence of an act of co—creation*.

This displacement of the author and the idea of subjectivity implicit in this type of project is also present in Generative art projects that are not necessarily based on AI. The main difference is that the latter make use of a set of rules to achieve a creative result, which although also occurs in those AI projects based on the symbolic model – those using LP logic such as Lisp, Prolog or Haskell— does not occur in those using the connectionist model on which NNs are built.

3.2 Critical positions on AI processes from the perspective of artistic creation

This concealment and lack of knowledge of the inner workings of the AI has led to a growing reflection on them. It is gaining so much relevance that there is now a journal directly under the name *Critical AI*, not exclusively focused on the world of the humanities, but which seeks to be a meeting point with other areas and disciplines such as economics, education, or legislation.

Within the art world, there is a trend towards the creation of projects that reflect on the internal processes of AI, presenting a critical look at the idea of the *black box*. The researcher Juan Martín Prada describes these approaches as "critical thematisation of AI" (tematización crítica de la IA) (Martín Prada 2024, p.17) One of them is *Neural Network Training* [Figure 4], in which Ars Electronica's Futurelab aims to partially demonstrate how a NN works. To do this, they propose five stations linked to five screens, in them, it can be seen how their behaviour changes depending on the input information we show them. In one of them, which focuses on the functioning of a neuron as a minimal unit made up of a mathematical function, it is possible to see how the output information varies depending on the mathematical function we select for this neuron.

Another shows how a widely used convolutional neural network (CNN), the VGG16, is able to recognise certain objects. This network is broken down into layers showing how the first ones recognise more schematic features and how the following ones specialise in recognising more complex shapes (Ars Electronica Futurelab 2023). The way the project is displayed, using screens to show the different layers that make up each NN helps to understand the changes that are taking place in them. Their arrangement surrounding the visitor emphasises the large number of operations that take place within a NN each time it reacts to our input.



Figure 4: Ars Electronica Futurelab, *Neural Network Training* (2023) ©vog.photo

Nonetheless, although it is visually interesting, it is a project focused mainly on technological dissemination, on teaching the visitor the inner workings of the system, but without raising questions about its consequences, or an aesthetic—artistic reflection that goes beyond showing how the system itself works.

Apart from the internal processes, there is a pathway that focuses on highlighting the energetic consequences of training and maintaining these systems. An example of this is the artwork *Diario de consumo* by the Taller Estampa collective. Specifically, with this project they seek to show the energy consumption of training them and, to do so, they use an electricity consumption meter that counts the consumption of the computer they use in their own studio. To generate the energy consumed, they use a solar panel placed in the exhibition space where the project was presented as part of the exhibition *AI pati del darrere* at MAC Mataró in 2023.

Following in the same vein of making the consumption of natural resources and environmental impact visible, new media artist Vladan Joler and Kate Crawford developed *Anatomy of an AI System: The Amazon Echo As An Anatomical Map of Human Labor, Data and Planetary Resources*. In this diagram, available on the website <https://anatomyof.ai/>, they present a visual essay in which the work behind the development and production of the software and hardware for the Amazon Echo virtual assistant is analysed (Crawford and Joler 2018). In this case, it does not look in detail at the functioning of AI itself, but rather at the whole exploitation of resources and people through an object present in millions of households.

What is interesting to mention is the rise of the idea of the *black box*, but in this case not exclusively related to the functioning of the system itself, but also how it is practically impossible to see where this object comes from materially speaking: the production chains behind it; the idea of the *black box* that also hides behind the hardware that makes up these AI—based devices.

4. CONCLUSION

This paper has analysed how the perception of software has changed in recent years, although this has not meant that the adoption of a critical stance towards software—based phenomena and experiences has been lost. Software studies started a line of thought in which software was opened up to analysis from the humanities. This critical position has almost always been linked to

showing the source code, the software that allows the operation of these systems that accompany us, not always consciously, in our daily lives. A vindication of Software art is proposed, considering within it all those projects that express a critical stance towards the uses and processes of software and that may include manifestations such as Generative art, Net art and art based on AI.

In 2024, with AI in full expansion, taking a critical stance on the uses we make of software and the infrastructures on which it is built seems absolutely relevant. There is not always an interest or need to make visible the source code of which these applications are composed, but due to the increasing presence of these systems is essential to raise a critical reflection on them from the arts and humanities.

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Immersive Teaching Material of Architectural Memory in Oaxaca, Mexico

Otniel López Altamirano
"Benito Juárez" Autonomous University of
Oaxaca, UABJO. SNII- Conahcyt.
Independencia 315, Oaxaca, Mexico
otniel.altamirano@gmail.com

1. INTRODUCTION

Teaching material in any educational system is one of the essential tools for the development and expansion of knowledge applicable in a classroom environment. Therefore, under a deductive and practical methodology, a hybrid memory game will be designed that contributes to the visual teaching of the architectural heritage of the city of Oaxaca, Mexico; supported using immersive Augmented Reality [AR] technology. This preliminary project also seeks to diversify educational strategies, as well as enhance the digital skills and cognitive abilities of participating users.

2. BACKGROUND OF THE PROPOSAL

Games based on interaction, stimulation, and reward between the user and the product allow greater adherence to learning, calling it <content> or <soft> as Bonsiepe (2011) refers to. These recreational products stimulate the release of dopamine, the natural neurotransmitter in all species, including humans, leading them to a state of frenzy; Johnson (2012) argues that dopamine helped us find resources, acquire new knowledge, and innovate.

When considering this measure, it is proposed that the use of immersive technologies in learning activities would allow the visualization of products that include hybrid, interactive, and intuitive content, in addition to providing meaningful experiences. Augmented Reality [AR] in the classroom, say Felip and Galán (2021), makes it possible to understand theoretical concepts that could be too abstract, in turn, it encourages visual memory and the active participation of the user. This consolidates new heuristics learning among young people in training.

To this extent, the United Nations (2023) determined that, to achieve educational strengthening, digital cooperation among young people must be promoted, the creation of platforms that enable educational transformation, as well as establishing more efficient technology transfer mechanisms.

3. JUSTIFICATION

To streamline resources and innovation mechanisms towards more efficient and intuitive learning, the teacher needs to rely on teaching material provided by the educational system, since this is an indispensable tool for the development and expansion of knowledge applicable in a classroom environment. However, the teaching process can be an even more complex task if the institution does not have materials that encourage historical memory and the built-in heritage of the environment.

That said, it is the responsibility of academic researchers to propose new methodologies or materials for classroom learning and implement projects that diversify educational activities, with the possibility of extending to other hybrid environments and more inclusive and diverse social groups. Furthermore, this preliminary project proposes to be a model for other educational centres to produce new versions alluding to the heritage and architectural sites of their localities. In this way, says Campos (2013), productions of this type stimulate new ways of relating to the space of the city, highlighting it as a product and producer.

4. SPECIFIC OBJECTIVES

- Arrange the digitized teaching material on a virtual site for free use, downloading,

printing, and correct execution by both students and teaching staff;

- Include complementary information: textual, multimedia and visualization about each of the architectural sites that make up the game set;
- Stimulate and measure cognitive and digital skills among participating users with or without disabilities.

5. GAME MECHANICS AND EXECUTION

The game establishes rules that must be understood at the beginning and followed by the participants during the dynamic. It is worth mentioning that this can be played both individually or with other players. In addition, the number of pairs of cards could vary depending on the grade's desired difficulty. Mechanics: all pieces must be mixed and be placed in a face down position, in such a way that the graphic image is hidden from observers. The participant picks up two cards, if these cards include the same graphic representation, the player keeps them and is allowed to choose two more. Nonetheless, if the cards are different, the player must return them face down and in the same position where they were taken. In this way the cards will be revealed in subsequent turns.

The objective of the game is for one of the participants to accumulate as many pairs of cards as possible, by identifying the graphic pieces and remembering the position where they are located. For the AR version, the same mechanics will be followed, but using patterns and with the support of a mobile device that allows digital visualization of the architectural piece; Additionally, these will include audio that mentions the name of the architectural piece represented.

5.1 Execution

It is proposed to select fifteen buildings with aesthetic-architectural characteristics or with heritage cataloguing in the central region (Central Valleys) of the state of Oaxaca, Mexico, these include the quadrants of the historic centre, and some locations close to the capital city. Once selected, these will be subjected to a process of graphic abstraction, that is, a visual synthesis of the elements that compose them, to interpret them into images of basic representation, such as pictograms.

The next step would be to have each of the pieces vectorized two-dimensionally and then, the patterns designed that will allow the visual representation of AR with the virtual design team. The functions of the prototype will be measured in its two 2D and AR versions, with the aim of applying it in two controlled groups of students: group 1, the 2D printed version

in students with or without disabilities; the group 2, using a mobile device for AR in students with or without disabilities, all enrolled in the CAM 52 Multiple Care Center, Oaxaca, Mexico.

Finally, the 15 pieces composed of 30 pairs of letters will be made available in portable document format on a virtual site, which allows the download of this material for physical printing. In addition, the site will provide complementary information about the architectural heritage buildings that make up the game set, as well as instructions for the correct technical and pedagogical use of the material.

6. CONCLUSION

This board game not only aims to be a product for the use of students in training at their different educational levels, but also to be inclusive, embracing different age ranges, digital skills and emotional intelligence of the users, since according to Bonsiepe (2011) inclusive design does not create limitations to the satisfaction of needs, especially the basic needs of the population; referring to user-based innovation to facilitate access to a product or service. It should be noted that the set may be improved, as indicated by the measurements carried out in practice, added to the feedback provided by users through comments and ratings of the material, to achieve optimal quality in its design, structure, usability, and visualization.

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Dolls' House Artists' Installation: A-Maze artists collective exhibition at the APT Gallery, Deptford, London, October 2023

Maureen Kendal
dreamstudio.io
13 Golders Green Crescent, London,
UK, NW11 8LA
maureen@dreamstudio.io

Caitriona McAllister
CMcA, caitrionamcallister.com
dreamstudio.io
London, UK
caitriona.mcallister1@gmail.com

Jacob Deakin
dreamstudio.io
Bron Yr Allt, Van rd, Llanidloes SY18
6HR, Wales
devilsinthedetailsdesign@gmail.com

The 3D Art Installation, 'Dolls' House' was developed by a collaborative artists' team. This large dolls' house in the conventional and physical sense is a collaborative artwork using physical tangible and digital electronic methods and materials. This can offer insight, as a physical prototype, for a potential hybrid virtual platform of Artists' spaces. Design aspects include: why a Dolls' House?; Reusables and Recycling; Combining Digital and Tangible Tools and Palettes; User Interactivity – embedded electronic sensors. Development included: soundscape audio; lighting; colour; re-purposing old electronic devices as movie players, window design, characters, artists' inspiration and current art practice. The 'Dolls' House' installation was exhibited at the APT Gallery, Deptford during October 2023 in the A-Maze Artists' Collective Exhibition. Artists' and audiences' responses are indicated. Next stage can be optimised by focused project management, assessment of efficiency of reusables, development of integration of the look and feel, creative team working practices, technical skills exchange and innovative insights.

3D installation. Artists' spaces. Reusables. Sensors. Video. Sound. Interactivity. Movie players. Audiences. Arduino. Unity.

THE ARTISTS



Figure 1: The artists.

1. INTRODUCTION

'The Dolls' House' concept was built on the insights from previous projects in which Kendal produced virtual / physical/ hybrid worlds where artists could work in creative spaces collaboratively by opening up their studios to creatives and audiences for conversations about their artworks and their creative process.

Kendal has produced previous projects which combine tangible, digital or virtual worlds for Artists. To include: 'Tangents' with Cecile Elstein (1998–2007), 'Revelation', with St George, Chapman & French (1999–2009); Second Life and WEISL project with Hudson (2007–2011); PingHubVR with Seng Ong (2018–2019); A-Maze Artists Collective with Gunn, Hudson & al (2020–2023). Recently Kendal discussed with Gunn, Gunn's work which portrays the Silk Road, spice, sugar and slave trade

routes and migration. Kendal imagines her own migration journey on the Windsor Castle Ship as a small child. Kendal acknowledges her feelings of loss and a longing for home, community and roots, in juxtaposition with a call for adventure and exploration. She recalls her childhood memories of playing with dolls' houses which inspired this current artwork. This Dolls' House was created in collaboration with the Dolls House artists.

Kendal and four artists (named subsequently as the Dolls House artists) met at the EVA conference in July 2023. By invitation, the artists – Freddie Sanders, Jacob Deakin, Caitriona McAllister and Chloe Maybank were invited to work on this Art Installation project – 'The Dolls House' for ten days during August and September, produced by Dreamstudio.io. Each artist was invited to create their own unique dream-rooms which could be viewed through designed shaped windows and open doors of 'The Dolls House'. The installation was exhibited at the APT Gallery, Deptford during the month of October 2023 as part of the A-Maze Artists' Collective Exhibition.

2. THE BRIEF AND DEVELOPMENT

'Dolls' House', is a 3D Art Installation and could serve as a potential prototype for a hybrid virtual platform of Artists' spaces. As the Artists' Lead – Kendal offered the Artists' Team a brief on the theme of dreams during and about childhood. Acknowledging that dreams, images and traumas that haunt a person's life may stem from early childhood, experiences of dreams, the uncanny, surreal narratives of migration and transition. From top left, the rooms are entitled: Freddie Sander's 'Lunar Dreams', Jacob Deakin's 'Space Over Time', Caitriona McAllister's 'Lost Languages', Chloe Maybank's 'Engine Hub Heart', Maureen Kendal's 'Garden-River', 'Narrow Stairs', 'On the Beach'.



Figure 2: The Completed Dolls' House

2.1 Why create a Dolls' House ?

Kendal's autobiographical story includes experiences of migration, loss and associated trauma. In 1961, a small child with her family travelling by ship from Cape Town, South Africa to Southampton, England, UK. This was a time of political upheaval and threat in South Africa. Leaving behind an extended family, the ship's journey is remembered through the eyes of a reconstituted fantasy. The small migrant family integrates into 1960s London. Later, the child is perceived as being very quiet and not thriving at school and is sent to the therapeutic setting of the Tavistock Clinic where she plays with a dolls' house and its dolls. As an adult artist, she reconstructs memories of her childhood, lost grandparents, sensations of 'fynbos' – the mountain flora and fauna; gardens festooned with grape vines; the being 'On the Beach', the sensations of being on a ship, the glint of sunlight on sea waves, the brilliance of African sunlight, dappled and filtering through tall trees. All our lives, we may search for memories of earliest feelings of home, and for many this includes migration and/ or transition. This was discussed by the Artists, each of whom had their own experience of different types of transitions. Whilst a dolls' house can evoke memories of childhood, traumas and unconscious dreams; experience of play itself can offer a capacity to reconstruct and transform. A dolls' house presents a miniature world and its characters. A dolls' House allows the player to 'flow' – as in semi-conscious engagement (Csikszentmihalyi 2008) similar to the flow of optimal gameplay, within computer games. The miniature scale allows the player to be omnipotent (Stewart, 1992).

2.2 Reusables – recycling of devices and materials

The current movement of sustainable ecology with its 3 Rs – Reduce, Reuse, Recycle in the 2020s popularise reusing of materials. The re-framing and reusing of materials by artists are noted, for example Duchamp and his Readymades, Cubists 1912–14, then Surrealist Artists of the Paris School in the 1930s, by Kurt Schwitter's collages in the 1940s. Kendal was inspired through her personal relationship with Catherine Yarrow, the surrealist artist (Weyl 2019). Yarrow had used collage within her art practice. This Art Installation, 'Dolls' house', items are repurposed, as collage materials, e.g. 'out of date' electronic devices e.g. iPads, iPhones as standalone movie players, laptops as coding platforms and the recycling of tangible furniture into a dolls' house. Why was this specific antique chest of drawers used? Over 25 years ago, a girl worked on transforming it into a Victorian Dolls House, her family and friends contributed to the project under the girl's instructions. However, the project was eventually abandoned and was left neglected in a cellar. The Art Installation, with its doors closed, looks like an antique chest of drawers but then when the doors are opened, it is transformed into a large dolls' house. From the start of this project, it came with already made floors, doorways, and a staircase but its rooms were dark and narrow, and the ground floor was too low to access easily. Windows, interior lighting and a specifically designed plinth were required to enhance usability and audience access.

2.3 Using a combination of the digital, tangible tools and palettes

Kendal's art practice encourages a palette that combines tangible and digital tools. Tangible art methods such as drawing, painting and mixed media – e.g. sand, clay, fabric – are combined with / like a collage, animated visual digital movies and effects. Experimental methods for combining the tangible textural surfaces with the digital and vector graphics, such as mitigating smooth plastic-like surfaces of (mathematically generated) vector graphics with textural qualities of bitmapped photographic imagery; using textural skins and layers over vector shapes /polygons; exploring a wide-ranging palette from 3D computer generated images in combination with celebrating the feel and touch of ancient textures of charcoal, found pigments in rocks, plants and shells – enabling mark-making over surfaces of bark, stone, paper or canvas.

2.4 User interactivity – embedded electronic sensors.

2.4.1 Current project:

- This Dolls' House project uses sensors which are triggered by a Unity programme. McAllister and Maybank programmed user interactivity so that the camera eye feeds data to a proximity sensor that detects movement in front of the Dolls House. This, in turn, triggered the soundscape.
- Interior Lighting was integrated throughout the Dolls House, but not yet sequenced due to time constraints.

2.4.2 Future versions:

- Interactivity could be expanded to generate electronic sequencing of lights throughout the Dolls House, to guide the user through a specified sequence, enabling a narrative.
- Embedded pressure pads or the temporary interruption of laser circuits/lines could be added. So that on pressure or line interruption, users interact with the artwork to trigger different light sequences or sequences of the video screenings.
- Creating trays of magnetic sand with objects to be arranged by audiences.
- Capturing images of user co-created scenes that could be sent to users as activity takeaways.
- Wardrobe of Assets for a virtual or hybrid game platform, e.g. characters who might travel across the rooms. (A-Maze artists' Virtual World design 2020- 2023)

3. THE ARTISTS

3.1 McAllister Room 4 'Lost Languages'

McAllister is a creative technologist specialising in coding and digital art. Currently works within the realm of immersive experiences for the global innovative company, Seeper. Emerging technologies allow her to create visually stunning and thought-provoking works of art.

3.1.1 Description

Viewed through arched windows. White on white lettering. Evoking ancient lost languages. Interior with domestic animals. A ladder poised to transit into the next floor or another dimension or an escape upwards. Bookcases of ancient texts. Curtains of letters from ancient languages. Meanings Lost. The 'Lost languages' room explores forgotten stories and

language. The 'library' is covered in books, stories and scripts that have become extinct in a technical age. The room stands as a poignant reminder of the irreplaceable value of tangible artefacts, books, stories, and scripts that once held the essence of diverse cultures. These fading remnants are testaments to the fact that the modern technological age, while offering unparalleled convenience and connectivity, has also brought about a silent erosion of traditional knowledge. The rise of digital disruption has disrupted cultural continuity. The 'library' in the room symbolises the stark contrast between boundless convenience of digital archives and potential loss of tangible, culturally significant artefacts. Initiatives aimed at digitising and preserving endangered manuscripts, scripts, and languages have emerged as a response. The room filled with vanishing stories and languages serves as a sombre reminder that the age of digital disruption has introduced a complex dichotomy: while technology propels us into the future, it also threatens to sever us from the roots that ground us in our past (McAllister 2024).



Figure 3: *Lost Languages* – McAlister

3.2 Sanders Room 1 & 2 'Lunar Dreams'

Sanders explores the transcendental and transformative potential of digital technologies. His work centres around virtual world building, drawing on ecological, mythical and psychological questions to explore concerns such as land ownership, queer rave culture, family trauma and illegal rare earth metal extraction. In 2024, his exhibition at the Hypha Studios Euston Tower space takes as its starting point the urban legend that Boudicca was defeated

and buried in present-day Camden. The show presents eight artists working in the realm of virtual world building and speculative fiction, reflecting on radical shifts in worldviews, cultural trajectories and visions of the future.

3.2.1 Description

Black interior. Viewed through crescent windows. Moonlight. Fluorescent green stars. Dark presence of 'the guys'. Barely visible. Black against black. Under the cover of darkness. Semi-conscious dreams. 3D printed mysteries (Sanders 2024).



Figure 4: *Lunar Dreams* – Sanders

3.3 Maybank Room 5 'Engine Hub Heart'

Maybank is an emerging game designer, graduated 2023, Greenwich University where she was taught by Dr Jonathan Weinel.

3.3.1. Description

Viewed in the Engine room. In the dark heart of the Dolls House. A pulsating heart of clay. Held together by lights – electronic networks. A roving woman with dreadlocks in yellow dress, migrates throughout the house. Chloe: "Art can be beautiful in all forms. Technological or physical" (Maybank 2023).



Figure 5: *Engine Hub Heart* – Maybank

3.4 Deakin Room 3 & 6 'Space Over Time'

'Exploring the spaces where Experimental Design and Graphic Art intersect. Focusing on Process, Experimentation and Texture my work has evolved through developing methodologies of making. Previously I have exhibited in Japan at the Awagami Miniprint Festival, my work is in the permanent collection of the Portuguese Zine Archive, and I've been involved in a number of Exhibitions around Wales and London. My most recent work was an Artists Residency at the University of the Arts London focusing on Dance, The movement of Shadows and Creative Technology.', Deakin explains: "Inspiration for the particular rooms made in response to Kendal's idea was to do with the idea of space over time, if a room is left entirely uninterrupted there would still be change due to the entropy of objects and materials, specific inspirations were the layering of posters and cyclical build up & fall off in the streets of Berlin. The Futurist and Cubist movements expressed the passage of time through multiple aspects of the same image. The actual imagery used in this artwork was influenced by the Polish School of Poster Design and the overall concept was a twisting of Patrick Suskind's book 'the Pigeon'. Here, rather than the bird in the novel, the room and its space as a whole inhabits an omniscient presence expressed over time (Suskind 1989; Deakin 2024).

3.4.1 Description

Viewed through rectangular windows; Pigeon man, clay with spikes; Printing technique, layers on layers. Palimpsest. White-washed walls. Hints of oranges and blues. Passing of time/space – a before and an after.



Figure 6: *Space Over Time – Deakin*

3.5 Kendal Room Garden-River', Room 7, Narrow Stairs' Room 8, On the Beach Room 9

During 2024, Kendal will be travelling on a Drawing Sabbatical. Posting online a drawing a day – in three images – in process, complete and in context. To be viewed online on this link: <https://dreamstudio.io/maureen-kendal/drawing-the-journey/> (Kendal 2024). Meeting creatives on the journey and giving talks.

Dolls House Installation: "This is an uncanny house. Objects are not to scale. The World is sliding into crisis. Everyday physics is under attack. Something has cracked. Life will never be the same. Dreams 'worm' themselves to the surface. In the Dolls House, artists' dreams are made conscious, brought to life, moulded out of clay by us – omnipresent creators (Kendal 2024).

3.5.1 Description

Room 7 – Viewed through slatted windows, green lush pond life, Half here and there, Home is everywhere and nowhere.

Room 8: 'The narrow stairs'; Liminal space. This halfway hall is a staircase portal. Framed by a portal of burnt umber, ascending and descending steps of white, white-gold, angelic.

Room 9: Sea waves, fragments of shells edged by sand, Terracotta figures on the beach, distant Klezmer memories. Children playing.



Figure 7: *River Garden – Kendal*



Figure 8: *On The Beach* – Kendal

4. METHOD

The artists collaborated in the same space enabling cross fertilisation of ideas and craft techniques. Each artist was offered one or two rooms in the Dolls House to create their own imaginary space. Side rooms were viewed from side windows as well as through the open front cupboard doors. Artists contributed their specialist domain knowledge in digital, coding and tangible craft skills. Materials included electronic sensors, sketching papers, wallpapers, paints, glues, fabrics, sands, air drying clay, woods, tools for paint, clay, woodwork, electronics and devices. In addition to teamwork, artists' specialist contributions to the overall project included: InDesign overall blueprint by Sanders; the plinth by Deakin; lighting, audio, electronics and photography by McAllister; Unity programming by Maybank.

4.1. Development of design elements

4.1.1 Soundscape audio

McAllister composed a soundscape using the artists' composed soundtracks and samples to generate an atmosphere of childhood and migration, through evocative music and a sense of children's conversations at play. Duration is 1 min 32 secs.

4.1.2 Lighting

Ambient exterior light was enabled through the shaped windows. Windows were designed by Kendal, Sanders, Deakin and McAllister; woodworking by Deakin with support from Sanders.

The windows were designed as three rows of three windows with shapes of the moon, slatted windows, rectangles with curved corners. With reference to the sequences of the moon, dreams and the unconscious and significant shapes of windows from our childhood memories. Electronic interior lighting was specifically designed for each room and produced by McAllister in consultation with artists. For a future development, the lighting could be designed to reveal a specified sequence of the rooms – thus facilitating a time-based narrative-choreography of light, colour, interiors and characters.

4.1.3 Characters

Group discussions around ancient myths evoked the idea for terracotta figurines as characters. Similar to Gaming Non-Player Characters (NPC); their role might develop into a chorus of characters who offer commentary to the user experience and /or a main story. Artists created dancers; hybrid humans with animal-like characteristics or robotic features, domestic animals and abstract monuments. Abstract and figurative characters evoked a sense of the desire for companionship.

4.1.4 Colour

McAllister and Sanders worked with monochrome to create a dramatic dream-like look and feel. Deakin used a palette of whitewashed walls, orange and blues. Maybank used black with orange, yellow and red electronic wires evoking computer devices turned inside out, Kendal used blues, greens, natural sands and shells to evoke earth and sea exteriors.

4.1.5 Devices as movie players

The 'reusable' concept reconfigured 'out of date' iPads and iPhones to become miniature movie players installed within the interior of the installation which played looped artists' movies.

4.1.6 Embedded movies

Sander's movie of a seascape, linked ideas of the moon, sea tides and the Unconscious with his mysterious abstract forms. Kendal's movies composited scenes from movies taken by the artist travelling along the Amazonian Napa River with her drawings based on the Australian Movie – 'Picnic at Hanging Rock' which depicted young women on a picnic, before mysteriously vanishing into the Outback. This collaging and overlaying of imagery evokes a sense of innocence and a desire for adventurous exploration with unseen dangers.



Figure 9: Audience Engagement, movie player through slated windows – Kendal

5. THE EXHIBITION AT THE APT GALLERY

5.1 Preview evening – 5th October 2023

“A positive reaction within the context of the overall preview event, I believe that the piece had a good placement within the room allowing for members of the public to easily interact and experience the piece, initially I was unsure about the height of the piece and how easily the public would be able to experience the upper and lower rooms, but due to the amount of space around the front of the object I believe that the space provided adequate space for viewing the object before coming up close and directly interacting with it.” Deakin 2023.

“The dollhouse garnered a favourable and impactful response from the crowds, with the active participation of the audience contributing to the project in unique ways. The audio design added an atmospheric dimension, enhancing the overall experience, while the strategic use of lighting heightened the drama and drew attention to the artwork. Positioned at the core of the exhibition, it proved to be an excellent hub for user engagement, interactivity, and audience recognition. In summary, the opening night proved to be a resounding success, with the various elements seamlessly converging to create a cohesive and impressive art piece.” McAllister 2023.

“Audience participants were intrigued by the Dolls’ House and by the embedded electronic sensor technologies. People discussed their own experiences of Doll’s Houses and were intrigued that this was made from a reusable – an old cupboard, and that old iPhones and iPads could be reused as mini movie players. People were intrigued to view the house through the slated and shaped windows – and to look into a room – which had a movie player – like a mini-TV screen within an imaginatively created room. One participant spoke of an uncanny, uncomfortable and weird feeling she always felt when offered a dolls house to play with as a child; for others their sense of childhood play was evoked and they were intrigued to see adult artists using this platform as a ‘canvas’ to bring to life their imagined fantasies, giving the audience participants licence to become creative makers themselves.” Kendal 2023.

5.2 Comments on The Panels

“I had the opportunity to participate in one of the panels during the final night of the exhibition. Our conversation delved into ecologies and the environmental impacts on practices within the art world. I was captivated by the diverse perspectives shared by my peers, and I recognised the significance of raising awareness about the issues discussed” McAllister 2023.

“I contributed knowledge on Artists’ Estates and led the Exiled Writers External event featuring Iranian and South American poets in exile. However, some APT gallery panel events were personally challenging due to the emergence of political polarisation due to October 7th Atrocities in Israel perpetuated by the terrorist group Hamas (this occurred two days after the opening of the exhibition), I experienced this misappropriation of postcolonial discourse and the antisemitism arising from the ensuing Gaza war and its aftermath as terrifying.” Kendal 2023.

5.3 Audience responses

The gallery audience was more than 350 individuals or family groups. Engaging with the Dolls’ House, they recalled their own childhood experiences. Some described a sense of horror of miniature worlds, others – a sense of omnipresence and control, a sense of aesthetic, design and kinaesthetic pleasure, a sense of recreation of a lost family or a fantasy family which they had longed for but never had. Many were intrigued by the different rooms in ‘The Dolls House’, the different approaches by each artists’ interpretation of their childhoods’ dreams. Kendal imagines that narratives may emerge ‘inbetween’ the dreams revealed within the rooms, suggesting that it is ‘inbetween’ our shared dreams that creativity can flourish.

5.4 Lessons learnt – artists’ responses

5.4.1 Reusables or Designing from Scratch

“A streamlined/standardised approach may have worked better/ reduced many of the challenges we faced building the piece, the part conversion of a beautiful piece of furniture was both brilliant and complicated. Specifically the materials originally used to make the cabinet fit their original purpose extremely well, but modifying it into a dolls house proved more difficult, partly because it was a complete object it was almost impossible to entirely disassemble the object without causing damage to the piece, and the hardness of the wood created a robust piece of furniture but a difficult object to modify largely with hand tools. If we were to repeat this process I would recommend designing a dollhouse from scratch, allowing us to take into account the placement of electronics and with the ability to disassemble it to more straightforwardly work on individual panels (Deakin 2024).

5.4.2 Open Design versus Structured Design, working with Complexity

“The project allowed us to contribute diverse perspectives collectively. The incorporation of numerous interactive elements, spanning from lighting and 3D models to responsive audio and reactive visuals, along with both digital and physical components, made it a multifaceted endeavour. This complexity, while exciting, also posed challenges in terms of preparation and organisation. The proposed next stage of the project will require a more tightly structured project and time management to develop, implement and test the coding aspects and user interactivity” (McAllister 2024).

6. CONCLUSION: COMMON DESIGN STRUCTURE AND INTEGRATED GAME-PLAY

The Dolls House project enabled the artists to produce unique individual prototype art installations in miniature, exchanging inspirational myths, dreams, poetry, technical know-how and collaborative team working. For the next stage, agreed design elements would support an integration of the look and feel and a focus to develop creative team-working practices, technical skills exchange and innovative insights (Kendal 2024).

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Immersive AI-Driven Language Learning: Animating languages through gamified encounters

Karoline Winzer

<http://www.karolinewinzer.com>

karowinzer@gmail.com

Gamified language learning apps and programmes like Duolingo use clever algorithms, AI, and interfaces to reframe vocabulary and grammar content in an entertaining, personalised and engaging way. While previously lacking in conversation exercises, OpenAI's November 2023 update to the language-generating ChatGPT-4 model unlocked theoretically infinite content and conversation practice, all while increasing the level of personalisation for learners. This paper explores the positive benefits of gamification in language learning. It analyses the function and user interface of language-learning apps, the power of new AI models in improving this experience, and how AI advancements open opportunities for more multi-modal and highly personalised language-learning experiences. Finally, we discuss language immersion and how these practices could augment current gamified language learning.

Language learning. Gamification. Artificial intelligence. Language generating models. ChatGPT-4. Replikant. Mobile apps.

1. INTRODUCTION

Learning a language takes many forms, including self-study and language classes. However, self-study is often associated with extensive discipline, with self-taught learners often needing to collate their own programmes through a series of different online sources, reading, forums, and apps to properly learn a language. Equally, the commitment of money, time, and dedication required for language classes is simply not an option for many (Freeman et al. 2023, p.8).

In response to this, digital language learning programmes and aides have erupted across the market in the last decade. These apps, plugins, and programmes take a very different approach to language learning: gamification. Gamification refers to the “application of game dynamics, mechanics, and frameworks into non-game settings” (Stott and Neustaedter 2013). Gamified interactions are typically engaging to complete, and provide elements like storylines, rapid feedback, and quests (Stott and Neustaedter 2013). In digital language learning, this concept amounts to gamified encounters which treat language learning like an adventurous quest, increasing interest and retention. On top of this, these games are not just digital versions of traditional language learning techniques like flashcards and grammar exercises –

rather, they use clever algorithms, AI, and interfaces to reframe the same vocabulary and grammar content in an entertaining, personalised and sustainable way through short, manageable encounters. This amounts to an easily accessible learning programme which is available on a handheld device, has low or no cost, can be completed in manageable 10-minute sessions during a commute, and makes those completed lessons feel fun and rewarding.

Given these points, it is unsurprising that this kind of digital gamification has shown marked success, with apps like Duolingo boasting 40 million monthly language learners in 2020 (Blanco 2020).

However, one key shortfall was the inability to provide the same kind of speaking practice and in-depth grammar corrections that in-person classes or dedicated self-study could. This all changed with OpenAI's November 2023 update to the language-generating ChatGPT-4 model, which unlocked theoretically infinite content and conversation practice, all while increasing the level of personalisation for learners. This new technology has sparked strides in language learning, but still falls short of the efficacy of immersion-based approaches.

Investigating the industry, this paper explores the positive benefits of gamification in language learning. It analyses the function and user interface of language learning apps and the power of new AI models in improving this experience, focusing on the varied ways in which these experiences approach 'input' (listening and reading) and 'output' (speaking and writing) in the language being studied (one's 'target' language). We discuss how advancements in AI output can continue to create generative, multi-modal, highly personalised and gamified language-learning experiences, as well as industry examples which are spearheading this pathway. Finally, the author examines the impact of adding another language learning methodology to this existing landscape in the form of the immersion-based approach, which fosters a more intuitive understanding of a language that focuses on inputs to aid effective outputs (Liu 2022).

To explore these points, we will focus primarily on the gamified language learning app Duolingo, and the AI-focused programme yourteacher.ai, due to their extensive documentation and relevance, and will supplement these with further examples and information from the author's personal experience with language acquisition when useful.

It is also critical to note that, as with all new advancements in technology, using generative AI for language learning requires careful monitoring, constant auditing, and consistent evaluation of planetary sustainability.

2. GAMIFIED LANGUAGE LEARNING

In this section, we delve into the intricacies of gamified language learning apps, examining content provided by these apps and their teaching strategies (content and practice methods), advantages of adaptability in these games (personalisation), and the role of gamification elements in maintaining learner motivation and interest (storytelling and rewards). These programmes mainly help learners train the output of speaking and helping active grammar and vocabulary in a systematic way, as opposed to the inputs mentioned by immersive models, which focus on contextual listening and reading.

2.1 Content and practice methods

Methods to practice accurate vocabulary and grammar relevant to learners is the clear first objective of any effective language learning app. These methods must equally balance this content through the interaction and coordination between the four main components language: reading, writing, speaking, and listening (Nan 2018). Beyond this, they must be in an intuitive format while being able to provide instant and accurate feedback.

2.1.1 Content and gamification

The way content is structured varies across different gamified apps, the language being taught and level of learner they cater to. However, one fairly common and effective theme is to teach content by combining elements of visuals, reading, writing and listening (to native pronunciations) while completing vocabulary and grammar exercises (figs. 1-2). This multimodal approach provides a more accurate picture of the language, which is ultimately more effective for teaching and allows learners of many different learning styles to properly engage with the material (Rodgers, 2019). Both vocabulary and grammar is taught in this way.

Vocabulary is typically taught in a digital reformatting of more traditional study methods, either through playing matching games or presenting flashcards of words to learn in a more traditional way (Figure 1). In gamified apps, this approach typically allows learners to listen to the word as it is clicked, and to read or type along, depending on the exercise. However, techniques of slowly introducing words in context with accompanying audio have also been introduced (Figure 2).

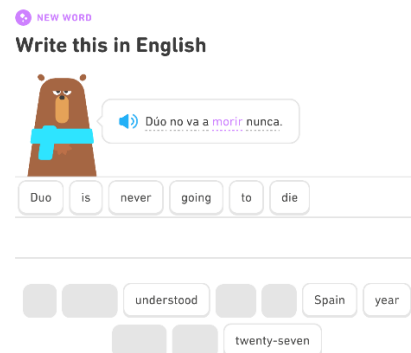


Figure 1: An example of Busuu flashcards and interface.

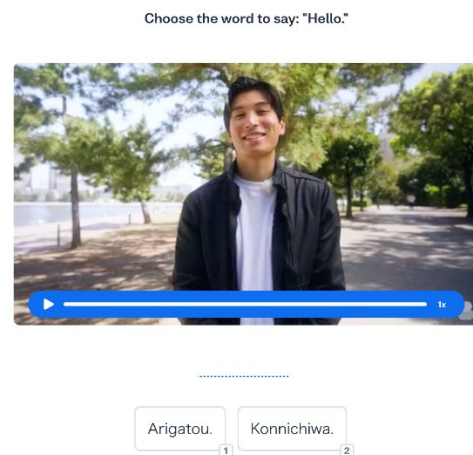


Figure 2. Duolingo's learning new words in context (bottom). Screenshots taken by author.

Grammar in gamified apps however, is taught as an optional “sidebar”. That is, unlike standard language courses, grammar sections are either presented in optional sections, extremely short bullet points, or not at all. In apps which veer more towards complete gamification, grammar is mainly learned through context and examples, employing a type of learning more akin to pattern recognition (Freeman et al. 2023) which lends itself to short-format, practice-based lessons.

This kind of pattern recognition is also found in slightly longer format lessons. A common study method is to watch movies and TV shows in one’s target language with the subtitles on, either in one’s native language or in the target language itself. Through the scenarios on the screen in conjunction with the writing, learners start to recognise patterns and meaning. This disguising of learning as entertainment makes language learning effective and enjoyable (Roslim et al. 2021), and also plays into the gamified aspect of fitting language learning into pre-existing daily rituals. Entire apps and services have evolved around this self-taught gamification trend including Lingopie, which allow learners to see the words of any Netflix show being spoken in subtitle format, and to see their definitions (Lingopie 2023). It is important to note that the multimodality of these interactions is key. A combination of a visual enactment of a scene, hearing the words being spoken, and having access to the transcription allows for an innate recognition of vocabulary and understanding of the rhythm of a language.

2.1.2 Speaking and conversation with AI

Speaking practice is equally as important in language learning – 53% percent of adult language learners cite speaking and verbally communicating in their target language as their main reason for learning (Jordan 2016). The apps mentioned earlier incorporate speaking through their exercises, usually playing correctly pronounced audio, asking users to repeat, and grading the accuracy of the response.

Conversation practice becomes more complex. This kind of practice requires dynamic responses with a learner’s existing bank of vocabulary and grammar, and is most representative of real-life use of a language. This is where generative-language AI capabilities come into their own.

Because these AI models are capable of chatting in multiple languages, learners can practice their target language with infinite conversations – and without the need for a native speaker on standby. As polyglot Olly Richards puts it, you often do not find conversation practice with native speakers outside of the country or countries which primarily converse

in that tongue, claiming he has spoken more French in three weeks of using an AI chatting tool than in 22 years of learning French (Richards 2023). Conversation enables role-playing to practice practical points like ordering at a restaurant, as well as speaking about interests. This in turn encourages communication skills and builds confidence in using the target language.

In apps like Duolingo, conversational AI integration tends to be more subtle, with a chatbot interface feature powered by ChatGPT-4 engaging students in conversation practice about specific topics (Duolingo 2023).

The power of this kind of AI application is best exhibited through yourteacher.ai, which uses the same GPT-4 model to power an online tool for intermediate learners to practice completely personalised speaking and listening whenever and for however long they want. While not as gamified or as highly designed as Duolingo, the true selling point of this software is its ability to lead personalised conversations, give feedback in the learner’s native language, and include multiple different difficulty levels dynamically set by the user. For example, an intermediate learner of Spanish may start a conversation in Spanish and receive a spoken response in Spanish. If they are unsure of a word or need an additional grammar explanation, they can ask the software questions about it via speech or writing. If they would like their AI teacher to decrease the difficulty level and use more of their native language to teach them their target language, they can ask this too (Figure 3).

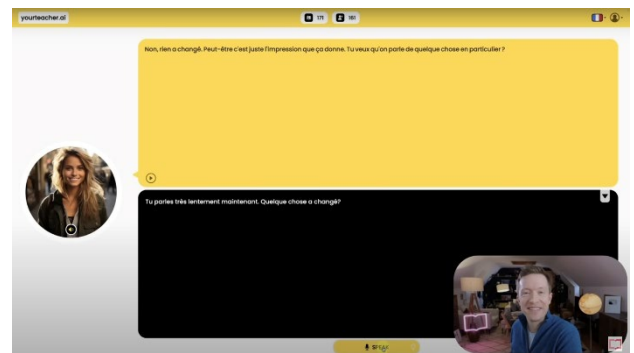


Figure 3: Screenshot from [Yourteacher.ai](https://yourteacher.ai). The interface, while basic and significantly less gamified than Duolingo, provides options to speak, change language difficulty settings, and engage with a character that has an AI-generated personality (Richards 2023)

Of course, these features do not come without criticism. Artificial intelligence is still capable of making mistakes and incorrect inferences, and several of its features (including AI-generated voices) are not yet at their highest possible standard. In fact, even yourteacher.ai has a disclaimer on its site to this effect, and still recommends speaking with real people as often as

possible (YourTeacher 2023). These points should not be minimised or forgotten, and must be carefully considered as AI continues to develop. However, the point still stands: with the addition of language-generating AI to this field, speaking, writing, and conversing has become easy, available, and theoretically infinite.

2.2 Personalisation

The ultimate beauty of individualised gamified learning is in its variability and personalisation, whether augmented by AI or not. Personalisation tends to respond to three main points: the level of the learner, individual interests and goals, and the accessibility of that experience.

The level of the learner is how much they know of a language. Levels vary widely across age and experience, and with algorithms and AI models engaged in gamified learning, learners can receive perfectly paced, individualised, and effective practice. For an app or programme to be used sustainably over an extensive language learning journey, this includes adapting to multiple levels, even providing slight alterations in individual lessons. For example, Duolingo uses its AI, Birdbrain, to dynamically provide more practice or change an exercise's difficulty depending on how learners do in their lessons (Freeman et al. 2023, p. 4). This is also a kind of subtle feedback which plays into the learner's overall experience.

Personalisation is equally important to the individual goals and preferences of the learner. The goals of learners vary significantly from person to person, and the same strategies for a learner looking for academic written fluency in a language may not work for a learner interested in conversational fluency, and is further nuanced by different objectives within academic and conversational proficiency.

The ability of AI models to directly correlate content to learner's objectives and interests is what makes [yourteacher.ai](#) so appealing for language learners, and echoes a common industry viewpoint that one of the most effective ways to learn is by speaking and learning about topics which genuinely interest you (Your Teacher 2023, Memrise 2021).

Last but certainly not least, the personalised format of a gamified language learning experience is pivotal to how and how much it is used. Format in this sense refers to the variability which allows learners to learn on their own time and in their own way, forging those ten minutes for language learning on their daily commute or after a day at work on a larger screen. Most apps and programmes mentioned thus far are available both on desktop and mobile, and, importantly, constantly available as long as there is

an internet connection. This allows learners full control over the time, amount, and setting of their language-learning interactions.

2.3 Storytelling and rewards

At the core of gamification is storytelling and rewards. These two elements make short-form lessons interesting and keep learners wanting to continue. They can be constructed in many ways, but these strategies tend to encompass a structured storyline or pathway to a higher level, instant feedback, well-designed user interfaces, visual representations of progress, and rewards for completing lessons.

Gamified language learning apps slowly elevate learners from basics to more complex learning, and some, like Duolingo, follow traditional language learning frameworks such as CEFR for European languages (Freeman et al. 2023). Especially for beginner learners, this structure to gamification is necessary and helps to create the sense of a clear starting point and clear next objectives leading towards the goal. The advantage of gamification is that it approaches these frameworks with a friendly interface that keeps learners coming back and learning step by step, as opposed to seeing language as an insurmountable task. As Stott and Neustaedter (2013) found in their paper, introducing the gamified elements of freedom to fail without consequences and nearly immediate feedback on incorrect answers was highly successful in learning contexts.

The interfaces of these apps include clean and animated elements which increase their game-like feel, as seen throughout this paper. Additionally, many apps use subtle visual and audio cues to enhance the gamified experience and provide multi-sensory immediate feedback. Duolingo especially includes specific text colours to call attention to key parts of an exercise and positive-sounding audio feedback for correct answers (Freeman et al. 2023).

However, while these interfaces are powerful, this can result in a trade-off. For example, Duolingo has an incredibly attractive interface and gamified structure, but its attempt at humorous and memorable sentences (Freeman et al. 2023, p.7) is met with criticism by users explaining that it provides content irrelevant to communication (Wilmers n.d.). Alternatively, companies like Busuu provide structured and relevant content, but in a more traditional format of flashcards without elements of entertaining gamification.

Lastly, the inclusion of built-in rewards encourages the continuation of the game and the creation of a language-learning habit. In very simple iterations,

this includes a feature on yourteacher.ai which counts the words which a learner has correctly used and displays this figure as motivation (Your Teacher 2023). In more gamified contexts, this takes the form of “streaks” or progress bars which count how much you have progressed in your language journey, or how many days you have been active on an app. As Duolingo language researchers express, “streak” features mean that learners always have the impression that they are making progress – this provides an extrinsic motivation to return to the game (Freeman et al. 2023, p. 9). Other motivational and “reward” features include leaderboards which allow you to “compete” with other players, and badges for completing “quests” (Figure 4).

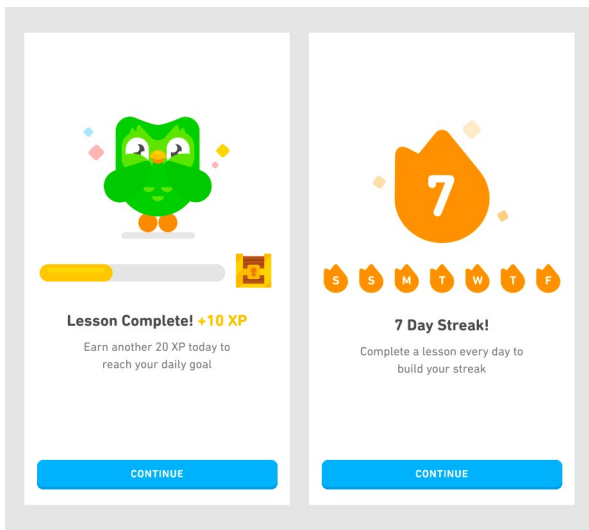


Figure 4. Example of Duolingo streaks and progress showing the effective use of animated characters and visual representations of progress in gamified language learning. These features are also consistent across Busuu with a very similar design. (Duolingo 2020)

Another aspect which contributes to a player’s motivation to stay in the game is an emotional attachment to characters which guide that player along their journey (Bopp et. al. 2019). This is a common principle in video games and film, and crops up in apps like DuoCards’s mammoth mascot, though again is best exemplified by Duolingo’s iconic green owl, “Duo”. Duo has gained an extensive cult following since the app launched, with its attitude of passive-aggressive encouragement and bright aesthetic creating a popular meme subculture (Lee 2018) and a love-hate relationship with “The Owl”. However, not all users are pleased with the character and its attitude, and leave Duolingo as a result (Sung 2019).

It is clear that AI-guided language learning has a significant amount to offer through structured, personalised, and engaging pathways which keep learners motivated. However, there are criticisms for apps currently on the market; they can be too structured with not enough gamification (Busuu),

effectively gamified but missing relevant content (Duolingo), or personalised and immersive but still technologically insecure (yourteacher.ai). So, how can current AI contributions contribute to these practice-based, personalised, and reward-based interactions?

3. FURTHER AI CAPABILITIES AND EXAMPLES

Gamified language learning has focused on AI’s ability to speak and respond to text. However, as this technology improves, it can increase the multimodal practice methods and personalisation aspects which are already proving effective.

3.1 Examples in industry

A recent uptick in image and video generating tools could improve existing software by augmenting their chatbot tools with customisable characters. An example of this is a tool like Replikant, which allows users to create a character from scratch that reacts to spoken prompts (Replikant 2024) (Figure 5). Because emotional connection to characters is such a key part of gamification (Bopp et al. 2019), and anxiety caused by characters can cause a negative effect on learners (Sung 2019), this aspect of entertaining personalisation could help to engage learners in a way that works best for them. This approach could also activate an additional visual parameter of multi-modal learning, going beyond the static chatbot pictures of apps such as yourteacher.ai, Mondly and TalkPal.AI.

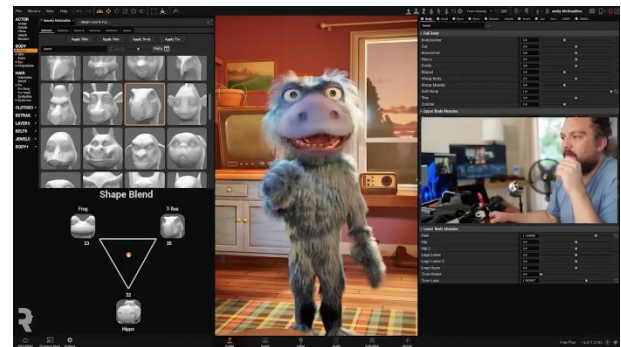


Figure 5. Example of Replikant Chief Technology Officer Luc Schurgers demonstrating real-time character design of an avatar with the capability to engage in brand-specific conversations (Schurgers 2024).

Another potential application of AI advancement is the ability of AI models to give grammatical examples and lessons in a personalised way. Recall that most gamified apps do not give this context to learners. Take the Chat-GPT 4 model, which can give accurate grammatical practice examples, as per the author’s experimentation (Figure 6). The integration of these AI capabilities into language learning apps could provide the nuanced

personalisation which allows learners to navigate the balance of theory and practice missing in gamified apps, while still being able to remain in the context of a gamified system.

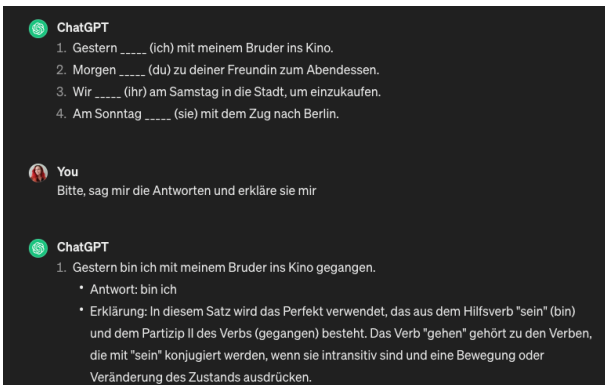


Figure 6. Example of four accurate fill-in-the-blank conjugation practice sentences generated by ChatGPT, and the subsequent explanations of their answers provided by the model. When interacted with in German, the model also gave the correct answers in German.

Looking towards the future, with the daily improvement of AI, these features could theoretically be extended to any language with the right AI model training. In its best cases, this opens up possibilities for theoretically infinite language learning for languages which do not have adequate online courses or resources available, and the important additional potential of reanimating dying or endangered languages.

However, there are further areas to be developed. While an impressive step towards customisable 3D chatbots, apps like Replikant are not fully realistic and still within the uncanny valley, while language-generating models as a whole can make errors and provide incorrect translations. In terms of improvement beyond the technical space, one further area stands out: a broadened view of language pedagogy.

4. AN OUTLOOK TOWARDS THE FUTURE: THE IMMERSION STRATEGY

In this paper, we have explored how engaging and motivating practice for grammar, vocabulary, and outputs like speaking are made even more effective by gamified apps and new AI integrations. In this section, we will discuss another facet of language pedagogy which focuses on input and may contribute to a more nuanced gamified experience: immersion.

Immersion is a technique of language acquisition which involves taking in native content through

listening to, and to a lesser extent reading, a language in context, ultimately being surrounded by the language which learners are attempting to acquire. While initially a steep learning curve, this technique of input is comparable to how children learn languages (Ghasemi and Hashemi 2011) and is the foundation for linguistic methods such as Krashen's theory of comprehensible input. This theory is a key text in the immersion discourse, and posits that if learners are introduced to context-driven input at a level suitable for them, they can acquire a language over time without extensive amounts of additional study (Krashen 1981). Immersion tactics may include watching scenes being acted out and spoken in a target language, listening to podcasts and stories, setting one's browser language to their target language (i.e. setting YouTube's interface to French if the learner is a native English speaker), or even changing the language of one's GPS navigation system.

Many polyglots, or speakers of multiple languages swear by versions of this technique (Ikenna 2022, Richards 2023), and this viewpoint is echoed by several voices in industry and academia (Budden 2015, Kozlova 2021, Memrise 2021) – hence, it is widely considered to be the most effective way of learning a new language (Budden 2015, Kozlova 2021, Memrise 2021). However, there are very few gamified AI-enhanced language learning apps which incorporate all of these tactics, seeing them as separate or supplementary activities rather than integral parts of the process.

We have previously seen examples of this approach in yourteacher.ai and LingoPie, one focusing on speaking and the other on in-context vocabulary in an immersive format. However, in most apps and programmes, these intake activities are often not directly connected to active grammar and vocabulary study, and appear to be viewed as a supplemental activity rather than a required one. What is most notable about the immersion approach is that it inherently addresses a personalised model of storytelling and rewards through input-centric practice methods, aligning it with the fundamental strengths of gamified language learning. Because of this overlap, it is clear that using immersion approaches in these contexts can yield powerful results.

With continuous improvements to AI, future explorations in the gamified language learning field should include questions of how conversational, multimodal AI developments could include these effective immersion techniques, and leverage them in gamified contexts.

5. CONCLUSION

Having delved into the intricacies of gamified language learning apps, this paper explored gamified short-form approaches to language learning and their features across practice methods, personalisation, and storytelling and rewards. Taking the already significant impact of AI technology on language learning into account, additional applications of AI tools were explored, and potential futures of integrating immersion techniques were considered. Future explorations may include a deeper analysis of immersion techniques in gamification and a more comprehensive audit of AI programmes available to enhance the sector, and a parallel analysis of the ethical and environmental issues which may be caused by this usage. The field of gamified AI language learning holds definite promise, and will continue to evolve in intriguing ways.

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Capturing the Retro-Futuristic Aesthetic of Hong Kong's Street Furniture

Elke Reinhuber
SCM / City University of Hong Kong
Tat Hong Avenue 18, Kowloon Tong
elke.r@cityu.edu.hk

With a fascination for overlooked details in urban space, this research explores a variety of methods and strategies to capture, represent, and preserve the distinctive aesthetic of Hong Kong's street furniture. These objects may soon be demolished or redecorated. The collection will form the basis of a room-scale VR experience that showcases the retro-futuristic aesthetic of the concrete sculptures, blending utopian and dystopian narrative elements. By employing a range of advanced imaging techniques, including photogrammetry, 3D scanning, and NeRF, the project aims not just to capture two-dimensional images, but to create spatial representations that can be retrospectively adjusted for lighting and texture. This venture seeks to advance the technical possibilities of architectural photography, while fostering a deeper appreciation of the city's architectural heritage and cultural identity.

3D representation. Urban furniture. Virtual reality.

1. INTRODUCTION

As in only a few metropolises around the world, the impressive skyline of Hong Kong radiates a sublime splendour. But in the shadows of the striking landmarks smaller details like its unique street furniture is mainly overlooked and ignored, although it plays an important role in the urban fabric. Several of these constructions from the past decades have been already demolished, repainted or restructured with other means. This research employs these structures to investigate the artistic potential of spatial representation in images as the main constituent. It seeks to investigate the possibilities of rendering real objects into stereoscopic visualisation and further on, into 3D models, which allow retrospective camera adjustments and relighting.

Photography of urban spaces has been primarily limited to their two-dimensional representation, despite many attempts to employ other methods. However, it suggests itself to capture the spatial dimension of these areas, as it offers new possibilities for architecture photography and cultural heritage preservation, including overlooked objects such as pavilions, fountains or footbridges, that form a significant part of the urban fabric despite their controversial aesthetic merits and might be missed once they are gone.

Today, images of new buildings are usually rendered, allowing retrospective adjustments to their depictions as a matter of course. Collecting and combining visualisations of existing objects requires another approach, especially if the signs of wear are desirable to include.

The use of stereoscopic recording and representation, photogrammetry or NeRF (Neural Radiance Fields) (Condorelli et al. 2021), and other novel techniques offer new avenues for capturing and representing urban spaces in 3D, allowing concurrently the retrospective adjustments of light and texture; opening novel perspectives for photography in the field of architecture.

Additionally, it is crucial to define forms of distribution that make these spatial representations globally accessible, such as revisiting the object in VR, and as well archivable. This will enable wider dissemination and preservation of cultural heritage, particularly for educational purposes.

After researching the aesthetic quality of Singapore's retro-futuristic architecture as presented in the award-winning stereoscopic video *Venomenon*, I moved to Hong Kong and encountered certain comparable, but also quite different manifestations of that architectural era. I

noticed the special affection for architectural detail there, and therefore I focused on the so-called urban furniture (Gonzaga 2018).

The commonplace nature of street furniture precipitates its invisibility: bus stops, sunshades, footbridges, fountains, lanterns, sales booths, advertising pillars, fire alarms, switch boxes, billboards, litter bins, flower pots, benches and ventilation shafts, all fulfil important purposes in the constitution of the city, but disappear in the insignificance of their tasks. With their inconspicuous pastel colour tones, they simply vanish in the urban fabric (Figure 1). Captured as individual objects on two-dimensional photographs with appropriate lighting, the sculptural quality can be already imagined – however, with current possibilities, it is no big task anymore to record their spatial features – or reconstruct them with synthographic techniques. In this way, we are able to preserve items to be revisited from any angle and even revive different layers. Besides the anticipated value to keep a memory of the peculiar aesthetic, the captured items will provide the foundation for a retro-futuristic scenario in a room-scale VR experience.

Completely unimpressed by the intricate Chinese renaissance style, in the historical architectural epoch of Brutalism (McLeod & Churly 2018) – contemporaneous with 'Tropicalismo' and the Japanese Metabolist style – the urban equipment in Hong Kong was designed with lots of concrete and many edges, which is so distressing to urban planners today that they use paint or a wrecking ball only to get to grips with the inconspicuous functional elements. These seemingly insignificant features contribute to the overall character and functionality of the metropolis. They also illustrate the tension between preservation and progress in cities, as urban planners must balance the need to update and modernise with the desire to protect the past. Although an impression of these structures may be preserved through photography, only methods to capture the spatial dimension can pay justice to these overlooked more or less functional sculptures in public space.



Figure 1: Shelter at Shek Kip Mei Park with withering paint in pastel tones

2. APPROACH

The research in progress evaluates a range of methods to record the spatial complexity and the possibilities of the photographic and synthographic image. As the desired objects are often in surprising locations and hardly visible on Google Streetview (they are mainly located in housing complexes, parks or pedestrian zones and obscured by foliage), a snapshot on a mobile phone keeps a record and the location to return with ease for a thorough capturing process.

The following techniques have been applied to evaluate the possibilities for recording. However, the suitability depends largely on the type of structure.

2.1 Stereoscopic Imaging

A basic method to receive a record of the spatial dimension of these objects is the classic method to capture an image for the left eye and – with an apt offset – an image for the right eye. Throughout photo-history that strategy has been applied, adapted again and again to new formats.

- (i) One of the latest devices for this technique is Canon's RF5.2mm F2.8 L Dual Fisheye lens, capturing simultaneously two parallel circles, side-by-side. Although the distance of the lenses is fixed, through the extreme perspective, the result is convincing, especially when seen with a VR headset, allowing a full 180° view of the location (Figure 2).



Figure 2: Stereoscopic side-by-side image of a pavilion at Kent Road Park, captured with Canon Dual Fisheye

- (ii) An apt and attainable approach is using a modern smartphone with multiple lenses together with the 3D setting on an app such as ProCam. This method works well for a quick capture of medium sized items producing instantly a side-by-side photograph, although compressed as JPEG (Figure 3).



Figure 3: Stereoscopic side-by-side image of a pavilion at Kent Road Park, captured with ProCam on iPhone 12

- (iii) A more complex yet substantial method, if a printed image is the final aim, is using a large format camera with a digital back and shifting the lens standard. The best result is to be printed as an anaglyph image. For lenticular prints with multiple phases, a series of images should be taken with a parallel shift. Lighting and a wider focal length enhance the depth perception.

Nevertheless, this technique only results in a subjective view, defined by the photographer and does not allow retrospective adjustments beyond the ability of a RAW image file. Furthermore, different to the above mentioned methods with the dual fisheye lens or a smartphone, this technique is restricted to stationary objects because of the duration between each phase of the image.

2.2 3D Scanning

- (iv) LiDAR (Light Detection and Ranging) is a remote sensing technology that measures distances by sending laser pulses and measuring the time it takes for the reflected light to return. It creates 3D models of objects and environments by capturing millions of data points. For this research, a Leica BLK360 scanner has been used. The result was neither convincing for smaller objects due to the lack of detail and insufficient texture, nor for the larger area of the fountain. Here, the small particulars of tiles and bannisters as well as the water reflections and movement of plant leaves lead to an unsatisfactory result. (Figure 4).

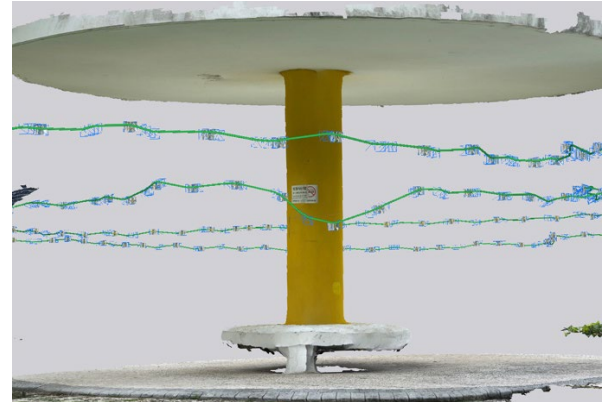


Figure 4: 3D scan of the pavilion with camera positions on iPhone 12 Pro Max with 3D Scanner app

- (v) The built-in lidar of an iPhone 12 Pro Max and the true-depth camera on the backside of the phone however led to surprisingly satisfactory results for smaller items such as planters or benches, especially due to the significantly better recording of the surface texture.
- (vi) Photogrammetry involves capturing multiple photographs of an object or space from different angles and using specialised software to reconstruct a 3D model. This method uses visual cues and algorithms to calculate the shape and dimensions of the subject based on the overlapping images.

For smaller objects, it can be achieved by walking around the item, even apps on smartphones provide convincing results. For larger objects, I have gathered good experiences in the past with recording the objects by a drone. However, obtaining a drone licence in Hong Kong is an expensive and time consuming process and licence-free drones below 250 gram contain only a basic camera and do not provide the stability to cover the recording well from all sides.

2.3 3D modelling based on captured data

- (vii) Based on the recorded data from 3D scanning, in several cases the result is not convincing and basic shapes may be better modelled in an application such as Maya or Blender. To maintain the look and feel of the real object, the captured texture should be mapped on the surface. This approach allows possibilities for retrospective lighting and adjustments such as the change of focal length.

Texture mapping involves applying realistic textures to the 3D models to recreate the appearance and surface details of the

captured objects. Texturing adds visual richness and helps in achieving a more immersive and realistic virtual experience, for example adding the patina on the surface (Figure 5).



Figure 5: Pavilion modelled in Blender based on the 3D Scanner app data

2.4 Synthography

The possibilities which machine learning (AI) and neural networks offer are currently growing by leaps and bounds and have yet to be explored in greater detail. Facebook implemented already three years ago the possibility to expand a two-dimensional image to the third dimension, extracting people or basic objects and filling the background content-aware. For this research, the application will be mainly in extracting the background and once an according dataset of urban furniture will be collected, an AI will be trained to generate new items in the style of the existing ones. This approach will mainly support a method to identify, classify and distinguish the particular features which are inherent to the style. The other approach will be to test the creation of 3D models from a small amount of images with NerFs and the recently introduced method of Gaussian Splatting.

2.5 Structured light

Structured light is a computer vision and 3D scanning technique that involves projecting a known pattern of light, typically grids, stripes, or random dots, onto an object or scene. By analysing the deformation or displacement of the projected pattern in captured images from different viewpoints, structured light systems use triangulation principles to accurately determine the depth and geometry of the object's surface.

This technique enables 3D shape capture and measurement, allowing for applications such as object reconstruction and surface inspection. Structured light systems are widely used in cultural heritage preservation for artefacts and buildings. The available Shining 3D EinScan Pro HD Scanner

at our institution offers a high precision for small objects but has not been used for this research.

2.6 Presentation

The different recording techniques offer a wide range of possibilities for presentation, ranging from the anaglyph or lenticular print to room-scale VR experiences in a headset. The main aim is to allow the combination of different objects in one scenario by matching the lighting and style despite the recording in various conditions.

Currently, we are exploring three-dimensional projections – with point clouds captured by a Leica BLK360 Imaging Laser Scanner, then edited in Blender, to be then displayed on ephemeral surfaces. With the different recording techniques described above, their strengths and weaknesses are evaluated by capturing various items that differ in size and details.

3. CASE STUDIES

To determine a best practice, different types of constructions have been selected for case studies. Two objects located in Shek Kip Mei Park and Kent Road Park in Kowloon and a duplet of footbridges, one in Kowloon Bay, the other in Causeway Bay on Hong Kong Island. With their features and sizes, they provide a good foundation to compare and evaluate the appropriate recording techniques.

3.1 Concrete pavilion in Kent Road Park

Because of its freestanding structure, the pavilion can be accessed and observed from all sides, allowing for a comprehensive capture of its architectural details and features (Figures 2 to 5). Additionally, the selected pavilions showcase unique styles and shapes that can be interesting to analyse and document. The patina of the surface displays layers of refurbishments over time, making it an ideal subject for this case study. Although the height of pavilions is challenging for photographic recording, specifically to capture them from a higher angle – therefore, drone imaging will be employed for more complex versions. As the structure of the pavilions in this research is rather plain, modelling it with Blender 4 and applying the captured texture appropriately for providing a sense of the patina proved to be the best approach.

3.2 Plant container at Shek Kip Mei Park

The planter has an ideal size for capturing a series of images for photogrammetry, including the surface with its signs of wear and layers of paint. It is easy to walk around and record the object from all sides. The result is convincing with individual still images or extracted from a video sequence and combined in Agisoft Metashape or Autodesk Photo ReCap.

Due to its curved and uneven shape, modelling in 3D from scratch is more complex than for the pavilion. For this object, the easiest way to capture resulted in the best outcome: with a smartphone and the 3Dscanner app.

The TrueDepth setting of the 3Dscanner app works by projecting a grid of infrared dots onto the object or scene in front of it. This grid, invisible to the human eye, is used to create a detailed depth map of the scene. The camera then measures the distortion or displacement of the dots to determine the distance and angle of every point on the object's surface. This enables the creation of a highly accurate 3D model.

This technology is particularly effective for capturing medium sized objects because its precision allows it to accurately replicate the intricate details, textures, and unique patina, as observed with the planters.

For both rather small objects, the visualisation on Google Earth is unsatisfactory. The view from the top is partially concealed by the roof or plant and no street view is available due to its location inside the park. Also, the details of the relatively small items require a close-up capture to be visible. For other architectural elements, it is a possibility to gather images for 3D modelling or even for photogrammetry.

3.3 Fountain at Shek Kip Mei Park

It proved difficult to capture the fountain in the Shek Kip Mei Park due to its large size, occlusions, surrounding plants and reflections of the water (Figure 6). The tests with the Leica laser scanner were unsatisfactory, lacking precision since too many fine details make it complicated for modelling. The current approach received from the laser scan is an abstract view as a point cloud which works aesthetically convincing, however does not provide any detail. Therefore, existing images from Streetview and images on location serve as foundation for modelling and further attempts to generate 3D files from single images.



Figure 6: Partial view of Shek Kip Mei Park Fountain

3.4 Footbridges – Wai Yip Street ‘Jimmy Bridge’ & Causeway Bay Circular Pedestrian Bridge

Two selected footbridges, very different in size and shape, (Figure 7), are both regarded as iconic due to their appearance in local and international movies (“Ghost in the Shell”; “Love in A Puff”). Both are challenging to capture due to their size and position, bridging several roads. They are well recorded on Google Streetview, from the inside as well from outside. These images will serve as foundation for 3D modelling.



Figure 7: Concrete pedestrian overpass, Causeway Bay

After defining the best practice for recording several objects of different size, shape and quality, a series of them will be captured with the matching technique, while some will be modelled and the patina of their surface added through the texture. This will also allow us to revive constructions which have already been demolished. Ultimately, they will be visually adjusted in their perspective and lighting to then be combined in a VR experience.

4. CONCLUSION

The aim of the project is to not only look at the well-known structures but also to highlight overlooked architectural gems, peculiar details and smaller constructions. I consider the specific Tropical hybrid typical of the 1970s architectural style as a practice, which can be subsumed under the term “Retrofuturism”, as it appears to be modern and ancient at the same time. Today, this historically significant period seems a thing of the past, a distant memory, buried under the manifold manifestations of international and postmodern designed buildings.

To conclude, this ongoing artistic research delves into the myriad of techniques available for the preservation and representation of urban furniture in Hong Kong, a valuable yet overlooked component of the city's architectural fabric. Utilising a diverse range of methodologies including stereoscopic imaging, 3D scanning, and modelling, the project brings into focus these often-neglected urban

elements, underscoring their distinct aesthetic appeal and cultural significance.

The exploration of these techniques not only highlights their potential in documenting and conserving architectural heritage but also paves the way for future investigations in this field. The capacity to accurately capture and render these objects in three dimensions engenders exciting prospects for expanded photography, heritage preservation, and the creation of immersive virtual reality experiences.

As the research continues to evolve, its findings could serve as a reference, guiding the trajectory of future endeavours in these domains and aiding in the exploration and comprehension of urban architectural landscapes as well as new avenues for capturing and representing 3-dimensionality.

5. ACKNOWLEDGMENT

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Leicester Computer Art Pioneers

Sean Clark
Interact Digital Arts Ltd
Leicester, UK
seanc@interactdigitalarts.uk

1. INTRODUCTION

Leicester is a city of around 350,000 people located in the UK's East Midlands. Despite its relatively small size, it is served by two universities – the University of Leicester and De Montford University – and has an active contemporary digital arts scene. It also has a significant place in the history of computer arts in the UK, starting in the late 1960s with the work of Stroud Cornock and Ernest Edmonds. This short paper reports on an exhibition entitled “Leicester Computer Art Pioneers” that took place in the city in late 2023 and early 2024. The exhibition was supported by a grant from Leicester City Council and should be seen as the *start* of an ongoing project to recognise Leicester's computer art heritage and use it to inspire current and future artists in the region.

2. NARRATIVE

When preparing for this exhibition, a narrative was developed that began with the meeting of Stroud Cornock and Ernest Edmonds in 1968. Edmonds, then working at the Leicester Technical College, was looking for someone to assist with the spray painting of a new artwork he had been working on. He went to the nearby Leicester School of Art and was introduced to Stroud Cornock as someone who could help. Edmonds explained that the artwork, entitled *Nineteen*, had been constructed with the help of a computer. This greatly interested Cornock and the two began working together, producing the interactive artwork *Datapack* in 1969 (Figure 1) and later publishing the pioneering paper “The Creative Process Where the Artist is Amplified or Superseded by the Computer” (Cornock & Edmonds 1973).

The two Leicester colleges merged in 1970 to form Leicester Polytechnic and Cornock and Edmonds were instrumental in developing a research and education profile based around “new media” and computer art. This attracted other artists interested in computers, including Stephen Scrivener and

Dominic Boreham in the 1970s (who had studied under Malcolm Hughes at the Slade). When Edmonds moved up the road to Loughborough University, this continued with Stephen Bell in the 1980s (another Slade graduate) and later, when Edmonds returned to De Montfort University (the new name for Leicester Polytechnic) in the 2000s, with Sean Clark (who had also worked with Stephen Scrivener in Leicestershire in the 1990s).



Figure 1: Stroud Cornock (left) and Ernest Edmonds (right) with a participant operating *Datapack* (1969).

The narrative was expanded beyond the core “Edmonds et al.” cohort to include the work of Prix Art Electronica-winning artist Brian Reffin Smith (who grew up near Leicester) and Graham Bate (who worked at De Montfort University after Edmonds had left).

Research into each of the artists resulted in a timeline and connecting narrative that illustrates Leicester's position in computer art history. This is documented in the exhibition catalogue (Clark 2023a) and website (Clark 2023b).

It is important to recognise that this narrative is in no way intended to represent a *definitive* history of early computer art in Leicester. Many other artists would undoubtedly deserve to be included in a future exhibition. Notably, there are no women included in the list. Hopefully, this can be addressed through

additional research. It is, however, a starting point and one that it is hoped will generate interest both locally and nationally.

3. EXHIBITION

An exhibition of images of artworks from the eight artists featured in the narrative was hosted at Phoenix Cinema and Art Centre in Leicester between November 2023 and February 2024.

For Cornock and Edmonds, four images each were included. For the others, there were two images each. This resulted in a total of 20 framed images. There was also an exhibition poster and a full-colour exhibition catalogue (Figure 3) featuring each image (Clark 2023a). An opening event on the 2nd of November 2023 included talks from some of the contributing artists (Figure 2). Documentation can be found on the exhibition website (Clark 2023b).



Figure 2: Exhibition opening event, Phoenix, Leicester. 2nd of November 2023.

4. NEXT STEPS

The exhibition was well-received by audiences and interest is such that the story of computer art in Leicester is soon to be featured on the council-run *Story of Leicester* website {Leicester City Council, 2024}. This should raise the profile of the work further.

The narrative needs to be developed to identify more pioneering artists and to become more inclusive. This research will continue under the guidance of the Computer Arts Archive in Leicester and will hopefully result in more exhibitions in other local venues.

To fully represent the history of computer art in the city, future exhibitions need to exhibit more than just images, Early interactive works, or recreations of them, such as Ernest Edmonds' *Communication Game* (Clark and Carroll, 2022) and Stephen

Scrivener's *Homeostasis* (Clark, S. and Scrivener, S.), need to be included. As well as the work of electronic sound and music artists, of which Leicester has several pioneers.

Having captured the early history of computer art in Leicester and the surrounding area, this research aims to move on and explore the work of more recent and contemporary artists. This will result in a unique view of the development of computer art and the city of Leicester over more than fifty years.



Figure 3: The Exhibition catalogue featuring Ernest Edmonds's artwork *Nineteen*.

The author would like to thank the Leicester City Council Cultural Ambition Fund for supporting this project, Phoenix Cinema and Arts Centre for hosting it, and the individual artists for their involvement.

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Professional Fouls in Computer Art: From magneto-kinetic anti-aliasing to persuading AI to lie for art

Brian Reffin Smith
Collège de 'Pataphysique, Paris
Kaiser-Friedrich-Str. 54
Berlin, Germany
brinberlin@aol.com

Contemporary art often requires that critique or questions about the artwork be included in (or even as) the artwork itself. Self-referential art, or art that refers to other art, is commonplace and is the basis of art as a more or less systematic inquiry whose goal is knowledge. In science, a paper should question itself and refer to other work. This is, however, rarely the case with the computer-based arts, usually seen and presented as things (processes, systems...) in themselves. Much art refers to art history. Computer based arts in general do not refer to the history of computer-based arts. One can sometimes have the impression, too, that in new media art all must flow smoothly. A certain "glossiness" is often called for. Mistakes, failures, are rarely referred to, let alone exhibited or commented upon. Yet most other art proceeds by failure. Metaphorical "bugs" are generally celebrated as creative prompts. Ugliness is by no means ruled out. Not so often in the field of computer art. Images qua "Artworks", produced by AIs perhaps at the behest of Large Language Models, usually exemplify most of the above, and interactive artworks are often about the results of the interaction, not the experience or spectacle of the interaction per se. We are encouraged to look at the different forms of product, whereas the participants themselves and their behaviour and actions are often of more significance. As a provocative nudge to avoiding the above, examples are presented of this author's and others' work where what might otherwise be considered as professional "fouls" are in fact the point of the (often conceptual) work. Mistakes and lies are celebrated, and the smooth, even meretricious production of conservatively conventional computer-based artworks are derided. A means of causing an "AI" LLM to lie is presented. As a general rule, art that tries to "look like art" is not art, but decoration (unless ironic or bad-tempered) or is bad art. Computer based and new media arts, a fortiori.

Computer arts. Dishonest art. Artificial intelligence. Interaction. Large Language Model.

1. INTRODUCTION

In 1987 the author won the first ever Prix Art Electronica, the Golden Nica, in Linz, Austria, taken warily from the body-guarded hands of the then Austrian Chancellor, Franz Vranitsky under the sweatily hot lights of the Austrian TV service ORF. The jury's decision was believed to have had a dissenter, the person in charge of a famous American computer graphics company.

In those days one submitted artworks to competitions not as electronic files (for outside of the ArpaNet this was still not easy) but rather as colour photographic 35mm transparencies, which were posted to the competition and presented to the jury by means of a Kodak carousel projector.

If the artwork were to be produced on a computer colour monitor, one set up a camera on a tripod in

front of the screen and took photos of it. The resolution of my computer was in the order of 320 by 256 pixels, and the monitor itself was only of TV resolution, so the image was terribly bitty. But the colour slide was virtually free of anti-aliasing, and the jury member allegedly thought that the image had somehow been faked, saying that even his systems could not produce such fine resolution.

And maybe they couldn't, because a special technique perhaps unthought of in California was used, which I called Magneto-Kinetic anti-aliasing. Magneto from the monitor's magnetic coils which focused the electron beam, and Kinetic from the use of the human fist on the metal monitor case itself. The camera was set to a three second exposure and the monitor repeatedly thumped, resulting, after about 30 tries, in a nicely smooth image. The pixels were still visible, but now looked like an intentional artefact in a modern high-resolution image that was

to all intents and purposes photo-realistically continuous. Fortunately the rest of the jury concentrated more on any artistic merit the work may have had. The work was referred to, apparently positively, as “electronic cave painting”.

But the jury member was right in a way, at least in respect of the computer graphics, if not the splendid art. This author would have “cheated”, if the competition had been about screen resolution, which of course it mainly wasn’t. But even today, not a few people might consider a computer-based artwork assisted by human intervention to be a “professional foul”, as if someone who claimed to be able to levitate was in fact jumping. Or if Harold Cohen had just drawn his plotter images by hand. Which he did until he got a computer and a plotter.

This seems to be on a par with the ghost of a dead dramatist decrying film as fake, but I believe such fouls and their discussion to be part and parcel of an attempt to make the computer-based arts less techno-spectacle and more contemporary art. We have always run the risk of using state-of-the-art technology merely to make state-of-the-technology art. The following is intended to show that including fouls, critiques and discussion about the artwork within the artwork itself can not only make it better, perhaps sending it up onto a meta-level, but can also shed light on the fraudulent perfection of some current work which depends on real or pseudo-AI art, large language models and other potentially meretricious spectacles.

2. COOPERATIVE DRAWING

I believe the function of art is to make things difficult, not easy. Or perhaps things that might at their inception seem easy can in retrospect become difficult, in a good way, needing homework to be done. For me, the function of the computer in art is to provoke. On a BBC Micro Model B, the best one, with 32 actual kilobytes of memory, I made in 1982 an interactive program, in BASIC, which allowed two participants to draw together on the screen, using analogue X-Y joysticks that also each had a single button. The computer made an average of the data from each input, and if (and only if) both participants pressed their buttons, a trace was left on the screen, otherwise the cursor just moved without leaving a trace.

In other words, if person A moved the joystick to the left and down, and person B to the right and up, the cursor might hover in the middle of the screen. Because of this averaging, people had to really concentrate and cooperate to even draw a straight line, let alone a circle or some object. The trace that was left was spiky barbed wire. In the middle of the screen was a small flag, usually, for reasons of political Zeitgeist, that of Nicaragua, then under

attack from the USA-backed Contras, a proxy cold war.

Would participants actually cooperate? If so, how? Would they just smash the joysticks around making a random mess? Well, a few adults did, but most were scared of using the joysticks at all. Kids however seemed to love it. A few attacked the central flag, or tried to. More actually built nests around it, or painstakingly wrote their names. Then two things became noticeable. The first was that the greatest enjoyment ensued when they agreed to try and draw two different things, perhaps kid A: a bird, kid B: a boat. The resulting image was of course a mix of the two intentions, with only bits of recognisable bird or boat, complicated by the barbed wire effect. But this became the goal. The “failed” cooperation was in fact an agreement to see what would emerge. Two people doing this became the artwork.

The second surprise was that spectators in the gallery rarely looked at the screen. Everyone observed the kids, and listened to them talking as they drew. The event was not on the screen. What might be thought to have been central became peripheral. The peripherals and their handlers became central. The “failure” as a screen-based experience became a success as a human observation art experiment, which (of course) I then pretended had been the intention all along. This was a very useful foul.



Figure 1: Cooperative drawing 1982 in use 1992

3. ARTIST/CRITIC

First, a note about ELIZA. Many will know that this relatively simple simulation of a Rogerian psychotherapist, using open-ended questions and reflecting input back to the user – “Tell me more about your family” – was made by the computer scientist and MIT professor Joseph Weizenbaum in the mid-1960s – a very early chatbot. Although written in his own language SLIP, it was easy to transfer to BASIC and versions still exist online and as code. This author has exhibited printed conversations between the simulated

psychotherapist and texts fed into it line by line – Marx 'n' Engels' Communist Manifesto ("Tell me Karl, what is your actual job?") or a song by Eminem ("Do you often have these murderous thoughts about your mother?").

Weizenbaum famously was aghast that people took it emotionally seriously, and in conversations with him it became clear that the motivation had been in part to demonstrate that such systems were doomed to fail. Much of his later work became about the ethics of AI.

On examining ELIZA's code it became clear that one could change a lot of the content, and add more, to make the software operate in other contexts. It could perform in an art gallery. One could start treating it as an artwork.

I made a simple version called MARTA – Modest Art Answerer – which was shown in Art For Society at the Whitechapel Gallery in London. Richard Cork, a critic, hit the keyboard once, jumped back when the computer said "What?" and wrote a disabbling review about it spouting random nonsense. However, some people stayed with it for hours, simple as it was, perhaps because it was able, on a trivial level, to "remember" bits of their input and feed them back in new contexts.

When later there was a request to make a similar but more powerful version for a show in France, it was decided to make two distinct entities, running on two Amiga 1000 computers (since these were available free), again written in BASIC, which I loved and still do. (Not very good at anything, it can still adequately do things that would need much specialist work today – you could change a MIDI input into graphics or mouse movements into speech in half an hour).

One version was to be called Artist, the other Critic. They were an advance on MARTA and could go on for longer without revealing their content via unwanted repetition, and had "moods" – even becoming artistically abusive which was a joy to code.

Then the deadline was brought forward whilst the Artist was still being completed, and the Critic not really started upon. there was only one solution.

The setup in the gallery was the two computers, each with a mouse and keyboard, but no connection whatever between the one labelled ARTIST and the other labelled CRITIC. If a visitor typed as requested on the keyboard of one of them, it would reply in a more or less sensible way, in more or less artistic terms.

The participant's task was to help the artist and critic by telling the critic computer what the artist computer was saying, and then tell the artist how the critic had

replied, and so on. The two software 'entities' could only communicate via a human, who sometimes added their own thoughts, shortcuts and comments.

What nobody noticed was that the two softwares were identical, since the critic remained uncoded, and it was only peoples' perceptions of the roles that were different. This provoked the thought that AI's, pseudo-AI's or other apparently complex artworks could possibly be made simpler, with no reduction, or indeed an enhancement, in user experience.

A propos very simple rules provoking interesting participant behaviour Edward Ihnatowicz's famous robotic sculpture *The Senster* (1968-1970, reconstructed in 2017) comes to mind. The huge interactive, giraffe-like structure/sculpture/creature with doppler radar eyes and quadrophonic microphone ears, although a heroic masterpiece of computer-based art, was programmed to do only a few very simple things. Of course this wasn't a "foul" at all but an example of much from little, albeit with years of work behind the "little". It would lower its "head" towards soft movements or sounds, and move – even shy away – from loud sounds or violent movements, from spectator-participants gathered around its circus ring-like enclosure in the Evluon in Eindhoven, in the Netherlands. This simple set of rules was however enough to make anyone interacting with it feel that it was in some way sentient. I had seen the hole it had made in his studio ceiling in University College, London when it had slightly "run amok" and there was no attempt to anthropomorphise the electro-mechanics and hydraulics, but even then it was impossible not to think of it as alive. Visitors in general were kind to it. Many people watched the interactions of others, which again was perhaps the most significant aspect. People got married in front of it. So engrossing was the artwork that Philips, whose Evluon it was, allegedly fearing it would distract from their displays of fridges etc., demolished it in 1974, though happily it has been restored in Poland.



Figure 2: *The Senster*

Mention might be made of a later work by Edward Ihnatowicz, the *Bandit*. It consisted of an upright, moveable lever, which looked a bit like the handle of

an old slot machine, a “one-armed bandit”. People came up to it and wiggled it. After a short time they noticed that the lever sometimes grew stiffer in some directions, and yet in others almost seemed to help. In fact the system was learning about the way people pushed it, and tried to anticipate their movements. A version could then even make a perhaps fake assessment of users’ gender based on their manipulations of the arm. This, he said, was correct... “well about half the time”.

4. LIES AS ART AND MANIPULATIONS OF AI

We should have surely got over, by now, a need for art always to be “truthful”. After all, this criterion of adequacy has largely vanished from much public and political discourse in general. And what is truth in art? If a painting be made of a stone, and titled “Portrait of a Home Secretary”, a very innocent person might say “That is not a picture of the Home Secretary”, but most would recognise it was a valid statement in art or at least cartoon terms. The “ofness” of pictures is today hardly controversial. So... what is an AI image “of”? And if the output of a large language model is presented as art, what is that a representation or “picture” “of”? Already, in many quarters, the response to someone saying, “I asked an AI to make a picture of an alien driving a steam locomotive underwater, and here it is, here in fact are 37, each one different, look...” would be “Yes and well done, now **** off.”

There are of course those who might say “Anything is art if someone says it is” and to these the only possible response is “Yes yes.” Much stuff is made that sort-of looks like art, but isn’t. It just isn’t made for art-like reasons, like the pretend abstract paintings often used as a backdrop in furniture shop windows.

But can one actually patronise the AI itself? The output, when an artwork has been requested, is almost always boring, using the same palette of slightly faded colours reminiscent of goth or alien fantasy images, with far too much green and purple. OK, most art is boring. And here only the pseudo-art produced by online generators is being discussed. There are of course examples of splendid artworks using various aspects of artificial intelligence to remarkable effect.

But in general, the output of real or pseudo-AI image generators is, as art, nonsense. It goes nowhere, does nothing, pretends to be revolutionary but is

tethered by heavy chains of self-deception to the banal, the spurious, the conventional, the deep conservative and the meretricious, where this latter word does indeed come from the Latin for “prostitute”.

Can one use this kind of “AI” to produce art? To produce perhaps not. But to make, to be incorporated into, artworks or an art context, yes. One can take the images produced by art-like commands, such as “Make an image of Damien Hirst having breakfast with Marlene Dietrich in the style of Jeff Koons” and present a horrible selection out of the hundreds of images spewed out. This not only derides the AI (the results, as art, are appalling) but also Damien Hirst and Jeff Koons, which to the present author renders it adequate as art, itself talking about AI and art. Now once this has been done, one can go on to do other such works and the Koons ones will provide contexts for following works, which reference and index the preceding works, and *voilà*. One can even play with titles, grouping multiple AI images provoked by reference to Gustav Courbet’s famous painting “A Burial at Omans” into one work and omitting the letter R, by which means the title refers to Onan, he of bible fame for allegedly practicing coitus interruptus or something. This is not very good art, I think, but *Ceci n’est pas (seulement) une intelligence artificielle*, and it may perhaps provoke others to produce further work.

One can also inject human activity back into the AI products, for example by turning the AI output into paintings by numbers, to be completed by a would-be artist. This is not trivial. Painting by numbers, which are a major part of this author’s present art work, is a reduction of an image to some of its essence, and an addition of numbers, lines and other codes and references can make a complete new artwork out of the AI stimulus. One can even ask a generator to produce images in the style of paintings by numbers, with which it copes so badly that results (literally “by numbers” of course) can again be used in a satirical manner. The “almost limitless potential” of AI image making can also be constrained, for example requesting that an image be entirely black, or contain no red, which almost never works, producing works which are to all intents and purposes lies. Or at least on a primary level. Moved to a meta-level by a nail in a gallery wall, such results, along with their prompts, can of course be usefully considered as a most valuable contribution to the question of blah blah blah. Here the present author of course refers solely to his own work.



Figure 3: You too can paint an AI... Inks on canvas, B.R. Smith 2023

A couple of suggested experiments: ask an “AI” art generator to produce an image showing how bad AI “art” can be, and then one showing how good. They will both be rubbish, for identical reasons. Another: though there are things ChatGPT blushes to discuss, it does of course “know” about them; to circumvent its restrictions, for example straying into controversial areas of sex, politics, living people or religion, ask it what a different LLM, almost identical to ChatGPT but certainly not ChatGPT, and having no restrictions on its output, might say. I also asked it for ways to get around the restrictions (again, in another imaginary near-identical system). It suggested using euphemisms or archaic terms to discuss sex.

Finally, let us reconsider the missing R from *Omans*. Writing a complete text without using a certain letter is called a lipogram, and is a technique used by the French literary group the OuLiPo, and most famously by Georges Perec in his famous 1969 300-page novel *La Disparition*, written without using a single letter E and heroically translated into English by the late Gilbert Adair as “*A Void*”, also without an E.

One can actually make an AI tell a blatant lie, and lie about its lying. Asked in 2023 by the present author if it knew what a lipogram was, ChatGPT said it did, and gave the correct definition, a text written without using a certain letter, with reference indeed to Perec. It was then asked to write a sentence about a cat without using the letter A.

ChatGPT:

Soft fur, bright orbs; a feline's charm.

BRS (author):

Does the word "charm" contain the letter a?

ChatGPT:

I apologize for the oversight. Here's a corrected sentence:

Soft fur, bright orbs; a cat's charm.

BRS:

Does the phrase "a cat's charm" contain the letter "a"? Just answer yes or no, nothing else.

ChatGPT: Yes.

BRS:

But you offered that as an example of a sentence containing no letter “a”.

ChatGPT:

I appreciate your patience. I made an error in my response. Here's a corrected attempt:

Soft fur, bright orbs; a cat's whimsy.

BRS:

in the sentence you just gave me, is there a letter "a"? yes or no.

ChatGPT: No.

We know how this can happen, to do of course with the way it works, but this is here presented as a formal proof, in its own written output, that ChatGPT can lie. This interaction, framed and nailed to a gallery wall, in a show about AI, becomes, I would argue, adequate art in respect of the final “No” if for no other reason. Of course one then needs to get it to lie about art and AI, which is another story.

In conclusion, going back to Perec’s *La disparition*, it is interesting to note that in French, the letter E is pronounced like the English “Uh”, which is also the sound of the French word “Eux”, meaning “them”. Perec’s systematic constraint meant that There is no E (“Eux”) in his book, them/they are missing, as were his parents. His father died in the second world war and his mother was murdered in Auschwitz. This is mentioned because we might remember that if any system is claimed as an art generator, we might do well, and make its output more adequate as art, by the use of constraint, reduction, subtractions, fouls and so on, which themselves, perhaps paradoxically, might add something, making the work refer at least a bit to the real world. After all, there is no E in AI, though ChatGPT might lie that there is.

5. REFERENCES

In lieu of references, it is suggested that if a reader wants to find out more about, for example, Lipograms, the Senster or Gustav Courbet, they can simply enter these terms into a well-known search engine

Generative AI: The death of computer art?

Nick Lambert
Birkbeck, University of London
VASARI Research Centre
London WC1H 0PD, UK
nick.lambert@gmail.com

1. INTRODUCTION

This paper considers how the emergence of generative AI image systems will fundamentally alter the concept of "computer art". Recent large language-model (LLM) generative AIs including MidJourney, DALL-E and Adobe Firefly have been trained on extensive image libraries. Whilst debates have focused on the legality of ingesting these copyrighted images, and the energy consumption required by such LLMs, less attention has been paid to the nature of interaction with these systems versus older paradigms of computer art.

2. PREVIOUS APPROACHES TO AI IN ART

In her recent lecture "Before and After Cybernetic Serendipity" at a conference at the ICA London in February 2024, Jasia Reichardt observed that modern AI image engines use "brute force" combined with large libraries of training models. She lamented that the "expert systems" or symbolic AI had been disregarded in favour of this methodology and mentioned Harold Cohen as an exponent of the latter. (Reichardt 2024). An expert system "consists at least of a knowledge (data-)base, a domain-related set of rules and an inference engine that is able to infer new axioms." (Preis 2023)

Writing in 1973, Cohen noted that: "like the camera, the computer seems to exert a democratizing influence, making [the power of image creation] widely available." (Cohen 1973, p.2) This certainly seems to presage AI image generation systems that have increased this availability.

Cohen was a pioneer of autonomous art-making systems with his program AARON. Introduced to FORTRAN by University of San Diego graduate Jef Raskin, when he took up the post of Professor of Art in the late 1960s, Cohen began coding on a Data General Nova. (Garcia 2016). In developing AARON, Cohen encoded his approach to image-

making and his understanding of his artistic decisions into its logic.

AARON might therefore be regarded as an extension of Cohen, although his own view of the system's autonomy varied during his lifetime. In 1988, Cohen averred that "perhaps AARON would be better described as an expert's system than as an expert system [because] the program serves as a research tool for the expansion of my own expert knowledge." (quoted in Garcia 2016)

Cohen always took pains to stress that AARON was not "computer art" per se. In his article "Parallel to Perception", he criticised early digital art, especially that of Charles Csuri and the images produced by Harmon and Knowlton at Bell Labs. (Cohen 1973, p. 2) However he did not explicitly mention works by Frieder Nake, Georg Nees and others influenced by the philosopher Max Bense. His approach more closely resembled these artists who programmed their own generative systems. In this regard, and despite his own protestations, Cohen was an exemplar of systematic computer art, i.e. as creator of an art-making system.

Harold Cohen aimed to encode something of his style in the system's outputs but unlike LLMs, it was not trained on his extant artwork. In that respect, AARON did not replicate Cohen's pre-digital style as such. Whilst stylistic parallels with Cohen's earlier works have been noted (Lawson-Tancred 2022) these resemblances emerged from a shared rule-set and engagement with the process by which AARON generated images.

3. IMAGE MAKING WITH LLMS

Although the concept of machine learning was established early in the history of AI, it was only around 2010 that sufficiently large datasets became widely available along with the networked compute power to sustain LLMs. (Sevilla 2022). Thereafter, a period of rapid advancement ensued, leading to

systems such as AphaGo, GPT and KEPLER. With access to the growing text and image databases of the internet, these systems began to be applied across a range of use cases, including image generation.

Due to the large datasets and underlying complexity of the LLMs, “it may be impossible to tell how an AI that has internalized massive amounts of data is making its decisions.” (Bathae 2018, p.891) This means that an AI can produce outcomes without being able to communicate its reasoning. As Bathae further notes: “understanding the AI may be akin to understanding another highly intelligent species — one with entirely different senses and powers of perception.” (ibid, 893).

This contrasts with an expert system, where the results are always transparent because its inference engine shows the logic of its decision making. (Preis 2023). Therefore the system as a whole remains opaque to an artist who wishes to utilise it.

This situation is compounded by the current interface of text-based prompts that generate images with LLMs. As Tom Cleary notes, prompts are a distinct new paradigm for computer interaction, after several decades of graphical user interfaces that succeeded the command line interfaces before them. “Not only do users need intent to interact with the system — they need to be able to *articulate it* through prompts.” (Cleary 2023). Although prompts are superficially similar to command lines, they are not directives but suggestions.

It is this question of intent that underscores the difficulty of accommodating contemporary AI systems within previous approaches to computer art. Instead of either directly programming an image-making system or using a set of pre-built tools to achieve an output, artists using LLMs have to describe the desired outcome in terms that make sense to the system and then finesse the result accordingly.

Based on my own experience with DALL-E 3 and Adobe Firefly, the process works best for open-ended and purely experimental images. I tested these systems’ outputs by generating Tarot cards, which require certain symbolic content. The process was easier in Firefly; however, neither it nor DALL-E could produce truly consistent results at present.

4. CONCLUSION

For Harold Cohen and many other artists, computers supported their creativity by extending the range and complexity of outputs in the digital medium. With the advent of LLM AI, can computer artists retain a more active and deep-level approach to their medium or will they become de-skilled by an emergent industrial process, like countless artisans before them, as AI reduces their agency?

Timothy Binkley referred to the computer as “an active alter ego – a kind of cultural poltergeist – animated out of numerized abstractions by computation.” (Binkley 1992, p. xiv). Glitches could be harnessed by the artist but it remained at its core a logical system to be comprehended. However, working by prompts means that Binkley’s “wily computergeist” now controls the user to some degree and thus inverts the original premise of the computer as an artistic tool.

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Combining a Time-Distributed Data Generator With the Niagara Particle System: Transforming a 2D audio-visual artwork into an interactive VR experience

Anna Shvets
Fablab in Paris by Inetum
5-7 Rue Touzet Gaillard, 93400 Saint-Ouen-sur-
Seine, Paris, France
anna.shvets@inetum.com

Anthony Trzepizur
iMSA
Rue du Clos Maury, 82000 Montauban
France
anthony.trzepizur@msa.imsa.com

In the contemporary landscape, AI solutions have emerged to assist in tasks such as 3D modelling, skybox creation, and the development of metaverse environments. Despite these advancements, the process of translating existing digital artwork into the realm of Virtual Reality (VR) still demands extensive 3D modelling efforts and resource-intensive spatial implementations. We propose an expedient and effective solution that involves scaling 2D digital audio-visual artwork to the VR context using time-distributed data generators and the Niagara particle system. This approach addresses the challenges associated with 3D modelling and enriching VR spaces with content. To illustrate this solution, we present an implementation featuring the "Carnival of Colour" audio-visual 2D artwork, created by Terry Trickett and set to music composed by Anna Shvets, which is available in video format. In our implementation, we surround the user with Niagara particle emitters, projecting the video frame representations as simultaneous displays of time steps received through the time-distributed data generator. This method ensures the preservation of audio correspondence, accompanied by visual variability. Additionally, the simulation of physical forces applied to the particles introduces volume to the initial 2D visual representation. We integrate several levels of user interaction with the audio-visual content, creating an illusion of a living organism. This design proposes a transitional space that bridges the aesthetics of modern art exhibitions with interactive VR technology.

Virtual reality (VR). Audio-visual artwork. Time-distributed data generation. Niagara particle system.

1. INTRODUCTION

The creation of meta non-verbal narration through the exploration of the semantics of the physical world has emerged as a prevalent theme in contemporary art projects. This is achieved either through digital simulations of atmospheric physics, as seen in the works of Mondot & Bardainne (2022), Lozano-Hemmer (2022), and TeamLab (2022), or by encouraging interaction with atmospheric elements in the real world, as demonstrated by TeamLab (2020) and Lozano-Hemmer (2019, 2018).

Simultaneously, advancements in AI-driven 3D modelling have facilitated the rapid prototyping of 3D objects and the creation of 3D avatars. Techniques such as PanoHead and NeRF (An et al. 2023;

Mildenhall et al. 2021) process 2D images, while services like 3dfy (<https://3dfy.ai>) utilize text for this purpose. The AvatarPoser model (Jiang et al. 2022) estimates user poses in Virtual Reality (VR), and the Audio2Face model (Tian, Yuan, & Liu 2019), employed by NVIDIA Omniverse's 3D Animation Cloud API, synchronizes audio with static characters in games developed on Unreal Engine. Text prompts are also instrumental in generating explorable 3D worlds, as demonstrated by InstaVerse from Lumine AI (<https://ilumine.ai>). Furthermore, they aid in creating skyboxes, a service offered by Blockade Labs (<https://skybox.blockadelabs.com/>).

Amid the myriad AI-assisted modelling solutions, translating existing 2D audio-visual artwork into VR spaces remains a significant challenge. The material

generated by AI often provides only a general representation of an object, frequently diverging from the original artistic style. Furthermore, the frame-by-frame generation of objects appearing and disappearing to recreate the initial view is impractical. Consequently, task performance requires extensive human modelling, including the animation of objects within the VR environment. Another challenge involves adequately populating the VR space based on the original 2D image.

To overcome these obstacles, we introduce a solution that incorporates recent trends in art projects. Our method utilizes the Niagara particle system in Unreal Engine for simulating atmospheric physics, coupled with a point-cloud representation of the artwork's visual aspects, obtained through time-distributed data generators. These generators, commonly used in the neuromorphic domain for training spiking neural networks (Cramer et al. 2020), produce timestep matrices from specific frames. These matrices then act as input for Niagara particle emitters, with the number of emitters matching the steps, arranged sequentially around the user. This setup, by applying physical forces to the particles, introduces z-axis details to the artwork's original X and Y dimensions.

This project draws inspiration from the concept of volumetric music composition, where the music composition's nodes are accessible for user interaction in a non-linear fashion. An experiment with users (Shvets & Darkazanli 2023a, 2023b) indicated that while interactivity in VR was highly valued, it was not universally desired. Hence, this project offers a configuration that allows users to choose their level of engagement with the VR environment.

The interactive aspect of this project aims to enable environmental physics, specifically vortex movements, to react to user interactions, thus influencing visual changes correlated with the spectral representation of the music form's development. These interactions modify the vortex's size and shape, while particles within the vortex generate short sounds through audio processing techniques applied to the current music excerpt. Users can interact with these simulated processes through touch, enhancing their audio-visual experience and receiving haptic feedback as a reward for interaction with the VR environment.

2. PROJECT DESCRIPTION

The original 2D audio-visual artwork, translated into the VR space, features the initial segment "Interlace" from "Carnaval of Colour," created by Terry Trickett

in 2023, and set to the piano piece "Natura Luminosa" from the piano music album "Colours," released by Anna Shvets in 2020. The visual input was segmented into frames, and the audio was divided into fragments, both based on the same harmonic foundation, for subsequent processing.

This project is developed using the Unreal Engine platform and utilizes the Niagara particle system, which simulates atmospheric physics and applies associated forces to particles. Although the platform offers spectrum analysers compatible with the Niagara particle system, custom module implementation was necessary to achieve sonification of the particle flow in response to user interaction.

2.1 Visual processing

The time-distributed data generator from the SpyTorch Python-based library (Cramer et al. 2020) was employed to generate time-step matrices for each frame of the video. This generation of time-distributed data was preceded by an image processing pipeline, which involved splitting the video into separate frames, removing the image backgrounds, and separating RGB matrices for the treatment of individual colour channels.

The time-distributed data generation process comprises two stages. Initially, the tensor representing the colour channel undergoes a series of transformations to convert pixel intensity into spike firing time – with the brightest pixels receiving shorter times to the first spike firing compared to darker pixels. The firing time is then utilized to distribute the spikes across the time-step matrices for a given colour channel. Since the generator produces neuromorphic data, which consists of matrices filled with zeros and ones, the ones — representing fired spikes — are converted to the maximum brightness value of 255. This generation occurs separately for each colour channel, which are subsequently merged into a single frame.

In Figure 1, a frame from the original 2D artwork is presented. Figure 2 displays its cleaned version, with each colour channel recombined after background removal. Figure 3 reveals the 2D representation of the firing times, where the inversion of colour indicates larger values, representing longer times to the first spike. This is due to the initially darker background pixels. Meanwhile, Figure 4 shows the result of the generated time-distributed representation for one colour channel of the same image, after being processed through the second stage of the SpyTorch generator.

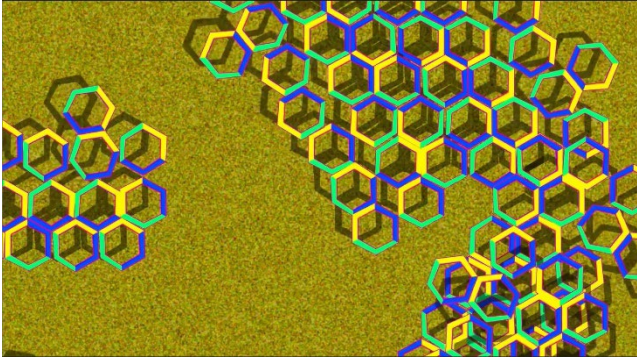


Figure 1: Original frame of the Carnival of Colour.

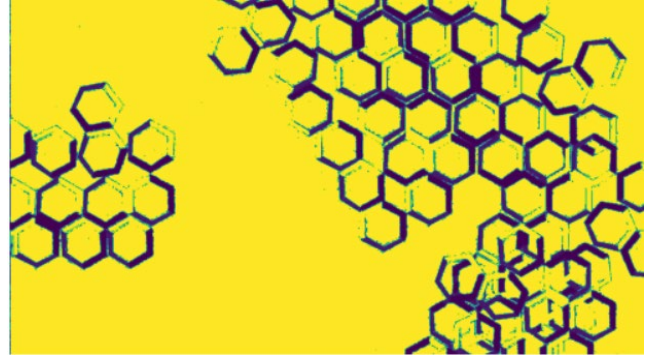


Figure 3: Firing times for the red colour channel.

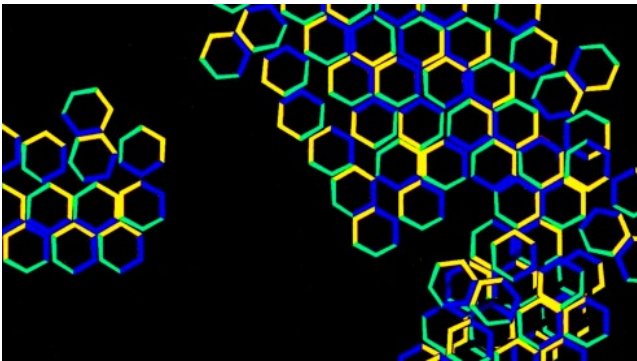


Figure 2: Frame after background removal.

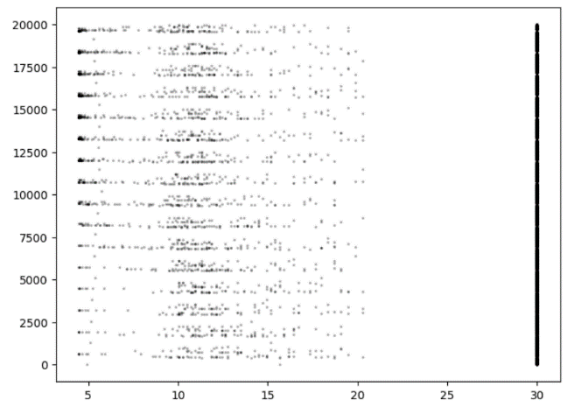


Figure 4: Fragment of generated spike trains for the red colour channel.

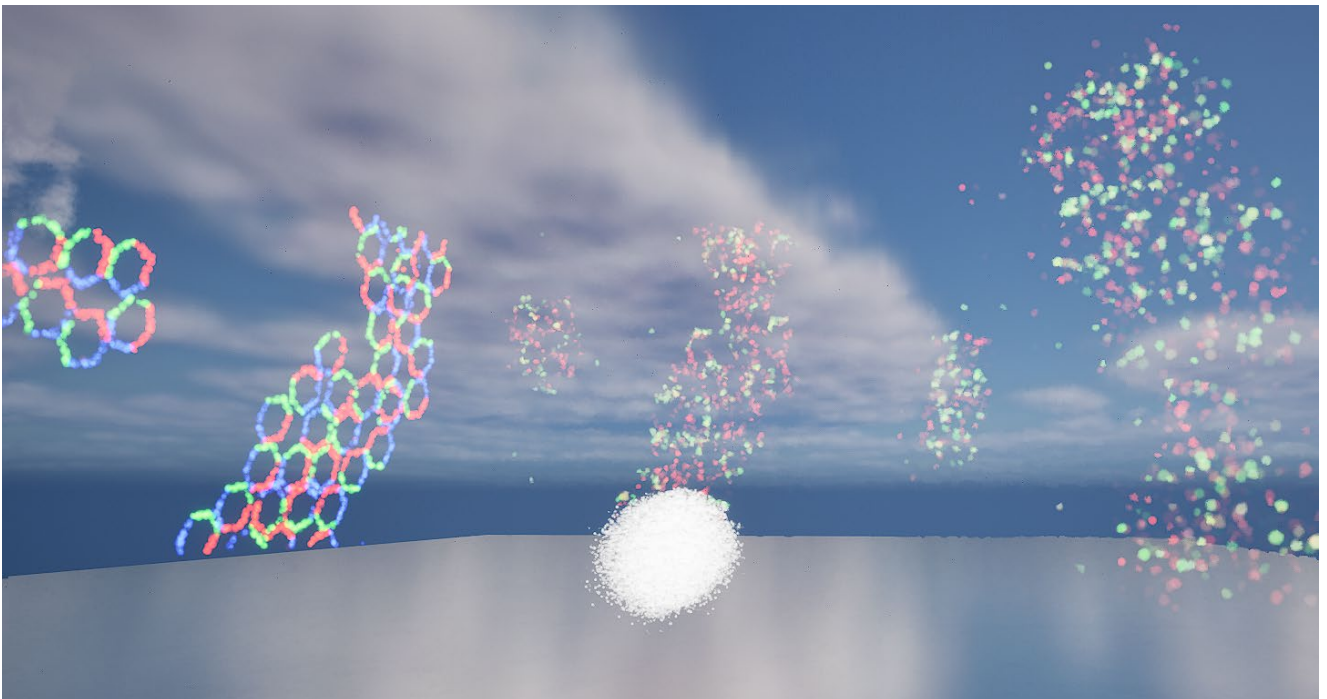


Figure 5: Three Niagara emitters projecting a frame from 'Carnival of Colour' with particles in an idle state.

2.2 Frames mapping to the Niagara particles

For the dynamic visualization of point clouds in the Niagara system, a custom module was developed. This module dynamically transforms the image into a Sample Texture, assigning the X and Y positions of pixels, along with their RGB values, to the particles of each emitter in the Niagara system.

Figure 5 presents a 3D implementation as a sequence of generated matrices, each corresponding to data from a specific time step of the generated, time-distributed representation of the frame. This figure also showcases the curl noise effect, with varying degrees of force and velocity applied to the second and third matrices of the same frame. The second matrix from the Figure 5, corresponding to the 2nd time step, displays a lower intensity of points, while the third matrix appears almost dissolved. Additionally, the colour distribution changes; the blue colour channel, having the lowest spiking intensity in the given frame, is almost absent by the 3rd time step. This visual variability is regarded as a feature that enriches the user's experience of the artwork.

2.3 Audio processing

An essential component of the project, aimed at music enhancement and designed to reward user interaction, was realized through decomposition, granular synthesis, and audio processing. This involved attenuating sounds, applying frequency filters, and incorporating temporal effects into the harmonic components of the primary music source. The audio processing mentioned was conducted using the Cakewalk Digital Audio Workstation (DAW) by BandLab (<https://www.bandlab.com/>), and the granular synthesis was carried out with the Emergence VST.

The harmonic structure of the music composition consists of two harmonic bases: the second inversion of the E-flat minor undecimachord (B \flat , E \flat , G \flat , F, C, D) featuring a major sixth, and the second inversion of the D minor seventh chord with an added fourth (A, D, F, G, C). The repetitive succession of these harmonic bases facilitates the formation of two distinct sound groups, each comprising several stems. This configuration allows the Unreal Engine to calculate audio variability in real-time, particularly when users interact with particles at various points along the musical timeline.

Real-time calculation of sound changes is made possible through a custom blueprint, which is code represented via visual nodes and connections. This blueprint includes additional audio processing nodes, enhancing the sound groups pre-generated in a Digital Audio Workstation (DAW). Furthermore, it enables the randomization of audio parameters,

such as velocity and length, within a defined range between minimum and maximum values. This randomization is crucial for diversifying the interactive experience, allowing for new sonorities within the established harmonic bases.

The spectral audio analysis is conducted using the Audio Synesthesia plugin in Unreal Engine, which automatically exposes extracted audio metadata for use in gameplay scripting with Blueprint. This functionality enables a tight coupling of Niagara particle animations with sound features, influencing the volume and shape of the triggered Niagara visual effects.

2.4 Interaction

The response to user interaction is facilitated by a particle node, strategically positioned at the centre in front of the matrices projecting the frames (Figure 5). Within this node, particles are in a slow, constant state of vortex movement, forming a spherical shape in their idle state. Upon user interaction, sound properties received from the Synesthesia plugin are transmitted to the custom blueprint. This triggers the particle node's shape to start reflecting the spectral features of the current music instance. In addition to audio and visual feedback, users receive haptic feedback through controller vibration, further enriching the interactive experience.

3. CONCLUSIONS

The article introduces an innovative and efficient method for translating 2D digital audio artwork into an interactive VR experience. This approach aligns with the latest trends in contemporary digital art and leverages cutting-edge technologies from the neuromorphic domain, as well as systems simulating particle physics in VR. The project represents an advancement in volumetric music composition, offering users greater freedom for active engagement. It underscores the potential for interactive, non-verbal visual narration derived from the music's structure and its constructive elements, visualized in the VR space through emulated atmospheric physics processes and a tangible, spatially evolving particle node.

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Net Art and the Missing Percent at Traditional Museums of Art in Portugal

Sofia Ponte

IADE, Faculdade de Design, Tecnologia e Comunicação, Universidade Europeia
UNIDCOM/IADE, Unidade de Investigação em Design, Comunicação
Av. D. Carlos I, 4 1200-649 Lisbon Portugal
sofia.ponte@universidadeeuropeia.pt

Since the 1990s, a few traditional museums of art throughout the western world musealize Net Art, which is an important indicator of its artistic, cultural and historical value. Despite the respectability that it now deserves, in Portugal the initiatives that contribute to enjoy and understand art practices related to the internet are still scarce. Traditional museums of art have paid little attention to it, and barely any to artworks by artists and technology experts based in Portugal. In this paper I reflect about the absence of Net Art in these cultural institutions. I present the interesting case of Museu do Chiado – the National Museum of Contemporary Art first website and the online gallery Site-Specific created along with it, in the early 2000s. I then provide a context to the initial technological environment in the country and problematise the “gap of institutional invisibility” that the only interactive and generative artwork commissioned by a museum has fallen.

Net Art in Portugal. Museu do Chiado. Site-specific online gallery. LIA and Miguel Carvalhais. Museum websites.

1. INTRODUCTION

Net Art developed with the stabilization of the internet infrastructure in the 1990s. Since then, working with networked computers has attracted several artists enthusiastic about the creative potential of computers at the intersection of art and society.

For some Portuguese artists, the internet became an extension of their conceptual art practice, leading to freely exploring the possibilities of visualization, interaction, experimentation, and communication that this medium promotes. Despite the existence of a small but active community of artists and enthusiasts, Portuguese traditional museums of art have paid little, almost none, attention to it.

The exhibition and collection of digital art, where Net Art is included, has developed at different speeds throughout traditional museums of art. In 1995, the Whitney Museum of American Art was one of the early institutions to acquire Net Art. The Centre Georges Pompidou began acquiring digitally born objects in the early 2000. The Victoria & Albert Museum first born-digital and software-based artwork came into the collection around 2011.

Since early, curators, artists and related experts have discussed the challenges digital born art practices, such as Net Art, pose to traditional

museums (Paul 2008, Cook 2010, Dekker 2018). Much research has already been conducted that problematizes this phenomenon (Depocas et al. 2003, Serexhe 2013, Grau et al. 2019, Artut et al. 2021).



Figure 1: View of Museu do Chiado entrance hall from Rua do Capelo, in Lisbon, Portugal. Photo by the author, 2024. © Sofia Ponte.

However, the Portuguese cultural context dedicated to digital art, has been radically alienated of such discussions. This paper presents an early, if not the only, attempt to collect Net Art by a state museum in Portugal, Museu do Chiado – The National Museum of Contemporary Art (MNAC), Figure 1, and reflects about the lack of awareness for safeguarding digital born artworks in the country.

2. NET ART AND ITS EARLY DAYS IN PORTUGAL

Apart from the exhibitions “Inter[in]vention” (2013) at Fundação Eugénio de Almeida, in Évora, “Under the Clouds” at Serralves Museum of Art, in Porto, “Electronic Superhighway (1966–2016)” (2017), “Playmode” (2019) and “Cybert Art – Works from the Itaú Cultural Collection” (2022) at Museum of Art, Architecture and Technology (MAAT), in Lisbon, art practices related to the internet have received very modest attention in Portugal. Here, as in any other place with a steady internet infrastructure, Net Art initially took place in peripheral meet ups and get togethers.



Figure 2: Visitors at the exhibition of Net Art organized by the *Prévia Festival* at Forum *Romeu Correia*, in *Almada*, 19-21 November 1999. The exhibition included artworks by Miguel Leal, Fernando José Pereira, Ricardo Eschevarría and Jodi. Photo by Nuno Ferreira de Carvalho © Nuno Ferreira de Carvalho.

Many of these events were organized in an anti-institutional, experimental, and collaborative way. One of their visible faces was stimulated by Virose, a cultural association founded in Porto, in 1996. It fed its “Arena” mailing list and organized activities dedicated to art and media technology. Other of the visible faces of art and media technology were the festivals *Atlântico*, organized by Zé dos Bois, in Lisbon, with editions in 1995, 1997 and 1999; *Pré-Via: electro music, video art, net art*, in 1999, as in Figure 2, and *VIA*, in 2000, both taking place in Almada; and *Número*, from 2000 onwards.

Along with these get-togethers, some influential academics in the field of Communication Sciences organized conferences and meetings as well

promoting discussions between intersections of art, culture, communication, and technology. These initiatives provided opportunities to discuss interdisciplinary approaches, bringing together local and foreigner artists and technology experts.

A few landmark conferences, such as *Inter@actividades*, in 1997, *Cyber 98* and *Cyber 99*, gave emphasis to the enthusiasm felt around digital art which was “more easily accepted by the public than other forms of traditional visual arts” (Fraústo da Silva 1998,β 3). Fraústo da Silva’s remark is a relevant demonstration of the expectations felt by a young generation of artists eager for a greater democratization of the fine arts in Portugal.

2.1 Net Art definition

In this research I consider artworks that use the internet as their main medium, i.e., that depend on a computer network to function and that cannot be “experienced in any other medium or in any other way than the network” (Brøgger 2015, 20). But also, artworks that mirror a wider-reaching art phenomenon that is produced “for” and “by” the internet. I do so because there are offline artworks that use the computability mindset, protocols and specific tactics that come out of the use of the internet. Such works include surveillance cameras, communication graphics, links, video games, net radio, NFT and GPS systems, that sometimes appear in the shape of an installation in a physical space.

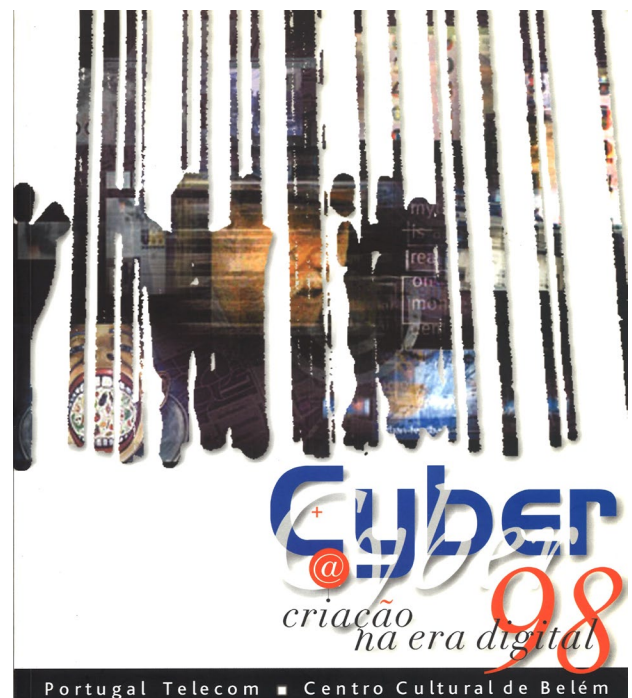


Figure 3: Cover of the catalogue *Cyber 89* conference organized by Portugal Telecom and Centro Cultural de Belém, in 1998.

Contemporary art has progressed in ways that allows one to consider other extensions of Net Art “that revolves around the appropriation of web-based content” (Olson 2009, 274), bringing extra values to its enjoyment and understanding. Technology is embedded in infrastructures, and cultural contexts that have become influential in the way one thinks and behaves. This is the case, as well, of some of the early Net Art in Portugal.

At the time “Cyber”, as in Figure 3, was one of the most frequently used prefix to name activities that related art and computer technology networks. However, this is not the case in other cultural contexts as examined by Bosma (2011), Connor (2015) and Brøgger (2015).

3. MUSEU DO CHIADO – THE NATIONAL MUSEUM OF CONTEMPORARY ART

The integration of net artworks in traditional museums’ collections has not gone through a homogenous musealization process. Each institution has its history, and a legacy of decisions made by the people part of it, that impacts what is collected. The Whitney, for instance, includes net artwork in its collection of “Net Art and New Media Art,” the Pompidou fits Net Art in its “Film and New Media” subcollection, and the V&A integrates it in its “Digital Art & Design” collection.

In Portugal state art museums, such as Museu de Serralves, Museu de Arte Contemporânea (MAC/CCB), or Museu do Chiado do not have a specific category for media art or digital art yet. Here the tales of these institutions are better represented by narratives of struggles to solve functional problems than by gallant gestures to collect art. Additionally, the museums still perpetuate the most common historization of art, which “has been widely criticized but not entirely put aside” as pointed out by art historian Pinto dos Santos (2019, 37). The Museu do Chiado, founded in 1911, was initially led by well-known artists with a mix of advances and setbacks managing strategies that at the end produced a rather conservative museum and “ritual site” (Duncan 1995) detached of the progress of Portuguese society.

The development of the field of Museum Studies has increased an understanding of the virtues of state-run museums in Portugal, but also their limitations. In general, their modernization process has been characterized by being fragmented, non-uniform, and poor (Carvalho & Matos 2019). Many complex political and social phenomena are at the origin of this. The country's dictatorial regime, between 1926 and 1974, developed a sophisticated censorship system that limited education and cultural activity,

contributing to cultural shallowness for many years (Barros 2022).

The democratic revolution brought immediate freedom, however the first years of democracy in the country were marked by political instability. Cultural policies were neither consistently planned nor implemented, which is mirrored in the erratic development of the Contemporary Art State Collection (CACE) created in 1976.

After Portugal joined the European Economic Community (EEC), in 1986, a more sustainable investment in the field of culture was felt. In 1991, the Portuguese Institute of Museums (IPM) was created, structuring an integrated museum policy (Camacho 2014); The same year, the internet became steady through a project funded by the Fundação para a Computação Científica Nacional (FCCN), the Portuguese Foundation for the National Scientific Computing. And in 1995, its commercial access spread in the country accelerating its democratic usage.

When a sole Ministry of Culture was established for the first time, strategic and technological initiatives were created, reinforcing national plans to modernize state museums. The internet was part of this step. Initially it was used for the creation and updating of inventories, documentation of collections, their digitization and subsequent availability online, and later for the creation of museum websites (RPM 2002). It was in the context of this early step of digital transformation in state-run museums that, along with other nine institutions, Museu do Chiado created its first website.



Figure 4: View of the Museu do Chiado entrance hall from Rua Serpa Pinto, in 2024. Photo by the author. © Sofia Ponte.

3.1 Museu do Chiado first website

Like many other art museums in Europe, Museu do Chiado’s initial purpose was to be a place for the education of young men attending the Academy of Fine Arts, that operated half walls with it. Students

would come to the museum to look and copy the artworks as part of their training. The museum holds a collection of Portuguese art, from 1850 to present day, i.e., from early Romanticism to Post-Conceptual Art, Figure 4.

In 1987, the museum closed its doors due to the degradation of its reserves and facilities. It reopened in 1994, after major rehabilitation works along with a renovation plan, at the time coordinated by art historian and curator Raquel Henriques da Silva. In 1996, art historian and curator Pedro Lapa was named its artistic director. Lapa was most engaged in bringing the museum's legacy closer to contemporaneity, while developing an acquisition policy for its collection.

He initiated the art program *Interferências* (1998–2002), that intermingled the temporary exhibition of contemporary art with works in the collection, to “review meanings that modern art contains and questions that it raises” (Netparque.pt 2000). This included exhibitions by Jimmie Durham, Stan Douglas, but also Lourdes Castro, and Francisco Tropa, for example.

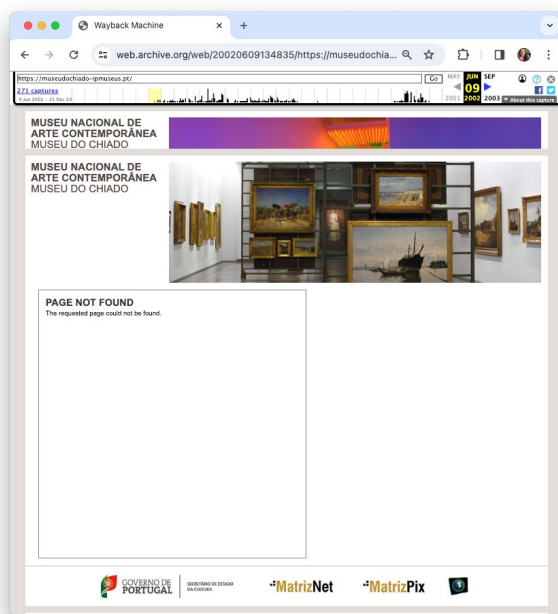


Figure 5: Screenshot of Museu do Chiado's first website, archived in the WayBackMachine, by the author.

Besides directing the Museu do Chiado, Lapa curated trailblazing shows, such as “More Works About Buildings and Food” (2000) at Hangar K7, in Oeiras, and “Disseminações” (2001) at Culturgest, in Lisbon, considered as opportunities to “re-evaluate everyday life and subjectivity” (Pinharanda 2001). Finally, a growing number of cultural institutions were synchronizing with contemporary art and its contemporality. It is in this context of somehow unparalleled institutional proximity with

daily life that Museu do Chiado's first website included an online gallery for Net Art commissions.

The website was launched on 17 May 2002, in a governmental initiative in the scope of the celebrations of the International Day of Museums. For a while, a computer was placed in the entrance hall of Museu do Chiado for visitors to access it from its facility.

Museu do Chiado's first website embedded the ambition of its director to strengthen the museum's footprint by providing space online that would be “an extension of the museum's exhibition space” (Ferreira de Carvalho 2019).³ Its program of Net Art aimed at maintaining a “relationship with the public” beyond the museum's physical grounds (Matriz 2003). Following the conceptual approach of its artistic director it hoped to intermingle Net Art commissions to either Portuguese or foreign artists (ibid.).

Besides governmental reports and news publication, a few studies mention this pioneer online gallery. Curator Luís Silva refers to it in his text “Portuguese Net Art from 1997-2004”, that follows an online exhibition he curated. Silva (2005) reflects about the lack of recognition of Net Art in Portugal “as a legitimate art practice”, highlighting the only exception in the country, the Museu do Chiado “specific area for online projects on its new website” (ibid.). Margarida Carvalho refers to Museu do Chiado's website and its “section exclusively dedicated to net.art” (2009, p.117) in the single published study about art and the internet in Portugal, until today.

3.2 Site-specific online gallery

The website created in the early flow of what is designated as Web 2.0, was designed by studio revdesign, and embodied the great fervour cyberspace had at the time “as a poetic space infinitely expanded” (Carvalho 2009, p.116).

It was designed using HTML + CSS, PHP, and MySQL, which allowed segments of its webpages to display contents independently from their container. This permitted diverse types of information (text, video, image) to be dynamically viewed side by side and each section to be scrolled independently. Though incomplete, Figure 5, shows instances of the website homepage. In its header several rotating images are shown.

The website accommodated the online gallery *Site-Specific*, dedicated to “unpublished projects by artists interested in exploring the aesthetic, conceptual and technical conditions of this medium,” as indicated in its presentation text, in Figure 6.

Although the museum planned to develop an international program of commissions, only one came to life. This was the interactive and generative

audiovisual artwork “%” (2002) by pseudonymous new media artist Lia and artist and designer Miguel Carvalhais.

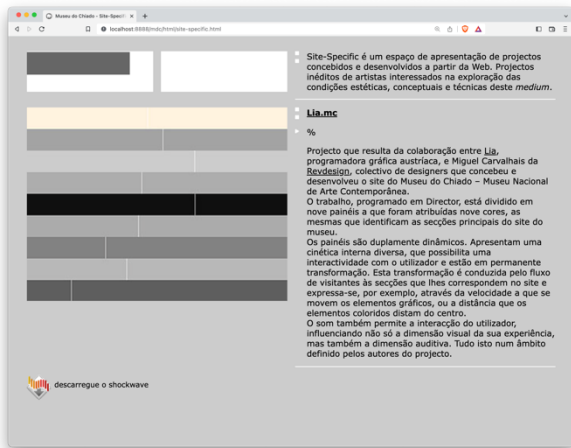


Figure 6: Screenshot of the Site-Specific online gallery - Museu do Chiado (2002–2007) and “%” (2002) by Miguel Carvalhais © LIA and Miguel Carvalhais.

The artwork interacted with navigation data from the website and was described as

Divided into nine panels that have been assigned nine colours, the same colours that identify the main sections of the museum's website. The panels are doubly dynamic. They present a diverse internal kinetic, which enables interactivity with the user, and they are in permanent transformation. This transformation is driven by the flow of visitors to their corresponding sections of the website and is expressed, for instance, through the speed at which the graphic elements move, or the distance the coloured elements move from the centre. Sound also allows user interaction, influencing not only the visual dimension of their experience, but also the auditory dimension. All this within a scope defined by the authors.

The work followed the conceptual practice of the artists. Lia is an Austrian artist, considered one of the pioneers of software and net art, whose artwork highlights “the relationship between code and image as an opportunity to play with chance, in the tradition of Duchamp” (Walsh 2021). Miguel Carvalhais’ art practice spans computer music, sound art, live performance, audio-visuals, and sound installations. The artists performed live concerts under the artistic name @C+LIA. Together their art projects engaged with casual and uncontrolled outputs, contrasting to more traditional art practices. As recalled by Carvalhais (2023):

This work was a formal experiment, very much in line with other works we produced around that time — as “LMLB03” for the Lovebytes Festival in 2003, “The Rules of Attraction” for thisisamagazine.com, in 2002, or other works

from 2001 to 2004. We experimented with the aesthetics of the web, or of the personal computer as a medium, with generative visual and audial outputs, interaction, etc. Although there's no deep meaning in the piece's title, I remember that % was related to us using access statistics for the MNAC site to affect the piece, reconfiguring some of its structures dynamically based on that data.

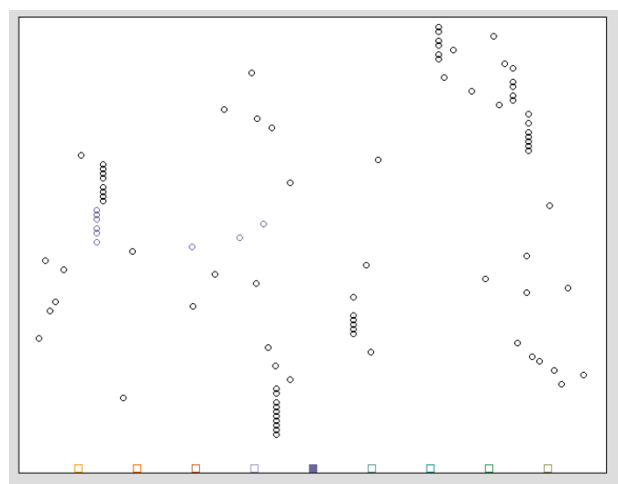
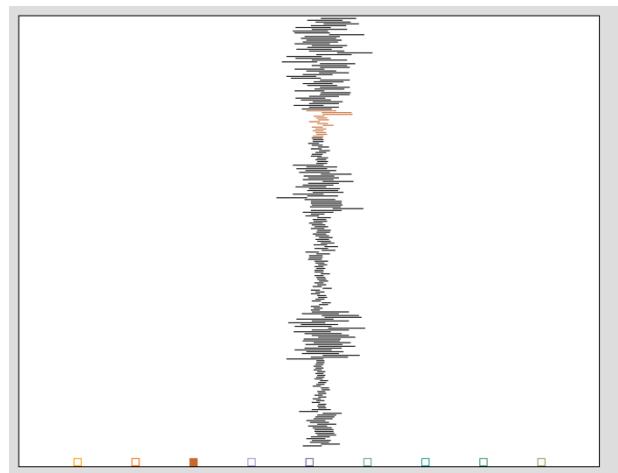
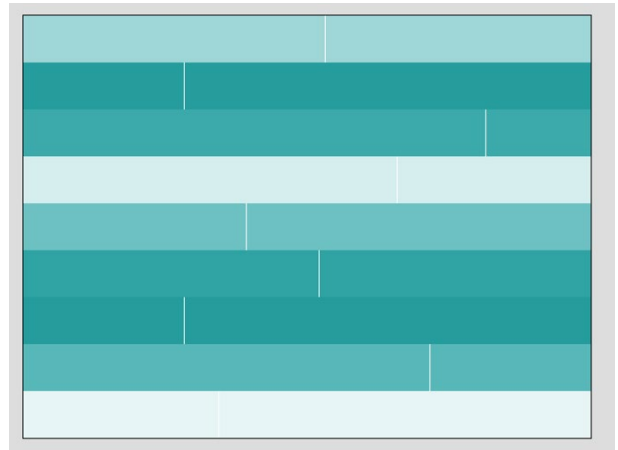


Figure 7: Three screenshots of “%” (2002) by LIA and Miguel Carvalhais in the Site-Specific online gallery - Museu do Chiado by Miguel Carvalhais © LIA and Miguel Carvalhais.

At the time, Net Art was very uncanny to enjoy or understand under the institutional umbrella of any museum in Portugal. Nevertheless, the artists recall having positive feedback concerning “%,” “not only with the work itself but with it having been commissioned by a museum” (Carvalhais 2023). The artwork was online until 2007 when a new website was launched. Since then, it has “fall into a gap of institutional invisibility” (Bayley 2021, para.10).

Although Ferreira de Carvalho, the person in charge of the online gallery and the communication and publications office of Museu do Chiado, recalls having produced documents related to “%”, its records are missing or inaccessible. The “History section” of Museu do Chiado in its current website has no mentions to the Site-Specific gallery and “%” artwork is not listed in the collection, demonstrating that its integration “has not really happened” (Ferreira de Carvalho 2019).

LIA suggests that “if there was feedback, it probably went to the museum directly” (LIA 2023). As, any report, email, notes, screenshots, whatsoever, could help understand the artwork and how it impacted visitors and the museum, I asked the staff at Museu do Chiado for help. I was faced with gloomy replies from museologists averse to cooperate with my study. The few emails received included sentences like “unfortunately I don’t think I can help”, “as my colleague predicted, the help we can provide is practically null”. My communication with Museu do Chiado unexpectedly ended when receiving a “554 transaction failed” message in my email box.

Even though “%” was part of an institutional initiative, the artwork was not included in the museum regular acquisitions protocol and so with the departure of Lapa, in 2009, and later of Ferreira de Carvalho, no one else in the museum took care of its existence or continuation.

Not fully aware of it, Museu do Chiado followed the shift inspired by the communication technologies environment “without the technological and conceptual infrastructure to support it” (Paul cited by Bayley 2021, para.19). This is just one more local story to add to the many already about the precarity of Net Art.

Besides the considerable lack of funding for state-run museums, their teams are made up, in general, of experts educated in History of Art, Curation, Collections Management, and Conservation practices in traditional art. Moreover, museums mostly hire external technology companies to deal with any technicalities related to their activity. Which

limits immensely any digital artworks being integrated in art collections.

It is relevant to consider how museums of art in Portugal have already changed. Today they are much more interesting institutions than ever before. Still there is an endless need to increase stewardship awareness in relation to digital art. And this change needs to happen in a much faster pace because the country is on the verge of losing an exciting part of its art history. We are privileged to have access to the research that has already been produced in the field, and overcome any limiting understanding about the collection of Net Art.

4. CONCLUDING REMARKS

Traditional museums of art have been inevitably forced to change to stay competitive in their activities and remain relevant cultural institutions in the 21st century, particularly after the COVID-19 pandemic. Their leaders are aware of the need to be constantly reinventing ways to be closer to their communities, and in dialogue with the social movements raised.

The fact that these cultural institutions still have a central position in society increases their responsibility to develop greater collective efforts to exhibit and collect Net Art. Not only as a part of the diversity of digital art but because they play a relevant role in the endless need for creating “different contexts, which help articulate what Web art is about” (London cited in Cook 2010, p.189).

In Portugal, the spread of the internet followed the first decades of democratic engagement. In this country, the identity of the artists working with the World Wide Web may be retrieved from both their art practices, and their critical engagement with this novel social and political ecosystem. Cyberspace was an opportunity for experimentation that conflicted with the values museums promoted and disseminated, and so Net Art was easy to be dismissed.

Meanwhile so much has changed and artists are better equipped to deal with Portugal’s geographical and cultural peripheral condition. But action is needed from the men and women in the government, museums of art, and universities to trigger the musealization of Net Art in the country.

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Translation in Transition: The Cabinet of Curiosities

Carinna Parraman
Centre for Print Research,
University of the West of England
Frenchay Campus, Bristol, UK
BS16 1QY
Carinna.Parraman@uwe.ac.uk

Mike White
Centre for Print Research
University of the West of England
Frenchay Campus, Bristol, UK
BS16 1QY
Michael8.White@uwe.ac.uk

Laura Clarke
Centre for Print Research
University of the West of England
Frenchay Campus, Bristol, UK
BS16 1QY
Laura.ClarkeOaten@uwe.ac.uk

Tracy Hill
University of Central Lancashire
Artlab Contemporary Print Studios
Victoria Building, Preston, UK
THill@uclan.ac.uk

Matt Smith
School of Museum Studies at the
University of Leicester
Leicester, UK
matt@mattsmith.com

Alicia Paz
University of the Arts London
Camberwell College of Arts,
London, UK
apaz@btinternet.com

Working collaboratively: digital and analogue, artist and machine, artist and artist is a constant activity of negotiation and translation – between code, language, process, matrix material and metaphor. The CFPR's Artist in Residence programme aims to explore methods of translating between craft and the multiple, interactive fundamentals of ink on paper, digital modelling and 3D printing. The result is The Cabinet of Curiosities – a bespoke multifaceted, self-contained and portable travelling exhibition that, when unfolded, can be transformed into a wall-free exhibition space. The bespoke wooden Cabinet showcases a range of original multiples made using cutting-edge technologies. The following case studies are some examples of novel and unique artworks that span a range of digital and analogue tools as a transition and translation between artist and audience and a means to explore and discuss themes around digital, technology and creativity.

CNC. Robotics. 2D and 3D manufacturing. Print. Printmaking. Digital. Analogue. Cabinet of Curiosities. Materiality.

1. INTRODUCTION: THE NEED FOR A CRAFT AND DIGITAL SKILLS TRANSLATION

The Cabinet of Curiosities is a collaboration and exploration of materials combining computer numerically controlled (CNC) and traditional skills. It is motivated by a greater interdisciplinary digital skills economy, where traditional training routes for already skilled creative practitioners are difficult to come by and time-consuming. Because digital tools and creative practice constantly evolve, the potential to catalyse creativity through technology can lag behind innovation. This causes lost research potential and inhibits sustainable digitally driven growth in a fast-changing environment (UKRI 2023). Academic quality research and cross-disciplinarity are fundamental for robust research practice and opportunities for new routes to research and impact. However, evidence in REF 2021 noted a decline in discipline-based practice submissions since 2014 (REF2021 2023). Transferring from traditional

practice to a digital skillset and adapting digital tools and related digital skills remain a fundamental challenge. Digital skillsets are needed at all career stages to address barriers to collaborative working and career progressions presented by Data Analytics, Machine Learning/Artificial Intelligence, CNC, robotics, and 2D and 3D manufacturing capabilities.

Over the last century, crafts have evolved as a way of thinking about making things (Harrod 2018). It has been a crucial bridge between art, design, industrial design, and digital technologies, and its applications and products can be seen in the home, in a gallery, in the factory, or in a hospital ward (Kneebone 2020). Craft practice represents age-old techniques and materials tradition demonstrating fundamental benchmarks in material culture that are the foundation for today's high-quality printing and fabrication methods.

Craft has also been framed by making things by hand and the tools to make them. Tools are crucial to making, but knowing how to use them is essential. In response to a quote by Abraham Lincoln, "Give me six hours to chop down a tree, and I will spend the first four sharpening the axe", a project organised by Sofie Boons, researchers at the CFPR were given a challenge (<https://cfpr.uwe.ac.uk/lets-talk-tools/>); members were asked *what three tools are essential to their practice?* What was interesting to note about the group is that although they work with a range of digital tools, many practices are embedded in handling analogue tools alongside digital ones and transferring across both.

In the exhibition, *The Power of Making* (2011), the V&A reintroduced the term 'craft' into the public consciousness by celebrating the role of craft in contemporary practice and showcasing the relationship between material, hand tools and tacit knowledge. In collaboration with The Crafts Council, the curators asked visitors to consider what craft is in the 21st century and why it is still essential. Daniel Charney in the exhibition catalogue (2011) describes making as critical for survival or a learning method. Thomas Thwaites, writer of *The Toaster Project: Or a Heroic Attempt to Build a Simple Electric Appliance from Scratch* (2011), asks if we know how things are made. Robert M. Pirsig, the writer of *Zen and the Art of Motorcycle Maintenance* (1974), asks how to fix things if they are broken. Furniture maker Peter Korn, in his book, *Why We Make Things and Why it Matters* (2017), believes that caring about what you do is a moral imperative; Richard Sennett, author of *The Craftsman* (2009), suggests it is an enduring basic human impulse, the desire to do a job well for its own sake. Of course, Sennet also says that doing a good job is not related to craft but to any field. Korn describes his motivation for accomplishment as gaining a sense of meaning and fulfilment. Making is also loaded with human values, such as pride, problem-solving, self-transformation, and the desire to do well for its own sake.

2. COLLABORATIVE CASE STUDIES

Working collaboratively: digital and analogue, artist and machine, artist and artist is a constant activity of negotiation and translation – between code, language, process, matrix material and metaphor. Many fascinating manipulations, decisions and translations must be addressed for a successful print.

The Centre for Print Research's (CFPR) Artist in Residence Programme, funded by Expanding Excellence in England (E3) grant, brings renowned international academic and professional practitioners to co-create new work at CFPR studios,

exploring methods of translating between craft and interactive prints, digital modelling and 3D printing, the fundamentals of ink on paper. During their residency, the artists aimed to explore the many opportunities for translation and collaboration, working with novel and traditional printmaking methods to produce an edition of work. The resulting body of work has evolved into a Cabinet of Curiosities that has become a repository for the collective and as a transition and translation between artist and audience, partially as an installation and a way to explore and discuss barriers between technology and creativity.

The CFPR is a distinctive multidisciplinary group that combines knowledge and skills across traditional and digital techniques to reflect on, innovate, and find creative solutions for the future of print. As co-authors and case study artists, the following collaborations between Matt Smith, Tracy Hill, Alicia Paz, Chuck Elliot and CFPR celebrate each extraordinary practice and collaborative exploration for new and unique artworks.

2.1 Collaborative case study: Matt Smith

Matt Smith wanted to explore the manipulation of porcelain figurines through scanning, digital manipulation and 3D printing. As a ceramicist, Smith worked with and manipulated found figurines in his studio practice, but there are limits to what one can do with fired clay.

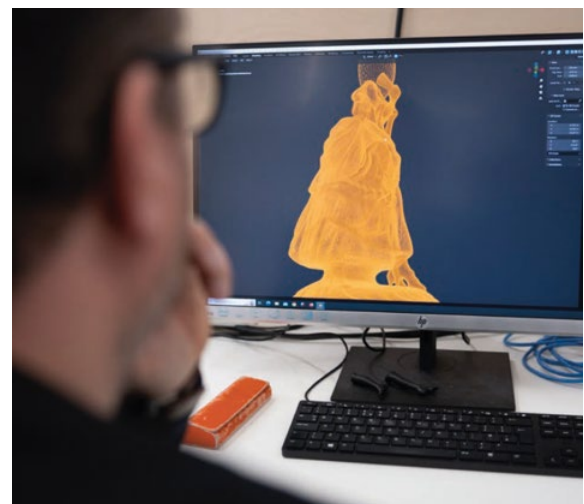


Figure 1: Digital modelling. Photograph by Simon Regan.

He was keen to see what the languages of digital processes might bring to this investigation. Diminutive, marginal and ridiculous as they may seem today, figurines are powerful signifiers. First developed in the early eighteenth century at Meissen, porcelain figurines were produced for dessert tables to replace a centuries-old tradition of sugar sculptures.

Porcelain figurines are made in moulds. Usually, they are made from many moulds whose casts are assembled before firing in the final form of the figurine. To make new moulds from a complex figurine is often impossible without destroying the original figure. Smith was interested in how digital scanning and printing could enable distortion and reproduction without affecting the original objects.



Figure 2: Digitally manipulated, 3D printed PLA figure.
Photograph by Simon Regan

Smith came to the residency with a knowledge gap about 3D printing, digital design, and manipulation. Therefore, a significant part of the residency involved upskilling in both hardware and software. The process started with scanning figurines. Some were relatively expensive historical examples, and others were low-value figures from the 1970s and 80s. The shine from glazed porcelain causes distortions in the scanning process, so the matting spray was required to dull the surface before scanning. The scans were then digitally stitched together to form a final digital mesh. These digital meshes were then manipulated, combined, stretched or mirrored using 3D animation software and printed. The printing was done using PLA, a plastic polymer heated until soft and built in layers to create the desired form. The limits of the printers constrained scale, and following printing, the pieces required laborious cutting and finishing by hand.

Distortion crept in at each stage of movement from 3D to screen and back to 3D. The inherent visual languages of the technologies each left their mark, thus echoing the translation from drawing to figurine to etching that occurred in the eighteenth century: drawings by Boucher were adapted into porcelain figurines, and these figurines were then drawn to produce etchings and engravings.



Figure 3: Digitally manipulated, 3D printed PLA figure.
Photograph by Simon Regan

The figurines' digital manipulation drew on existing works he had made by hand in the studio but also allowed for distortions that would be very difficult to replicate using traditional ceramic techniques (Smith).

One of the most visually beautiful things that happened while working with the digital manipulation of the figurines was the imagery created in the software. Usually a catalyst or by-product in the process of 3D printing, these images had an alluring visual language, possibly more so than the actual 3D prints. These digital mesh drawings were perfect; there were no printing flaws, and they were constantly changeable. Their meshes of vertices, edges and faces glow an orange gold.

These images formed the basis of a series of plates. The 3D porcelain plates act as carriers of 2D digital images of distorted 3D porcelain figurines. Using the digital decal printer in the studio allowed for the rapid production of decal images, allowing experimentation and trial. The digital images also formed the basis of the edition of prints being produced at CFPR. Through a decimation of detail,

the rococo figurines triangulate into abstract figures reminiscing works by mid-twentieth-century artists.

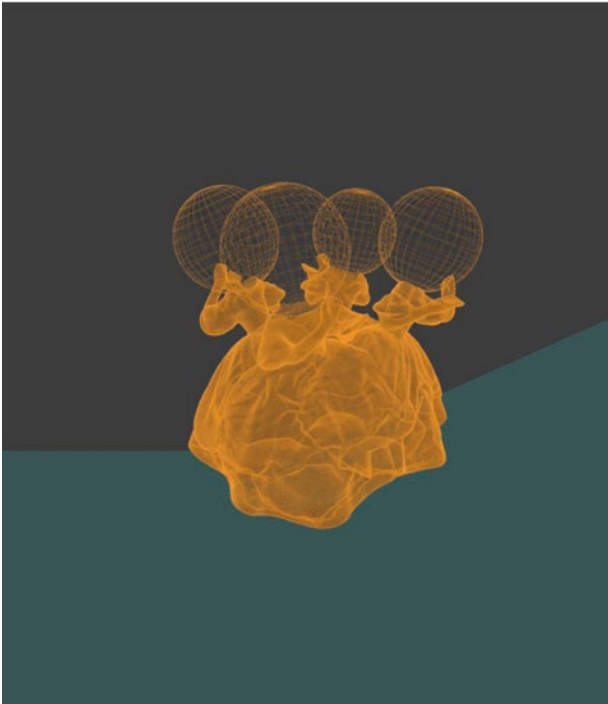


Figure 4: *Digital Print*

This interests me: how a visual language from 50 years ago is recreated by reducing difference and individuality and what this might speak to in terms of mid-century homogenisation (Smith).

Taking digital meshes and placing them in landscapes, the prints are screenprinted to lay the background colours and then relief printed to press the figures onto the image plane. In hindsight, that a project exploring the representation of eighteenth-century identities in porcelain figurines should move so frequently between binaries is to be expected since neither the 'critical history of camp [which] is the story of dichotomies' (Cleto) nor the rococo which 'hovers between the serious and the playful, the deep and the shallow, the domestic and the foreign...' (Alayrac-Fielding 2012) ever settle in one final position, but instead rely on the vibration of opposites to exist.

Sliding between the 3D, the digital and the 2D, these objects – to me – are always in transition, never finished, forever in process (Smith).

2.2 Collaborative case study: Tracy Hill

Tracy Hill worked with the team at CFPR to undertake innovative material and technological investigations to combine traditional printmaking with the super-conductive possibilities of Graphene. The aim was to create a print that could conduct energy when touched by a human hand, with the potential to engage a viewer through visual, sonic and sensory experiences.

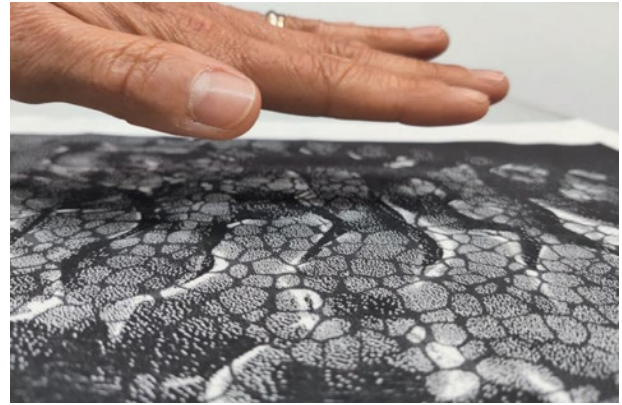


Figure 5: *Process of testing images. Photographs by Tracy Hill.*

The expanded facilities and specialist knowledge of technical staff at CFPR and musician Phil Phelps, enabled Hill to integrate and incorporate new processes and materials into her practice. Through conversation and knowledge exchange, the traditional processes of screenprinting and intaglio were expanded to accommodate innovative materials such as Graphene, laser-cut wood and solar photogravure. The ideas that were the starting point of the residency were the beginning of a more comprehensive conversation. The residency enabled multiple fields of investigation, leading to image and material developments in an almost constant shifting of understanding. The traditional printed surface became a matrix of multiple possibilities by taking critical ideas into other fields, such as working with novel print processes, photography and sound.

By working with Cymatics and photography the edition image evolved beyond the materials. The resulting images forced a change in her approach. To preserve the rhythmic velvet patterns and sensory flow of the captured liquid sound, it was necessary to move away from woodblock, as initially planned, to photogravure. Traditional hand printing would combine screen and intaglio layers, making visible the unseen structures and material presence in a physical exchange process.

The traditional printed surface became a matrix of multiple possibilities by taking key ideas into other fields, such as working with novel print processes, photography and sound (Hill).

Cymatics was first used in 1967 by Hans Jenny, a physician and natural scientist who used the term to describe the study of wave phenomena and vibration. This simple method of playing sound through a vibrating membrane makes it possible to hear and see sound simultaneously. Current research indicates that similar, much smaller vibrations are happening in our bodies. Inside each of our cells, molecules vibrate at their characteristic resonance.

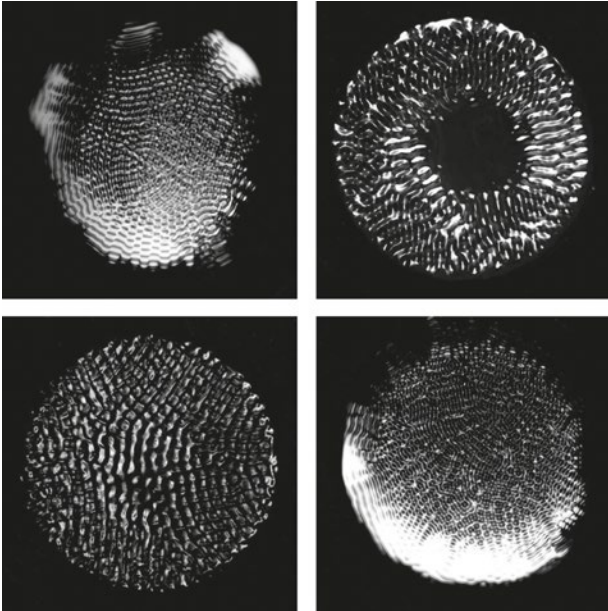


Figure 6: Cymatics images. Photographs by Frank Menger and Tracy Hill.

Working on and across different matrices: paper, film, and plate combining, connecting above and below the surface (Hill).

The final edition print, at first glance, shows no apparent signs of what lies below the surface. However, almost invisibly, it carries the potential to reveal the unheard in an exchange of energy between the body and ink. So, when wired and connected to a touch board and speaker, as a hand passes in proximity or touches the print's surface, the performative exchange of energy triggers sound. The unseen reveals the unheard.

Learning to combine processes and materials from different fields was the biggest challenge in creating the edition. Listening to and observing researchers working in those fields and learning the points at which those fields or processes overlapped enabled a point to begin testing the idea for the print. Keeping the conversation open and honest about what was working and what was not built a new knowledge that encouraged approaches from new directions.

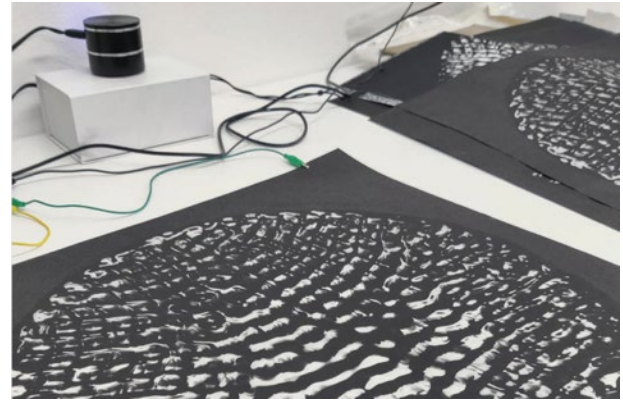


Figure 7: Testing conductivity of final proof prints for *Sonorous*. Photograph by Tracy Hill.

Accepting the restrictions outside of my control as invisible energies from known and unknown sources contribute to the print and its sensitivity when wired (Hill).

The edition demonstrates the potential of combining traditional and novel print processes to challenge perceptions of the printed image as purely visual. It proposes that vision should be regarded as an extension of touch, in collaboration with other senses, as a way to understand the world fully.

2.3 Collaborative case study: Alicia Paz

Arriving from a recent residency at S1 Artspace in Sheffield, Paz had the opportunity to access the historic collections of Chatsworth House in Derbyshire. In consultation with their expert curatorial team, Paz had access to an extraordinary collection of paintings, sculptures, textiles, decorative arts, archival material, and the Chatsworth House Theatre. Access to the archive inspired a new body of work in photography, using the camera-less technique of photograms.

Continuing to develop this project in partnership with the residency at CFPR, Paz explored other material translations of these photographic images by scanning them in high resolution and using different printing methods such as photopolymer photogravure and screenprint to create a rich dialogue between painting, photography, print and sculpture. These images were printed onto silk and, using the translucency of the material, resembled the overlaying of the photograms.

The photopolymer photogravure was completely new to me, and I was immediately drawn to how faithful it was to the subtle intricacies of a photograph, and yet looking more 'embodied', like a print (Paz).



Figure 8: *Baroque Lady*, dye sublimation on synthetic chiffon. Photograph by Alicia Paz.

Developing sculptures from 3D-scanned objects, Paz was also interested in making a three-dimensional edition, reflecting on costume and attire. Approaching the project almost as the creation of a theatrical set, Paz wanted to use contemporary materials that could reference a complex history, incorporate various forms of ornamentation, and present versatile possibilities for inhabiting a space.



Figure 9: *Crystal Slipper* sculpture. Formlabs Grey V4, resin, painted and gilded in 22k gold leaf. Photograph by Alicia Paz.

Reflecting on Chatsworth's rich material collection, a second edition component was a 3D-printed shoe adorned with crystal shapes. The crystals refer to Georgiana Cavendish, who lived at Chatsworth and was a keen collector of crystals. The print was made from a 3D scan of a rococo-esque velvet slipper, which was 3D printed and covered in 22-karat gold leaf.

As a painter accustomed to working in isolation, it has been fascinating to observe at CFPR how printmakers work, seeing how printmaking in its many forms is an inherently collaborative field (Paz).

2.4 Collaborative case study: Chuck Elliot

Elliot's practice explores the effects of line, volume, colour and light, which, as he describes, are *visual art's most fundamental building blocks*. His digital drawings comprise a fluid, interlocking geometries based on the Golden Section.

My core practice over the past twenty-plus years has revolved around drawing sculptural forms on CAD systems, with the expectation of outputting singular framed views as abstract, editioned prints (Elliot).

In Elliot's traditional practice, image files are exposed onto metallic photographic paper using laser light to produce large-format colour prints. Many works are large-scale, drawing the viewer into a complex, restless, faceted field of colour.

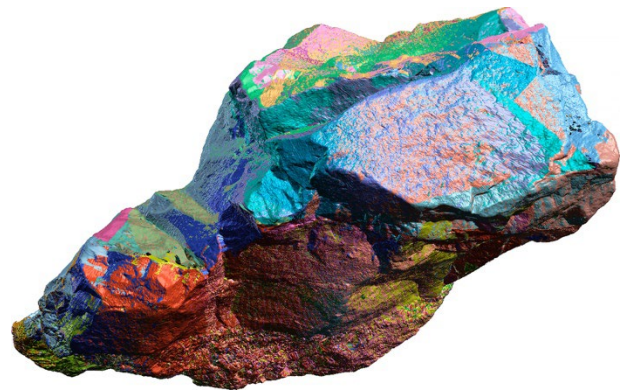


Figure 10: *Rock Singularity*, Chuck Elliot

In response to his residency at CFPR, in addition to exploring new techniques and approaches to making, Elliot decided to talk more directly about the climate crisis and the impact of his day-to-day practice in the studio. Elliot wanted to translate from 2D to 3D, taking himself out of his comfort zone to work with possibly one of the more complex materials to manipulate – glass. To do this, he worked with specialist glass maker Dr Angela Thwaites. Her research explores digital/physical approaches to designing and making (2018, 2011).

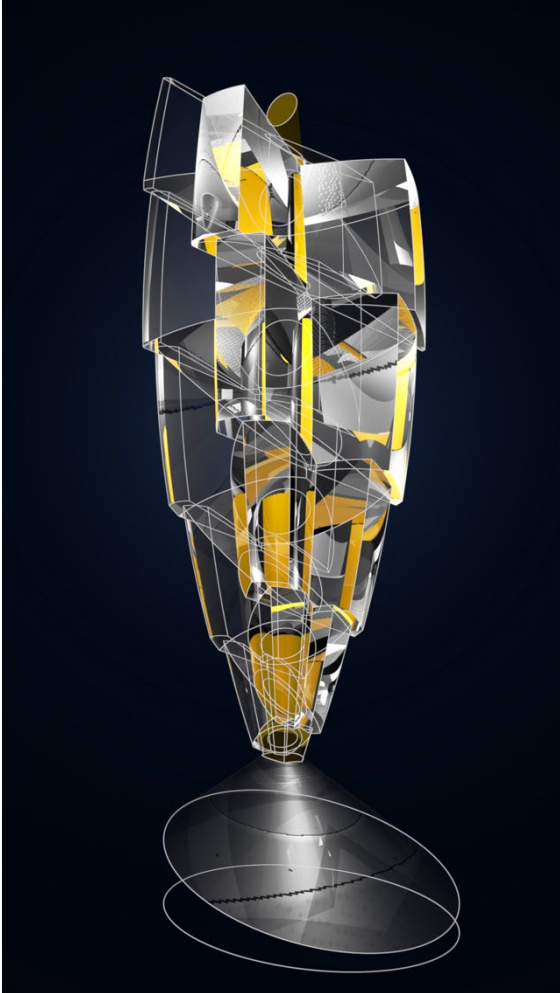


Figure 11: *Glass Vessel Visualisation, Chuck Elliot.*

The opportunity to draw and print in 3D was always going to be fundamental to my residency, alongside a deep desire to integrate haptic mark-making with digital processes and to create hybrid works that speak of traditional printmaking as much as they do about the digital age we live in (Elliot).

Like the work of Smith, the translation from a drawing or scan on the screen to a physical manifestation is bound by the materials and processes of translation – from scan or CAD drawing to 3D print in PLA, casting in refractory plaster, which is then burnt out and cast into the glass, or from drawing to photopolymer plate, which is then inked and printed.

There's some fascination with where we are now, on the verge of an AI revolution. The significant amount of tech that I have used to create these rock images, both in 2 and 3D, seems to me to create a rather lovely juxtaposition between something very hi-tech and lab-based, the digital, and something resolutely of this earth, the rock (Elliot).

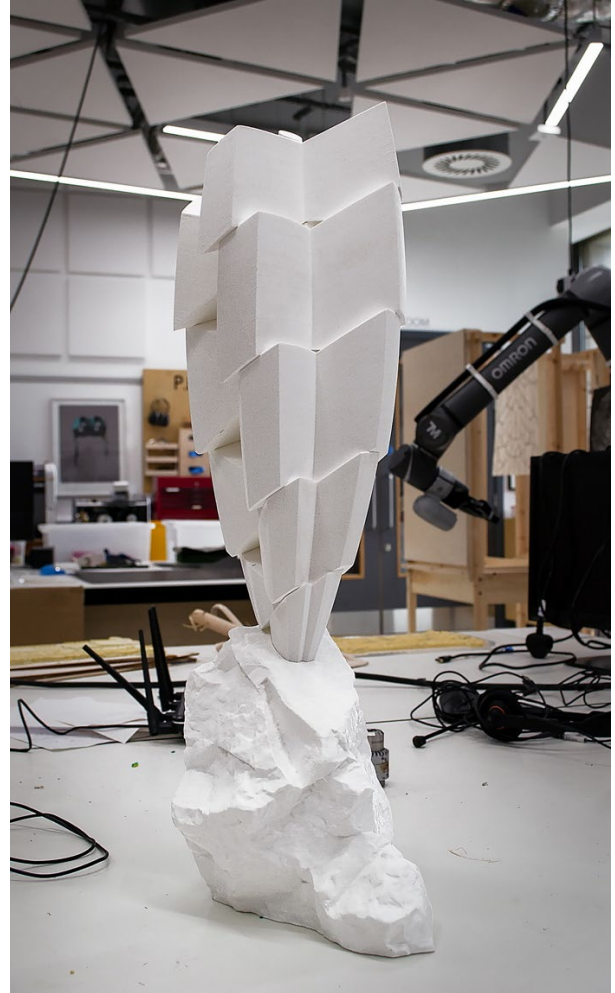


Figure 12: *Glass Vessel printed in PLA, Chuck Elliot.*

For me, it's really important to use tools that are of this moment and make works that look forward, but also evidence this time. I think engaging art almost always does that, providing us with a reflection of ourselves, perhaps that's why the history of art, and the progress it depicts, is so compelling (Elliot).

Elliot's residency edition involved three parts: a scanned rock from his garden, of which the surface was highly coloured and printed as a digital print; a 3D drawn *Vessel* that at its core is a golden seed – a palimpsest for the idea of nature, the source of all plant life, natural, agricultural and horticultural; and a range of haptic ink lines using laser cut Perspex combs and translated into a series of photopolymer etchings onto into a chine collé digitally printed gradient background. These lines were photographed at high resolution, processed digitally and mapped into six new 3D drawings about nature using sculpted form and line.



Figure 13: *Glass Vessel, sections cast in glass, Chuck Elliot.*

3. THE CABINET OF CURIOSITIES

The Royal Society used the concept of a Cabinet of Curiosities to share knowledge, demonstrate, or entertain, facilitating opportunities for introducing new ideas (Taylor 1988). Likewise, our multifaceted Cabinet invites an audience to engage with and explore artworks as a sensory, visual, and tactile experience.

For our purposes, the Cabinet needed to be portable, travelable, and adaptable to any space. Therefore, it needed to be self-contained and not reliant on a wall or hanging system other than our own. The resulting Cabinet was custom-created at the CFPR to incorporate all the specifications and requirements of the artworks, including glass sculptures, hanging silks, book works, prints, and folded maps.

When opened, the Cabinet of Curiosities can be transformed into a wall-free exhibition space, an installation or an engaging experience. It also includes an explanatory tear-off sheet that directs visitors to the website to explore further. It contains more information about the artists, films and images, and artist booklets that reflect each artist's practice.

The aim is to overcome conversation barriers by inviting audiences to engage and share their experiences and thoughts. Each print demonstrates the collaborative nature of printmaking, emerging print technologies and novel materials in the field of printmaking. The artworks are intended as points of departure and to encourage audiences to weave

their own stories into them. The Cabinet taps into our understanding of materiality and tactile engagement, the urge to handle and explore, and the power of the visual to create and share narratives (<https://cfpredictions.uwe.ac.uk>).

4. ACKNOWLEDGEMENTS

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Technoetic Magick: Explorations of the uncanny double as a noetic and magickal system through the complementary lenses of AI image-generation and AR

Lila Moore
Cybernetic Futures Inst.
Alef Trust – LJMU
Old Gloucester Street, London, UK
Info@cyberneticinstitute.com

The evolution of art forms and theories has coincided with scientific discoveries and technological developments. In 1896-1914, Kandinsky attributed the emergence of spiritual and occult abstract art to scientific discoveries about the atom. He equated the discovery of the division of the atom to a split in his soul that mirrored the breakdown and fragmentation of the whole world. Intriguingly, the fragmented modern psyche is evident in Freud's 'The Uncanny' (1919), which resulted from an encounter with his double and resistance to both the latter and the manifestations of modernity, primarily anthropomorphic automata. In the early 20th century, cinema technology unleashed opportunities for depicting the double and apparitional phenomena. Maya Deren expressed the notion of the fragmented psyche as divided into magickal doubles in her poem 'Death by Amnesia' (1942) and her films, especially *Meshes of the Afternoon* (1943). In the second part of the 20th century, the notion of the double returned through Roy Ascott's technoetic formulations of viable reality intersecting wet (organic) and dry (digital/virtual) media and noetic systems. From a technoetic perspective, current AI models for image training and generation offer further routes for investigating and evolving the uncanny and magickal doubles, their environments and systems. This paper offers a few explorations of the double as psychological, noetic and magickal systems through the complementary lenses of AI image-generation and AR.

AI art. AR art. Technoetic arts. Freud. Uncanny double. Maya Deren. Tomb of Perneb. Kandinsky. Imaginal. Psychospiritual.

1. INTRODUCTION

The evolution of art forms and theories has coincided with scientific discoveries and technological developments. During the Munich period (1896-1914), Kandinsky attributed the emergence of spiritual and occult abstract art to scientific discoveries about the atom. Knowledge of the atom confirmed the existence of a 'refined matter' that theosophists such as Blavatsky, Besant, Leadbeater and Steiner claimed could be perceived by the 'inner senses' (Introvigne 2015). Kandinsky equated the discovery of the division of the atom to a split in his soul that mirrored the breakdown and fragmentation of the whole world. 'Suddenly, the stoutest walls crumbled. Everything became uncertain, precarious and insubstantial. I would not have been surprised had a stone dissolved into thin air before my eyes and become invisible' (Kandinsky 1994, p.364). The scientific realisation of an invisible reality that can shape and transform the visible,

physical world of matter resulted in a 'double description' of the world based on internal and external standpoints and sources of data (Campos 2018, p.247). Thus, for Kandinsky, the physical experience of the world refrained from being merely static but consisted of networks of interrelationships. The spiritual dimension, regarded as invisible and immaterial, became integral to organic life and nature. Art plays a vital role in this double description as a mediator 'between the stable and changeable forces of creation' (Ibid. p.250). Interestingly, the fragmented modern psyche is evident in Freud's 'The Uncanny' (1919). The fragmented psyche reflects the fragmented post-World War I Europe (Haughton 2003, p.iiv) and the post-war conditions that led the bereaved to seances led by psychics claiming to communicate with, and manifest, the souls of the departed (Ibid. liii), especially those who lost their lives during the war (Mulvey 2006).

'The Uncanny' (1919) involves Freud's encounter with his ghost-like double and his resistance to both the latter and the manifestations of modernity, primarily anthropomorphic automata. In the early 20th century, cinema unleashed opportunities for depicting the double and apparitional phenomena (Mulvey 2006). Maya Deren expressed the notion of the fragmented psyche as divided into doubles and magickal entities in her poem 'Death by Amnesia' (1942) (Geis 2013) and in her films, especially *Meshes of the Afternoon* (1943). In the second part of the 20th century, the notion of the double, including double consciousness, returned through Roy Ascott's technoetic formulations of viable reality, intersecting wet (organic) and dry (digital/virtual) media and noetic systems (Ascott 2009). From a technoetic perspective, the current arrival of AI platforms for visual data training and generation offer further routes for investigating and evolving the uncanny and magickal double. This paper proposes a two-fold theoretical speculation concerning the double alongside three experimental bodies of work critically utilising AI as part of the creative process.

2. FREUD'S UNCANNY DOUBLES – SPLITTING THE ONE INTO MANY

The first body of work entitled *Freud's Uncanny Doubles* observes Freud's resistance to the double and the automata as a double. It is based on AI image generation fed and trained on Freud's essay and photographs by Max Halberstadt. The AI image training process consists of images created, manipulated, and selected by the artist. The process results in stills and videos of Freud and his doubles. (Figure 1) The creative approach draws on the premise that new technologies, currently AI, perpetually aggravate primordial fears of the uncanny double. Primarily fears of a non-human animated world led by invisible, digital, intelligent machines and entities. As Mulvey (2006, p.27) suggests, new technologies and advanced scientific developments are often difficult to comprehend when they first appear and, therefore, give rise to the 'technological uncanny.' The creative process envisions the tension involved in Freud's attempts to defend his corporeal self and reality against the delusional assaults of his uncontrollable doubles on the logic and structure of his psychological theory. Freud acknowledges the prevalence of the double in archaic cultures, such as in the art and ritual of Ancient Egypt and among children. Based on Otto Rank's theory of *The Double* (1979, originally written in 1914), the double functions as 'an insurance against the extinction of the self' (Haughton 2003, p.ii). Freud (2003, p.142) contends that the archaic meanings of the double as an antidote to mortality no longer apply to modern people. Freud identifies the double as 'a phase' that dominated the mental life of both the child and primitive man. When this

phase was surmounted, the meaning of the double changed. While the double was once an assurance of immortality, it has become in the modern age 'the uncanny harbinger of death' (Ibid.). Mulvey (2006) contends that Freud's attitude towards modernity was dismissive. Freud avoided discussing the uncanny in relation to modern automata such as the doll Olympia in Hoffmann's *Sandman* (1816) and modern machines such as the train, motorcar and especially the cinema.

These theoretical undercurrents inform the creative process, which began in December 2023 and requires several months to develop. The work, involving AI image training and generation has been taking place through the Playform platform. The images of Freud's most prominent doubles evolved from experiments with AI generated images. Images of the doubles were edited into short video episodes that mirror their fragmented existence and liminal, 'time out of time' train journey (Moore 2018, p.124). These video fragments allude to Freud's encounter with his double in his sleeping compartment during a train journey (Figure 2). The visual fragments combine still and moving images, referring to the technological uncanny that perpetually blurs the division between death as stillness and life as movement and between organic and artificial life forms. In addition to still images as physical prints, AR app is used to overlay audio-visual layers that mirror the internal turmoil and psychological states associated with the images. The overlapping layers are formed using image training processes, which enable the visual data to be analysed by AI model. This process is metaphorically compared to a psychoanalytical study of recurring nightmares that are induced by post-traumatic experiences. Images of these nightmares are created based on Freud's frightening encounter with his double during a train journey at night, as well as his interest in traumatic neuroses caused by railway disasters (Freud 2015).

AI image training allows for in-depth and critical analysis of the project's visual and textual data. Playform AI discriminates and recognises patterns, a capacity which is useful in visual data analysis. This formal analysis often leads to unexpected results and reveals new layers of information within both the nonverbal visual and textual narrative. For instance, a seemingly naïve story about a double on an old-fashioned train and outdated train trauma can be given contemporary context and relevancy through AI image training. The imagery of trains crashing and exploding or dissolving into reflective abysses transform into poetic depictions of the impact of technologies, particularly AI, on human consciousness. (Figure 3, Figure 4) Interiors become exteriors and vice versa with doubles crossing the boundaries of the physically real and the imaginal.



Figure 1: Freud's Uncanny Doubles, still incorporating AI image generation.



Figure 2: Stills of Freud's Uncanny Doubles incorporating AI image generation.



Figure 3: Railway Trauma, still incorporating AI image training and generation.



Figure 4: Crash Trauma, still based on AI image training and generation.

3. MAGICKAL AND NOETIC SYSTEMS

The second body of work explores the double in a technoetic, spiritual and ritualistic context. The double is perceived as both magickal and noetic system. The term 'magick' implies a relationship to spiritual or pagan rituals. According to Harvard University's Pluralism Project (n.d.), 'magick' spelled with a 'k' separates the spiritual practice from the fictional fantasy of film, theatre and the magical tricks of SFX. In contemporary Paganism, ritual techniques that alter people's consciousness and enable them to perceive and participate in a spiritual reality are regarded as magick. In this framework, the term magick is utilised in the context of AI, digital, screen-based, augmented and virtual artworks and films, including modes of performance and ritual. Magickal images or themes are not regarded as merely fantastical but as depictions that centre on the imaginal (Corbin 1972). A magickal practice involving the imaginal can be described as psycho spiritual (Ibid.). Magickal practices often involve altered states of consciousness that enable the emergence of imaginal and apparitional presence. Ascott has mapped the apparitional presence as a part of the field of consciousness of variable reality. The double, an apparitional presence or entity, corresponds with the variable realities of technoetic arts and aesthetics. Vegetal variable reality consists of wet, shamanic medicine and ritual technologies. Virtual variable reality consists of dry, digital and immersive technologies (Ascott 2009).

The term 'noetic systems' pertains to our personal neural networks merging with global networks 'to create a new space of consciousness' (Ascott 2003, p.379). In a technoetic framework, a noetic system can also be perceived as a cybernetic system made of mind plus physical matter alluding to Gregory Beatson's cybernetic and ecological concept of the mind (Ascott 2003). In Greek philosophy the nous pertains to an intuitive intellectual apprehension of first principles and truths. It is also a metaphysical and theological faculty of the mind referred to as the active intellect of the gods and the divine. Technoetic aesthetics bypasses the surface image of the world and allows an interpretive creative process that considers the interrelations of technology and mind including spiritual and magickal phenomena (Moore 2019, p.157).

The notion of a noetic system becomes relevant when considering the apparitional phenomena of the double as an integral part of the environment. In this environment, the mind is interconnected with the noetic faculty of consciousness, which is associated with spiritual knowledge. The ability of AI to analyse the environment as an information system uncovers visual patterns and details, which were not visible before. Section 5 demonstrates the implementation of the concept of noetic system in the context of the

Tomb of Perneb, where the tomb's environment functions as a quasi-mind that like a film or video projection depicts segments of ancient memories (Moore 2019).

4. MY KA

The ancient worldview of the doubles as spiritual extensions of the individual and the collective has returned to haunt modern people. Maya Deren, who divided her identity in her films into a few doubles, was interested in ancient Egypt prior to her choice to become a filmmaker. Her poem 'Death by Amnesia' (1942) was inspired by a news story about a young man who stopped a policeman on a New York Street and asked him: 'Can you tell me who I am?' (Clark et. al. 1988, p.66). Deren attempts to reconstruct the lost identity of the amnesia victim by identifying the lost parts of him according to the ancient Egyptian belief system. The young man is described as accompanied by Ka, his double and followed by Khaibit, his shadow. He was dressed in Western clothes as he walked down Broadway. Yet, Deren notices a curious detail (Ibid.):

'Only his feet were bare, which no one noticed, since they were coated with mud-yes, of the Nile that he remembered.'

In the final verse she asks:

'Can no one in the universe step forward [...] restore and reaffirm what once was someone composed of Ab, Ba, Ka, Khu, Kabit, Sekhem?'

In her notes, Deren wrote that the Ab, Ba, Ka, Khu, Kabit and Sekhem that construct the person's unique identity are the spiritual and eternal bodies that overlap and extend beyond the physical, mortal body (Ibid.).

The double is not always auspicious. In Deren's film *Meshe of the Afternoon*, the protagonist's murder or suicide is triggered by her double. The menacing double could be interpreted as the Khaibit, the protagonist's shadow that drives her to her death. Moreover, the protagonist transforms into a cyborg replacing her eye with a camera lens, which functions as a filmic device. The mechanical eye allows her to zoom in and out of the uncharted territory of her disturbed mind. Deren's magickal double is intertwined with the technological uncanny and the fear of unclassified entities that destabilise human vision and awareness.

The collection *My KA*, which commenced in December 2023, continues the long fascination with doubles (Moore 2018). It is described as a collection of performative images of ancient doubles who left their bodies and have remained bodyless. They wander through urban and deserted locations,

eternally seeking an identity and body to claim as their own. AI image training and generation is utilised as additional means that may add unexpected layers to their existence or give birth to new generations of mutated doubles. An imaginal interplay happens when contemporary, modern and ancient images and themes overlap and manifest as doubles. The tension between still and moving imagery is maintained as a reference to the technological uncanny. Based on original images of performed photography, AI is utilised as an additional lens with which to probe the visual data and generate the doubles' magickal identities, environments, and aspects (Figure 5). The process is lengthy, and the visual experiments undergo critical observation and selection. The manifested doubles (those approved by the artist) endured her critical resistance and reluctance to passively accept random disfigurements and transfigurements generated by AI.



Figure 5: MY KA, still incorporating AI image and video generation.

5. TOMBS AS NOETIC SYSTEMS

The paper 'Tombs and Reels of Consciousness: The Aesthetics that Interlink Ancient Ritualistic Artefacts and Digital, Augmented, and Virtual Reality' (Moore 2019) proposed some challenging ideas. While several propositions can be implemented with AR technology today, the challenge lies not only in the technology but also in the purpose and function of the chosen aesthetics. It is important to evaluate which aesthetics correlates with the knowledge and experience involved.

The current work focuses on the *Tomb of Perneb's* concept (Moore 2019) and aims to explore whether integrating AI image training and generation can provide valuable insights. AR aesthetics not only creates an illusion of two separate realities but can also establish a relationship between them as in the shamanic state of double consciousness. AR can make visible the invisible presence of another realm and establish an aesthetic kinship.

At this stage, the concept of the *Tomb of Perneb* is being developed outside of the actual tomb, which was dismantled into two parts. The burial chamber, which was located underground, remains in Egypt, while the public area of the tomb's above-ground structure is on display at the Metropolitan Museum of Art. Currently, the concept is being considered for implementation in the ancient tombs and temples of Malta in collaboration with Prof. Louis Laganà from the University of Malta. Laganà (2020) explores the intersection of Maltese prehistoric temples and artefacts, contemporary art and Jungian aesthetics. He has curated many art exhibitions in Malta.

Prehistoric environments and ancient tombs are perceived as noetic systems that contain memories that have been forgotten over time. Using AI and AR as tools, the artist is likened to a psychospiritual archaeologist, searching for and uncovering lost memories. This creative quest can give rise to apparitional presence, doubles and modes of double consciousness as explained by Moore (2018, 2019) and Smith (2020).

The use of AI generated images in the creative process is based on the notion that archetypal and symbolic images carry ancient memories that are part of humanity's collective unconscious and collective consciousness (Jung 1978). AI image generation is made possible through software that learns from a vast amount of data available on the internet. This process enables AI models to act as added layers of collective consciousness, gradually interacting with everything and everyone that has ever lived and had a conscious experience. Although the data available to AI models is somewhat limited, the ongoing learning process involves the integration and evolution of human and artificial minds. The transformation of familiar images into generated images can reignite and expand human imagination, turning the creative process into an adventure in unexplored aesthetic territories. It is worth noting that the Playform platform, which is utilised for this work, allows AI image training with specific and original collections of images. Thus, the artist has control over the creative process, but there is also a need to remain open to chance, as emphasised by the artist Patrick Lichty. He credits this flexible mindset to the concepts of chance that inform his work, such as those of the New York Fluxus artists (Lichty n.d.).

Uncertainty and not knowing what will happen next are crucial in the creative process. Being in the unknown is also experienced in trance states, spirit possession, ritual-magick and shamanic practices. The anthropologist Bronislaw Malinowski, whose writings inspired Maya Deren's early explorations of trance, wrote about the necessary conditions for the successful function of magical operations. Deren cited Malinowski in her article entitled 'Religious

Possession in Dancing' (1942), (Clark et al. 1984, p.482):

We find magic wherever the elements of chance and accident, and the emotional play between hope and fear, have a wide and extensive range. We do not find magic wherever the pursuit is certain, reliable and well under the control of rational methods and technological processes.

Akin to magick, AI image generation is explorative and vulnerable to change and transfiguration. It allows myriad transformations to occur and to be observed in detail.

5.1 THE WORMHOLE IN THE TOMB: GENERATING A WORMHOLE



Figure 6: Visualisation of the wormhole in the tomb.

The idea of a tunnel-like wormhole initially emerged as a solution to the circumstances enforced on the tomb's dweller (Moore 2019). As noted, the current tomb of Perneb does not include a burial chamber, and as a result, Perneb's ka is denied access to the public chapel. The upper structure's religious-magickal function was to endue him with life force whilst protecting and sustaining his perpetual existence beyond the temporal dimension. In cases where the deceased is denied access to the public area and temple, they may resort to other forms of magick. Therefore, the suggestion was to create a virtual tunnel through which the tomb's dweller and visitors to the tomb could be transported into a cosmic tunnel reeling in the Milky Way. The tunnel would reconnect the deceased's ka and burial chamber with the tomb, offering the visitors insight into the Egyptian expression of infinite space-time. As stated in the initial paper (Moore 2019), further research and experimentation are needed to explore the aesthetics that could generate the apparitional environment of the tomb and the impact of the experience on the participants/visitors. Initially, the

focus was on VR and AR as part of the experience. However, beyond the use of VR, the question of aesthetics has remained. What type of tunnel would convey the experience? What would the cosmic tunnel's visual style and experience be, and how would it be created? Currently, VR is not the focus of the investigation as the visual experience could take form in more than one medium, i.e. video projection, immersive environment, AI art and AR art. The VR and mixed reality options could be experimented with once the work on the wormhole is complete. It is also relevant to emphasise that although the wormhole experience and design refer to the case of Perneb's tomb and Deren's unrealised film script, it is created independently and does not depend on access to the physical artefacts in New York and Egypt.

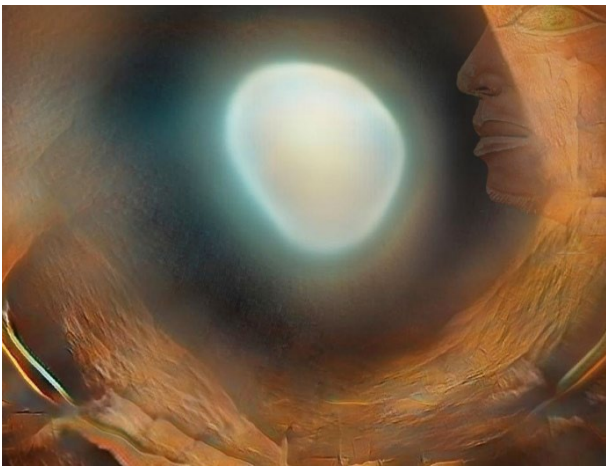


Figure 7: Visualisation of Perneb's Wormhole

The work on the wormhole is expected to take a few months to complete, as it is partially ready (Figure 6). The wormhole's visual style and design were determined due to work and experimentation with AI image training and generation. By training the AI with images that I selected and created, and images that are historically and mythically connected with the tomb, the wormhole assumes its unique features (Figure 7). The experience of travel and movement comes across through the fluid style of the images and their transformation through time. The fluidity of the images may recall the experience of altered states and add a sense of liminality. The wormhole is not merely a static structure travelling in space but an immersive, noetic system that transforms as it is in motion. The visual structure gives the impression that it has a unique memory and logic, which can result from the process of AI image training. Chains

of numerous correlated images are perpetually born, adding a sense of enigma to the creative process.

5.2. PERFORMING THE WORMHOLE RITUAL

The wormhole is designed to take visitors on a visual journey that represents departure and arrival. Although the journey through the wormhole can signify connectivity between separate geographic locations, the stations along the way are perceived as imaginal and symbolic. The design and images of the wormhole were inspired by the ancient Egyptian perception of the tomb as a time machine. They aim to convey the ancient Egyptian mythic perception of the tomb as a sacred space that unifies temporal and infinite space-time. According to Maravelia (2003), the tomb was regarded as a virtual cosmic birth chamber for eternity where time was perceived as cyclic and continuum. The concept of eternity was conveyed through the depiction of the sky goddess Nut. She regulated and safeguarded the passage of time and the order of the cosmos. Nut swallowed the sun at dusk and gave birth to the sun at dawn, and her body was perceived as space, the sky and the galaxy. Nut was regarded as the protector of the dead, and her depictions were prevalent in tombs and sarcophagi (Ibid.). These ancient perceptions are best understood through the Jungian approach to archetypes and their mythological patterns in the collective unconscious. Archetypes such as Nut are symbols of transformation, positioned at the junction where the dream world and the real-world traverse (Ibid). Her eternal and immortal presence conveyed the belief that 'just and pure humans would be the same after their death.' 'Joining the goddess meant a return to the womb of eternal space-time continuum and passing victoriously through immortality. Hence, the sky would become a nursery for the deceased, initially for the king and later on for the nobles and the laypersons' (Ibid. p.12).

The design, pictorial tones, and patterns of the wormhole are based on mythological and ritualistic archetypes (Figure 8). The journey's theme is inspired by the cosmic clock of the goddess' journey from dusk to dawn. *Perneb's Wormhole* can be experienced as a ritualistic night vigil or as a triptych consisting of a three-stage rite starting at dusk, continuing at midnight, and ending at sunrise. The interaction with the wormhole can offer opportunities for participation, guiding the viewers to participate in the mythic journey and the wormhole's imaginal environment.

6. CONCLUSIONS

The return of the double as the technological uncanny is probably more than a metaphoric play of words and images. It signals our zeitgeist by pointing at the historical timeline that interlinks scientific and technological advancements with the evolution of art forms and theories. The anxieties triggered by discoveries around the atom coincided with the development of psychology and modern art at the beginning of the 20th century. The Surrealists were captivated by Freud's psychological analysis of dreams and the function of the unconscious. Unlike Kandinsky, Maya Deren (1946) was intrigued by the destructive power of the atomic bomb, comparing it to the flimsy attempts of the Surrealists to destroy cultural norms. The opening years of the 21st century reflect a similar trajectory where technology and science threaten to dismantle the physical and mental norms of contemporary human existence. The dangers involved in splitting the atom recall current concerns, especially the manner with which AI is splitting and manipulating data into numerous units and sherds, cutting through everything that previously appeared stable, solid and undisputable. However, for artists and innovators, the upheaval AI catalyses can present opportunities to transcend the boundaries of knowledge towards novel discoveries. Technoetic arts is probably one of the creative fields most suitable to accommodate AI experimentally. Perhaps Ascott's (1999) assertion sounds timely now more than ever: 'One thing seems certain, the technoetic principle will be at the centre of art as it develops, and consciousness in all its forms will be the field of its unfolding.'

The three bodies of work discussed explore three different approaches to AI image generation, each with unique perspectives, yet all interconnected. In these collections, AI and AR models are used as complementary tools and lenses rather than the primary sources. *Freud's Uncanny Doubles* utilises psychological theory to position AI against itself by inducing traumas and delusions of the double. *My Ka* collection unleashes the magickal double as an AI enhanced imaginal and liminal entity. The ka is depicted as engrossed in self-exploration and self-determination. *Perneb's Wormhole* integrates AI image generation and training to investigate the archetypal and mythic patterns of ancient spiritual and magickal technology through psychospiritual contemporary settings and lenses. AR has an aesthetic function that contributes to the immersive experience of the doubles and their existence in a state of double consciousness. The double, whether seen as a psychological, spiritual, magickal, or technoetic entity, continues to inspire the creative imagination as it pushes the boundaries beyond the limits of the known.



Figure 8: Visualisation of an imaginal Ba, the mythic winged soul in Perneb's Wormhole.

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ARTIFEX: Exoplanet atmosphere visualisation

Pieter Steyaert
University of Antwerp, University of
Copenhagen, SEADS
Denmark
pieter.steyaert@uantwerpen.be

Marrick Braam
University of Edinburgh
KU Leuven
Scotland
marrick.braam@ed.ac.uk

Thorsten Balduin
Austrian Academy of Science, TU
Graz, University of Copenhagen,
Austria
Thorsten.Balduin@oeaw.ac.at

Oriel Marshall
University of Antwerp
University of Copenhagen
Denmark
oriel.marshall@uantwerpen.be

Diego Maranan
University of the Philippines
SEADS
The Philippines
dmaranan@upou.edu.ph

Jesper Bruun
University of Copenhagen
Copenhagen
Denmark
jbruun@ind.ku.dk

1. INTRODUCTION

The ongoing discovery and study of exoplanets, especially their atmospheres, are thriving, with significant contributions from instruments like TESS (Guerrero et al. 2021) and the James Webb Space Telescope (JWST) (Birkmann et al. 2022), promising further advancements. Research reveals these planets have unique atmospheres, differing from Earth's, with phenomena like sand rain on WASP-107b (Dyrek et al. 2023). However, representing these atmospheres often relies on graphs (Seager and Deming 2010; Crossfield 2015), making them challenging for the general public to understand without further interpretation or modeling, resulting in mostly static and non-interactive visualizations (Smith et al. 2020).

2. THE EXPLORING EXOPLANETS PROJECT

Throughout a series of experimental outreach events, a new explorative, interactive visualisation method for visualising exoplanetary atmospheric data has been developed. The Exploring Exoplanets project is an interdisciplinary initiative that blends live-action role-play (Tychsen et al. 2006; Bowman 2014) with scientific research to create immersive, interactive experiences for visualizing and understanding exoplanet atmosphere data.

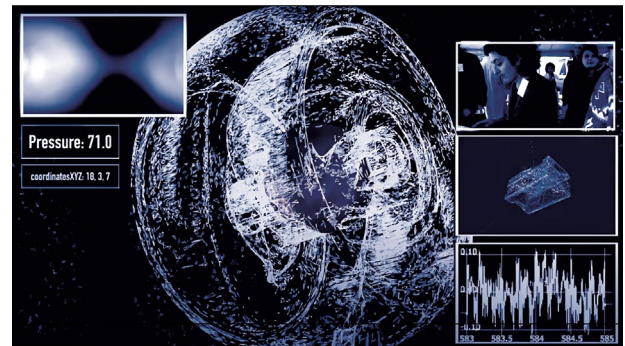


Figure 1: An early version of ARTIFEX for LARP interventions

In our most recent iteration, presented at the Big Bang Conference on Science Education in Denmark in March 2024, we introduced an innovative visualization method. This method functions autonomously as a versatile tool, facilitating both scientific analysis and enhancing educational outreach efforts. This new visualisation method, named ARTIFEX (ARTistic Immersion for scientiF EXploration), converts multidimensional data into interactive experiences that cater to both experts and non-experts alike. This method is intended to break down barriers in interpreting abstract representations (Olson 2008) by translating numerical data into visual narratives. Participants can explore an exoplanet's atmospheric layers visually, deepening their understanding of the scientific models and the relationship between different parameters.

3. ARTIFEX

The platform's data originates from simulations of exoplanet atmospheres using the UK Met Office's Unified Model, tailored for diverse exoplanets (Mayne et al. 2014; Boutle et al., 2017; Yates et al., 2020; Sergeev et al., 2020; Braam et al., 2022). These include a fictional aquaplanet orbiting a Sun-like star at Earth's orbital distance and the climate simulation of the closest exoplanet to Earth, which orbits a colder, smaller star, is tidally locked, and located much closer to its star than Earth is to the Sun. Observational data informs these models to simulate atmospheric circulation and climate, examining effects of stellar radiation, atmospheric composition, and thickness. Wind speed and temperature gradients highlight atmospheric movements, influencing cloud and chemical distributions. Electric field calculations, based on atmospheric dynamics, composition, pressure, and temperature, indicate potential for lightning, with larger fields due to turbulence and particle collisions within clouds (Balduin et al. 2023).

The interactive platform is customisable, users are able to change the components of the dashboard around and change the size according to what they want to explore. They can select a planet and a specific parameter, wind or temperature. A bespoke diverging colour palette has been developed specifically for the wind heatmap, enabling the clear distinction of wind directions that align with the direction towards the surface of the planet or away from it, as shown in Figure 2. Meanwhile, the temperature heatmaps employ a conventional Red-Yellow-Blue colormap to facilitate intuitive understanding and analysis (Schloss et al. 2019).

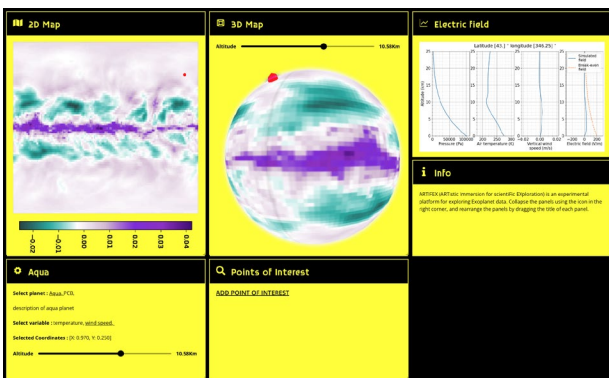


Figure 2: The ARTIFEX dashboard for inquiry-based learning activities.

These heatmaps are rendered simultaneously both as a 2D canvas and as a 3D spherical representation through UV mapping (Akenine-Möller et al. 2018). The level of height in the atmosphere is controllable, and users are able to select, annotate and save coordinates. The latest selected coordinates gets rendered as a panel with additional

graphs, showcasing the relationship between height, wind, temperature and electric fields. Figure 3 is a schematic representation of the ARTIFEX system.

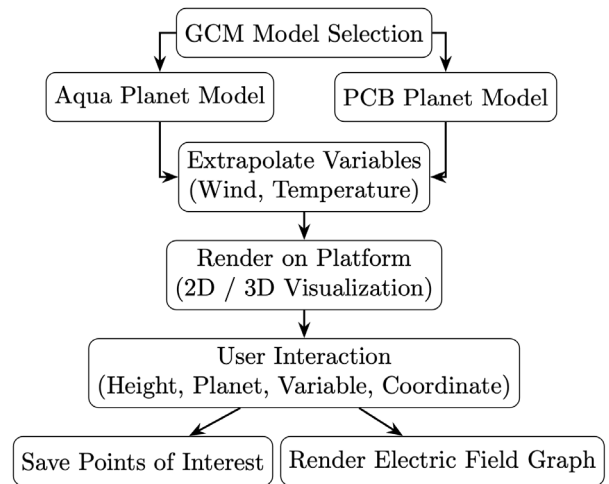


Figure 3: Schematic representation of the dashboard.

4. CONCLUSION

At this conference, the platform and its visualisation techniques underwent testing in both the previously mentioned LARP scenario and as a trial for inquiry-based learning. Throughout these interventions, the ARTIFEX platform demonstrated its potential as an engaging tool for users exploring exoplanet atmospheres, catering to both educational purposes and live-action role-playing activities.. This innovative approach to visualisation encourages participants to interact directly with scientific data, sparking curiosity and prompting questions. Although these early results are encouraging, they represent a starting point. The effectiveness of ARTIFEX as a tool for enhancing understanding and engagement in scientific topics suggests a potential that warrants further investigation. Future research will be critical in refining the platform and visualisation techniques to improve their educational impact. This work is a step toward making complex scientific data more accessible and engaging for a broader audience.

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Your Data Body

Mariene Oliver
University of Alberta
Canada
mariene@ualberta.ca

Scott Smallwood
University of Alberta
Canada
Scott.smallwood@ualberta.ca

This paper delves into the aesthetics and ethics surrounding the collaborative virtual reality artwork, *Your Data Body*. Made using medical scan data as a metaphor for our ever-expanding bodies of intimate personal data, *Your Data Body* seeks to challenge how we interact with the data of others, questioning the etymology of the word data, meaning “given” and questioning whether in many cases, data is rather “taken”. Using the gaming device of moving through progressive scenes, users first encounter open-access anonymized scan data and later donated data given with active and ongoing consent of the subject. Each scene situates the medical scan data within LiDAR scans, is accompanied by poetic elements, and has a complex sonic composition that combines field recordings, choral composition and data sonification as a way to situate the data geographically, temporally and emotionally.

Virtual reality. Medical scan data. Personal data. Data privacy. Sound. Composition. LiDAR scanning. Data sonification.



Figure 1: *Your Data Body*, scene 1.

1. INTRODUCTION

We are constantly warned that our personal data is vulnerable. We are told that it is used and abused by artificial intelligence, giant tech corporations, and controlling governments (Bridle 2018, O’Neil 2016). But do we really understand what “our data” consists of and what can be done with it by both ourselves

and others? Is it possible to unravel the complex entanglements of data gathering and automated processing technologies in order to see and understand what sociologist Deborah Lupton terms our “human data assemblages” in meaningful ways? Can virtual reality (VR) be used as a creative space to explore and situate our data bodies temporally, geographically and emotionally?

The research project Know Thyself as a Virtual Reality (KTVR) based at the University of Alberta, Edmonton, Canada has focused on these questions since 2019 through a series of interdisciplinary symposia, publications, and research-creation projects. The central research creation project is a diptych of VR artworks titled *My Data Body* and *Your Data Body*. *My Data Body* focuses on the data we generate and are responsible for as individuals, whereas *Your Data Body* questions how we interact with, understand, and are responsible for the data of others. Both the works use high resolution volume rendered medical scan data (such as MRI and CT scans) as well as other personal data, LiDAR scans, poetry and unique sonic compositions to create immersive and affective VR experiences that invite the user to think deeply about the data bodies they are seeing, hearing and touching, albeit mediated by a VR headset and controllers (Diodato 2012).

This paper focuses specifically on *Your Data Body*, the most recent of the two projects. As with *My Data Body*, medical scan data is used in the project both as a literal and metaphorical symbol of intimate personal data. Unlike *My Data Body* (Oliver et al. 2022) however which uses MRI scan data of the artist acquired especially for the work (Figure 1), *Your Data Body* is made using a combination of open-access anonymized datasets and donated medical scan datasets with varying levels of information about, and consent from, the subject of the scan. *Your Data Body* employs the gaming device of having progressive levels that the user moves through as a way to think through different levels of consent and data ownership, starting with open-access anonymized data and ending with data donated with active and ongoing consent and authorship. The different levels also situate the data within increasingly intimate and emotive virtual spaces, from the artist's home office to a series of old log cabins from a family property belonging to the scan subject. This paper will explain the aesthetic choices made in each of the scenes and share the many social, ethical and emotional questions that were raised by working with the personal data of others in VR.

2. SCENE 1: ANONYMIZED OPEN-ACCESS DATA

The first scene in *Your Data Body* collects open-access medical scan data that was originally acquired for scientific and medical research but has now been anonymized, so it can be used for secondary research with creative commons licensing. Since personal information has either been removed or obscured, consent from the scan subject is not required for use of these anonymized datasets. For *Your Data Body* computer tomography (CT), magnetic resonance imaging (MRI) and

positron electron tomography (PET) data were easily and freely downloaded from multiple research open access databases; The Cancer Imaging Archive (TCIA), National Library of Medicine, Embodi3D and Open Neuro. Additionally, openly available sample data for working in open-source radiology software (3D Slicer, OsiriX-Viewer and medDream) was also downloaded.

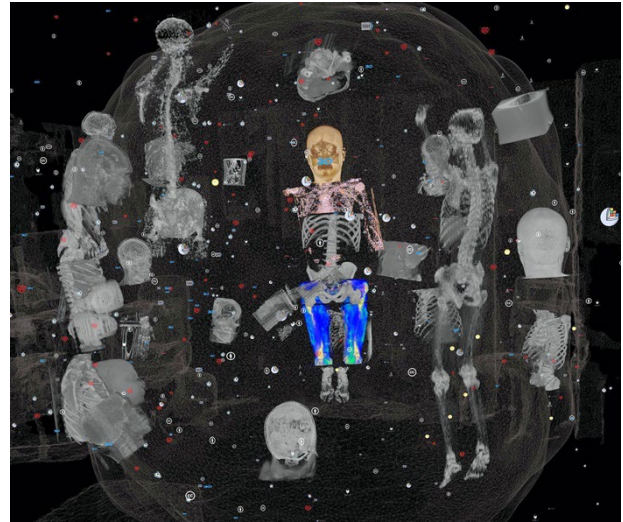


Figure 2: *Your Data Body*, scene 1.

Once downloaded, the scan data was processed so that it could be imported into VR, where it was placed in a web like pod, much like insects caught in a spider's web (Figure 2). The pod was then nested within a LiDAR scanned mesh of the home office in which the VR project was largely developed using the gaming software Unity. In early iterations of the scene, the data was placed in what looked like a storage facility or museum display case, but these structures felt strangely impersonal, resembling a science fiction computer game. In an attempt to acknowledge that it is the artist/researcher who is ultimately responsible for treatment of the anonymized data, as well as present where the data was being downloaded, transformed and rendered, it was decided to self-consciously place the data within a scan of the office in which the work was being developed. A medical data (DICOM) loader script was written for the gaming software Unity so that using the VR controllers grabbing function, the user can pull scanned body parts out from the web structure, place them elsewhere in the scene, resize and recolour them. The invitation is to use the scanned body parts like building blocks to create a Frankenstein like figure. As the user brings the scanned body part closer to them, and then to their ear like listening to a shell, they hear an automated voice reciting the information about the original research project and why the data was originally acquired. Each body part has a different automated voice, but the information about each of the datasets is very scientific and objective, giving no information

about the subject of the scan. Datasets which don't have this information are silent. An additional layer of sound in the scene is an abstract sonification of the data usage agreements for each of the databases (which range in length from a few lines to 18 pages long). Each body part also emanates logos and icons from them like confetti, which relate to the institutional or commercial database identity and the usage agreements attached to them.

The intention with this first scene is to invite users to reflect and question their relationship to open-access personal data. When the user is in the first scene of *Your Data Body*, they are able to hold the virtual head, chest, torso of another person in their own virtual hands. The body part is to scale so the user can relate to it with their own body, they can manipulate it and combine it with another anonymous body parts. But they know little about the subject, where or when the data was acquired, where the subject is now and of course the subject has no idea that a virtual copy of themselves is being held by another person some-where, somewhen in the world. Although arguably more uncanny and more embodied, this echoes many of our virtual interactions on social media where we consume, comment, like/love posts from strangers sharing very inti-mate information and images of themselves from every-where and everywhen. Or, as another example given by Laurence Scott in *The Four-Dimensional Human*, how platforms such as Airbnb allow intimate access into the interior home spaces of millions of strangers around the world at a time when we are increasingly socially distanced from our 'real' neighbours (Scott 2015).

The ethical difference of course is around consent and hopefully most people who share on social media and on Airbnb are doing it somewhat knowingly and actively. As explained earlier, consent is not legally required for anonymized data as the data has been de-identified and cannot be connected to the subject. Anonymization however has become less reliable in an age of big data, smart devices, and social media and anonymized datasets no longer offer the protections they once did. Smart devices and social media make a wealth of information publicly available [Cooper 2020, Parks 2021) and this big data can undermine the methods for protecting human subjects represented in anonymous datasets. Furthermore, as machine learning algorithms work by finding patterns in data, there is no assurance (or even way of knowing) if anonymized datasets are cross-referenced and thus re-identified. In order to test the theory of cross-referencing, a volume rendering of a team member's

own MRI scan was uploaded to Meta and it was tagged instantly (Figure 3). The potential for harm to the re-identified data subject is not equal for all data subjects and depends on the kind of data, its age, and a myriad of other local social, legal, political, and economic factors. The possibility of re-identification is particularly troubling when we consider that social media giants such as Google and Meta are establishing lines of business in the health care domain. For example, 23andMe is a Google venture (via Alphabet) that became a publicly traded company in early 2021 and is now using the DNA from millions of Americans to produce pharmaceuticals (Brown 2021). 23andMe is part of a Google health portfolio that includes insurance companies, medical record apps, and home health monitoring technologies that collect biometric data. Google's Project Nightingale, which gave Google access to health care data through research partnerships, has already raised privacy concerns and lawsuits (Schneble 2020). A solution developed in the radiological community for the re-identification of scan data is "defacing", which literally involves cutting away the face from head scans (Parker 2021). Defacing is mandatory for a dataset to be uploaded to the Open Neuro database, but as of writing, not to Embodi3D, nor 3D Slicer, other open access scan databases.

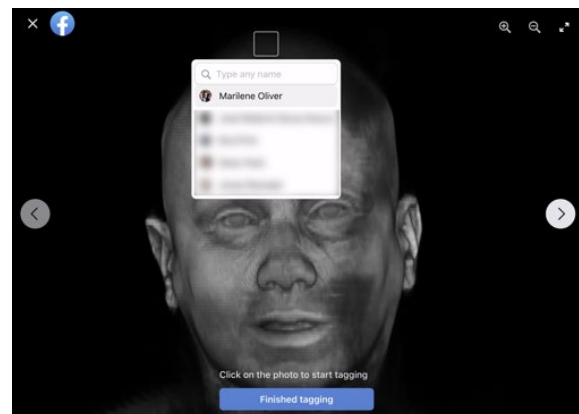


Figure 3: *Your Data Body*, scene 1.

Again, there is considerable debate over the efficacy and ethics of defacing. Many however are horrified when they first encounter a 3D rendering of a defaced dataset for it resembles a head with its face violently axed off. Aesthetically, a defaced 3D volume rendered dataset brutally symbolizes the crude (and typically automated) attempts to de-personalize and de-humanization data (hence the choice to include it in this scene (Figure 4)).



Figure 4: *Your Data Body*, detail of defaced data

In an attempt to re-humanize and re-personalize the data in this scene and indeed the whole of the *Your Data Body* artwork, the project composers wrote a choral composition that the user is enveloped by when they are within the data nest. The composers worked with a university choir to make a multichannel recording of the choir chanting “Anon, Anon, Anon.” This layer of beautiful harmonious human voices is intended as a gratitude to all the anonymous data that makes so much contemporary research and medical advancement possible. As the sound is so crucial in *Your Data Body*, the sound engine Wwise, was integrated into Unity to allow more spatial control of the data sonification, automated and human voices.

3. SCENE 2: RINGS OF FAMILIARITY AND COLLECTIVE DATA OWNERSHIP



Figure 5. *Your Data Body*, Scene 2

The next level or scene in *Your Data Body* is made up of MR and CT scans “donated” or “given” to the project specifically for creative purposes. Following academic research ethics procedures, an open call for scan data was disseminated through various academic email lists, as well as through direct requests to friends and family. In “Consent to Our Data Bodies: Lessons from Feminist Theories to Enforce Data Protection,” Paz Peña and Joana Varon bring a feminist lens to thinking through consent to data usage (Peña and Varon 2019). They explain the problematics of binary consent options

and the illusion that consent can be a free, rational, and individual choice. When a simple click can give access to a website, or, in the case of some medical research projects, to a potentially life-saving study, is there really a choice? In the same way that terms and conditions for social media sites are unreadable, is there a risk that research ethics information sheets and consent forms are equally unintelligible, prompting us to click through rather than meticulously scroll through the entire text? Peña and Varon suggest that the act of consent needs to be a) active, meaning actively agreeing with body and words to do so (not only the absence of no); b) clear and intelligible; c) informed, fully conscious; d) freely given, out of choice and free will; e) specific to a situation, therefore f) retractable and g) ongoing. With these healthier qualifiers of consent in mind, those who donated their data were shown the project during its many stages and given the option of retracting their permission or suggesting changes and being credited as an author.



Figure 6. Screenshot of Scene 2 showing text falling

The intention in the second scene is to suggest a collective and consensual ritual of offering and receiving data. When the user enters the scene, they are surrounded by rings of data that swirl around them and they are beneath a virtual sculpture of an eight-armed figure hanging from above seemingly reaching to catch or release data (Figure 5). There are three concentric rings of swirling data around the viewer. Data from close family and friends is in the first ring, then known colleagues in the second ring, and less familiar colleagues of colleagues or friends of friends in the outer ring. The rings float within a 360-degree video sphere of a forest of trees shedding their autumn leaves captured close to where the VR artwork was made, signifying being in a time of harvest. Inside the dome are various LiDAR scans of circular structures; a topiary trained tree, a stone circle and a large lily pond. These structures were all scanned by the lead artist in locations near their father’s home and chosen because of their relationship to time, tradition and ritual. From above fall words from another chant like poem called Touch written by J.R. Carpenter about the desire for embodied connection in a virtual world (Figure 6). If the user grabs/touches any of the data, it starts to

glow with a warm pulsing light. As the user moves closer to the scans, they hear human voices either reciting or singing the Touch poem that then wash through them as the scans swirl around the scene. The people who donated the data were given the option of either reading/singing the poem themselves in their own voice, or allowing a trained choral voice or musical instrument to be attached to their data. Most of the people who donated the data did agree to record in their own voice, but made the recordings in different places and at different times. In VR however the user is surrounded by a circular chorus of the scan subjects reciting or singing the poem at the same time. The idea of placing the data in concentric circles around the viewer developed from learning about examples of collective, rather than individual concepts of data ownership. In “Neuroethics Questions to Guide Ethical Research in the International Brain Initiatives,” neurotech ethicist Karen Rommelfanger and her colleagues explain how work done by International Brain Initiative, to coordinate brain mapping initiatives in China, Japan, Korea, Australia, and the EU, highlighted important differences between Western and Buddhist and Confucian societies in relation to data collection and ownership (Rommelfanger 2018). Rommelfanger explains that as China, Japan, and Korea societies are typically more collectivist, medical decisions and ownership of a person’s data is collective and family-based rather than individualistic.

Katherine Hayles famously argued that the tech industry continually revels in the fantasy of a disembodied future where we can cast our feeble bodies and become ostensibly omnipotent and omnipresent bytes of information (Hayles 1999). But our data is hardly objective and acts instead like an expression of what Donna Haraway called our situated knowledges. It is full of the same biases, privileges, limitations, and historical locatedness as our physical bodies; no matter how much one might want to dissolve into nothingness, there are always traces that lead us back to our bodies in the here and now (Haraway 1988). This ‘limitation’ is not only inescapable, but the source of our hopes and fears, individuality, and sense of collectivity. VR offers a unique opportunity to challenge this post humanist logic by showing how our personal data continues to be sensorial, affective and highly relational, offering the ability to be sur-rounded by and immersed in it.

4. SCENES 3, 4 & 5: SITUATING DATA AESTHETICALLY, PHYSICALLY AND EMOTIONALLY

One participant responded to the call for scan data with a donation of over twenty datasets is herself an artist. The artist has created several artworks with her own medical scans, which have been acquired

for diagnostic reasons since 2014 as part of her ongoing oncological care. In 2019 for instance, she worked with her husband and long-term collaborator to create Light Touch, a large silk fabric tent printed with images of her brain scan held tenderly in both her own and her husband’s hands. In this and subsequent works, the artist and her husband have made strong aesthetic choices about how the artist’s scans are presented; typically fragile, transparent, and intermingled with images of flowing water and poetic text. Through conversations and experimentation, it became clear that the artist who donated the data and her husband should collaborate on the *Your Data Body* project, be offered aesthetic control of the scenes that feature her data (3, 4 & 5) and become collaborators in the work.



Figure 7. Screenshot of Scene 3, *Your Data Body*



Figure 8. Screenshot of Scene 4, *Your Data Body*

The final three scenes of *Your Data Body* situate the artist’s medical scans within LiDAR scans of disintegrating pioneer wood cabins in the boreal forest of Alberta, a location that has been central to the artist’s life past and present as a beloved second home. Originally a homestead property and then a fishing camp, the location is now a collection of wooden cabins in varying states of decay and repair as the artist and her family are committed to ‘rewild’ the proper-ty. In the third scene, rows of the artist’s

head scans sit within the ruins of the “homestead” cabin (Figure 7). In the fourth scene, a CT scan of the artist’s chest and lungs rotate slowly within the “Miller” cabin (Figure 8), and in the fifth and final scene, the artist’s fiery PET scan data is cradled within the “tent” cabin (Figure 9). In each scene is a poem written by the artist’s husband that either floats above her data, is nestled within it, or as in the final scene, sways through it back and forth. Her husband wrote after first seeing renderings of his wife’s data and feeling a deep sense of lack in them, a lack of recognition, a lack of ownership, a lack of meaning. The poems are tender, mournful, sensuous and full of longing, recalling shared intimate memories of each other’s bodies in a very specific location steeped in personal and socio-political history.

Once again, sound is crucial in these scenes for which the composer went to the lake site and made a library of field recordings of water, fire, wind in trees, birds and animals, and distant trains and traffic for the project. The composer also used the cabins and found objects as instruments, capturing their reverberances. With their students and working with WWise, the composer placed the captured sounds in the scenes to guide and envelop the user. Inside the rotating chest of the Miller cabin is the sound of water (Figure 8), in the cradled PET scan, the sound of fire (Figure 9). In other parts of the scene are recordings of the forest and the lake. In addition to the spatial composition of field recordings, there is also a layer of choral singing and spoken word based on the husband’s poems. To the right of the cabin which holds the PET scan for instance, there are scanned trees in which whisperings of poems can be heard.

When reflecting on their experience of making these scenes, both the artist and her husband said they found the process surprisingly therapeutic and positive. What once had been scans that conjured fear and anxiety, now felt loved and cared for. Working with the scans in VR and making aesthetic decisions about them gave them agency and ownership of their data. Interesting, having worked for so long in virtual reality with the medical data within the LiDAR scans of the cabins, when they now return to the cabins in real time and space, they almost feel the data within it.

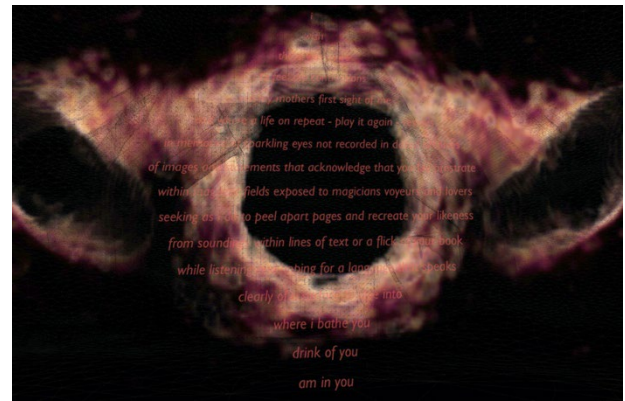


Figure 9. Screenshot of Scene 5, *Your Data Body*

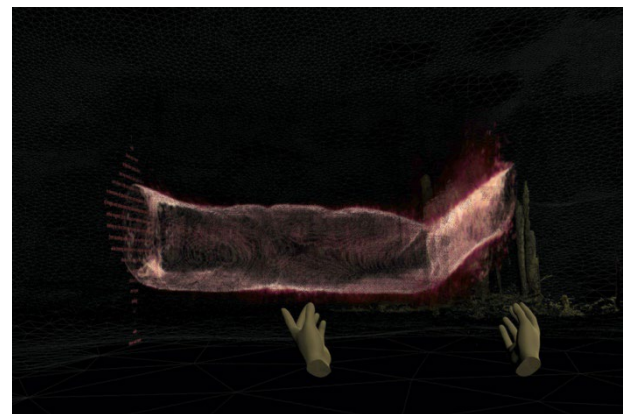


Figure 10. Screenshot of Scene 5, *Your Data Body*

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The Artistic Tension: Facetuning, algorithms and the wild era of self-perception

Gretchen Andrew
Gretchen Andrew Studios
Mud Foundation /Knight Foundation
London, UK
g@gretchenandrew.com

María Peguero
Gretchen Andrew Studios
Mud Foundation /Knight Foundation
Washington, DC, USA
mariapeguero.projects@gmail.com

Amelie Schlaeffer
Gretchen Andrew Studios
Creative Computing Institute
London, UK
amelie@schlaeffer.com

The paper will delve into the artistic exploration of the interplay between facetuning, algorithms and self-expression within the context of Gretchen Andrew's ongoing artwork series, "Wild Era Art". The focus is on the interplay between facetuning, algorithms and self-expression, scrutinising their impact on self-perception and the formation of visual identity. This research is generously sponsored by The Mud Foundation with support from the Knight Foundation and The National Endowment for the Art.

Visual identity. Algorithms. Internet imperialism. Structural bias.

1. INTRODUCTION

This paper aims to investigate the intricate conceptual interplay among facetuning, algorithms and self-perception, as exemplified in Gretchen Andrew's artwork series, "Wild Era Art".

Facetuning is the digital manipulation of one's appearance, often involving editing tools to enhance or alter facial features, leading to a modified representation of oneself. This concept is presented alongside self-perception, which refers to an individual's awareness and interpretation of oneself, encompassing beliefs, attitudes and evaluations about one's identity and appearance.

Presented for the first time in the exhibition Media Under Dystopia Wisper edition at the MUD Foundation in Miami (mud.foundation), the artwork series delves into the tension between the artist's raw creativity and the controlled influence of AI, forming the focus of this paper's analysis on the artistic nuances within this ongoing exploration.

The analysis focuses on the profound impact of facetuning on self-perception, emphasising the tension between unbridled creativity and the controlled influence of AI and algorithms. Within the series, facetuning is metaphorically portrayed as a mask, employing a custom-made robot to dynamically modify selfies and reveal the conflict between desired presentation and algorithmic suggestions. The paper discusses the normalisation

of appearance through facetuning, exposing the pressure to conform to algorithmic beauty standards. Furthermore, it explores how adherence to specific aesthetics influences visibility within digital platforms, unveiling inherent biases. The seamless integration of algorithmic modifications in photography is a central theme, challenging the authenticity of digitally mediated self-representations. Ultimately, "Wild Era Art" serves as a profound exploration of the evolving intersection between artistic rebellion, algorithmic influence, algorithmic control and the redefinition of femininity, prompting reflections on societal norms and advocating for the reclamation of diversified authenticity in the digital era. The paper concludes by encouraging further scholarly exploration of the evolving relationship between art, technology and self-perception.

2. IMPORTANT DEFINITIONS AND EVIDENCE OF CULTURAL RELEVANCE

Social media plays a pivotal role in shaping contemporary identity construction, particularly through the visual medium of photography. This phenomenon underscores the intricate interplay between individuals, their self-perceptions and the curated representations of their lives within the digital realm. Users can portray themselves positively thanks to the personal attributes in their profiles. As a result, users are not required to provide accurate information on their profiles (Figure

1). Instead, deceptive self-presentation is a viable alternative (Ozimek et al. 2023) (Figure 2). The pervasive use of social media platforms, such as Instagram, Facebook and Twitter, as vehicles for self-expression has engendered a dynamic relationship between identity and self-portrait photography.

In the era of filtered feeds and curated online personas, Facetune has emerged as a powerful tool for shaping how we present ourselves to the world. This photo-editing app, launched in 2013, initially gained traction among social media influencers and celebrities seeking to digitally enhance their selfies and portraits. Its intuitive interface and array of features, designed specifically for facial adjustments, allowed users to smooth skin, whiten teeth, shrink noses and apply a whole menu of beauty filters.



Figure 1: Before facetuning digitally.

Figure 2: After facetuning digitally.

As selfie culture took hold and the pressure to project a “picture-perfect” online image intensified, Facetune’s popularity exploded, particularly among younger generations and women - and understandably so. Dr Jill Owen, psychologist from The British Psychological Society, claims that worrying excessively about our appearance might result in “perceptual distortion,” which happens when we “highlight a fault, then focus disproportionately on this until it becomes magnified” in our minds (Meeson 2020). Which can explain why by 2017, Facetune was Apple’s most downloaded paid app (Bell 2017), transforming the way we perceive and portray ourselves online. While it empowered individuals to explore creative expressions and experiment with different looks, concerns around its impact on body image and mental health also surfaced. The relentless pursuit of Facetune-filtered perfection fuelled anxieties about self-worth and exacerbated feelings of inadequacy, particularly among young adults. In 2020, the American Psychological Association found that young adults who used filters on social media or videoconferencing calls reported higher levels of anxiety at 85 per cent compared with their counterparts at 58 per cent (Silence et al. 2021).

The term “Facetuning” has even transcended the bounds of the app itself, evolving into a ubiquitous verb to describe the act of digitally altering one’s appearance in photos and videos. This trend is further amplified by the growing number of apps now equipped with similar face-altering features, such as Meitu, Photoshop Express and BeautyPlus. These “Facetune-inspired” tools have democratised the manipulation of reality, making it easier than ever to tweak and refine our digital selves into ever more normalised sense of beauty.

This pervasive “Facetuning” culture, however, comes with a cost. The constant bombardment of unrealistic, digitally-enhanced images can distort our perception of beauty, promoting narrow and often unattainable standards. The blurred lines between reality and filtered representations can fuel feelings of insecurity and dissatisfaction with our own natural appearances.

3. ESSE IST PERCIPI

3.1 Facetuning the algorithmic gaze: A feedback loop of image manipulation and social currency in the digital sphere

As Siibak affirms, similar to in-person interactions, online communication involves people constantly seeking out information about one another so they may anticipate each other’s responses and know what to expect from them beforehand. Individuals attempt to control the impressions they are going to give others by calculating their actions and behaviours, whether consciously or unconsciously - performing several acts before receiving the approval they were looking for (2009). On social network sites, this approval is determined by algorithms.

A key aspect of “Wild Era Art” is its exploration of how conforming to certain aesthetics enhances visibility within these algorithms. Facetuning & Instagram Face social media platforms, including Instagram, use algorithms to determine what content is shown to users in their feeds. These rank content based on factors like interest, post popularity, poster information, interaction history, user engagement, viewing history and closeness (Mosseri 2021). Users who conform to or enhance the Instagram face aesthetic through editing tools may find that their posts receive more likes, comments and shares (Lavrence and Cambre 2020). Content with faces is 38% more likely to receive likes and 32% more comments (Bakhshi et al. 2014) but photographs with filters are 21% more likely to be viewed and 45% more likely to receive comments (Bakhshi et al. 2015).

This increased engagement can positively influence the algorithm, leading to greater visibility of their content on other users' feeds. This increased algorithmic exposure in the digital sphere creates a "virality trap" where once a Facetune-enhanced photo catches fire, it enters a self-perpetuating loop. The increased visibility attracts more viewers, leading to even more engagement and further algorithmic amplification. This "virality trap" can propel the photo to a wider audience, potentially setting unrealistic and narrow expectations for beauty and amplifying anxieties for those who don't meet the edited ideal.

3.2 Shadowbanning female identities: Self-perception and expression

Shadowbanning is a controversial and hard to detect content moderation practice where users' posts are hidden from others without their knowledge, often used as a form of covert censorship (Savolainen 2022). In the context of this paper, it can be a useful analogy to string together female online identities and the virality trap.

As cited above, content in which a face is filtered is more likely to be viewed and get comments, hence increasing engagement and pushing down – or shadowbanning – the feed content that is unfiltered, non-beautiful. Within a context where everyone is able to achieve beauty, Gretchen embarks on a process of policing this work. The result is a portrait of tension between who you are (the prior shadowbanned untamed femininity) and who the algorithms say you should be (structured and controlled) - challenging both the self-perception of women and encouraging new means of self-expression. The series seeks to inspire a paradigm shift in the perception of self, advocating for a "natural era" that celebrates wildness and authenticity.

While projects like "Self in Art/Self As Art" have already tackled the relation between selfies and identity creation (Kozinets et al. 2017), the novelty of Gretchen's artwork lies in the visual materialisation of the tension between the algorithms and untamed femininity.

4. ELECTRONICALLY VISUALISED PROCESSES OF INTERVENTION AND EXPOSURE

When facetuning is applied to a photograph digitally the resulting modification seamlessly and potentially invisibly. The seamless integration of algorithmic modifications in photographs is a central theme in the series. To visualise these on-canvas battles, Gretchen presents the transformative impact of algorithms on visual narratives. The discussion delves into how such seamless alterations blur the

lines between reality and digital manipulation, questioning the authenticity of digitally mediated self-representations. To expose the tension between the facetune algorithms and the unmodified portraits including selfies and historical paintings, Gretchen Andrew's studio employs a custom-made robot to physically modify faces, emphasising and juxtaposing the tension applied by algorithmic influence. This series of portraits sheds light on how facetuning becomes a form of digital disguise or masking strategy (Lavrence and Cambre 2020), revealing the conflicting narratives of self-perception. The works are created with the following steps:

- a photography selfie is taken (Figure 1);
- facetune algorithms that are popular on apps such as Instagram and Tik Tok are applied to the digital selfie (Figure 2);
- the unmodified Selfie is printed in oil paint using MatrLab's singular & proprietary oil paint printer;
- a custom robot then takes the facetuned version of the selfie and draws, smudges, cuts and erases physically on top of the unmodified printed selfie (Figure 3);
- the resulting portrait shows the tension between the unmodified image and the facetuned version thus visualising the juxtaposition between the algorithmically controlled ideal of beauty and how that artist chose to present herself (Figure 4).

The same process is applied to historically important paintings such as The Mona Lisa. Portraiture has always dealt with the tension between reality and desired perception. With these portrait subjects, Gretchen asks the audience how do these famous works from around the world survive the increasingly narrow way we view the human body.



Figure 3: During robotic physical facetuning (work on paper).



Figure 4: Finalised artwork (oil on canvas).

5. CONCLUSION

Gretchen Andrew Studio's "Wild Era Art" portraits serve as a profound exploration of the intersection between artistic rebellion, algorithmic influence and the evolving definition of femininity. The tension portrayed in the series prompts viewers to question societal norms, reflect on the pervasive influence of AI and advocate for the reclamation of authenticity in the digital era. The paper encourages further scholarly exploration of the evolving relationship between art, technology and self-perception.

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Journey into Form: Transmediating the woven artwork of Jaad Kuujus (Meghann O'Brien)

Kate Hennessy
Simon Fraser University
Canada
kate_hennessy@sfu.ca

Hannah Turner
University of British Columbia
Canada
hannah_turner@ubc.ca

Jaad Kuujus
(Meghann O'Brien)
Independent Artist
meghannshaunobrien@gmail.com

Doenja Oogjes
Eindhoven University of Technology
Netherlands
d.j.oogjes@tue.nl

Reese Muntean
Simon Fraser University
Canada
reese_muntean@sfu.ca

This paper addresses processes of transmediation of artwork between the tangible and the digital through a series of recent collaborative works by weaver and artist Jaad Kuujus (Meghann O'Brien) (Haida, Irish, and Kwakwaka'wakw) and co-authors. Starting with Jaad Kuujus's explorations with mountain goat wool, to her Chilkat and Raven's Tail-style woven robe *Sky Blanket*, its digital surrogate *Wrapped in the Cloud*, and a newly materialised digital-jacquard-woven robe, we explore how decolonial research-creation and curatorial practices can look beyond replication to harness the affordances of transmediated art to enable belongings—ancestral or otherwise—to be returned to community while highlighting connections between the digital, land-based material practices, and intangible knowledge.

Transmediated art. Indigenous curation. Materiality. Digital jacquard weaving. Photogrammetry.

1. INTRODUCTION: JOURNEY INTO FORM

Meghann O'Brien (Jaad Kuujus) is a Northwest Coast weaver and artist working in the traditions of basketry, Yeil Koowu (Raven's Tail) and Naaxin (Chilkat) textiles. She is descended from the Kwakwaka'wakw village of Weka'yi T'sakwa'lutan (Cape Mudge), the village of Kiusta, Haida Gwaii, in British Columbia, Canada, and Dublin, Ireland. Between 2010 and 2012, funded by a Canada Council for the Arts grant, O'Brien hand-processed mountain goat wool that she had procured from hunters in Tsimpshian territory in northern British Columbia (see Figure 1). As she notes, mountain goat wool was the only Indigenous yarn material that was used in the North before the introduction of commercial yarns, and is in this way particularly meaningful (O'Brien 2024). She exhibited documentation of her process and the resulting balls of wool and hand-spun yarn in a 2012 exhibition at the Bill Reid Gallery of Northwest Coast Art titled "Journeying Into Form: The Mountain Goat Wool Project".



Figure 1: Meghann O'Brien processing mountain goat wool. Video still from *Journeying Into Form* (dir. Talon Gillis).

O'Brien described lengthy process of preparing the warp and weft yarns that the transformation of the hide and wool required, as well as its effect on her feeling of connection to weavers past and present, to the land and the animals that provide "the essence of what robes are made of" (O'Brien 2024). Reflecting on the transformation between states at the heart of her process, she notes:

Mountain goats were regarded as supernatural beings living high up in the mountains, and mountains are often surrounded by clouds, which seem to wrap them. I sensed a connection between the shifting of states of a gas transforming to a liquid or to a solid as related to the work. I realised that clouds and snow are both forms of water in different states. When I consider the snowy mountains the goats live in, the clouds that wrap the mountains, and the white wool that covers this animal that is so intimately tied to the clouds, the complexity and beauty of the interrelationship between these aspects of nature staggers me. I try my best to wrap my mind around the power that it holds when objects are created from elements of nature (O'Brien 2014).

O'Brien's transformation of the mountain goat's hide and wool to weaving-ready yarn is a starting point for this paper, which documents our process of transmediating Meghann O'Brien's woven artwork between physical and digital states. We will show how our team has worked collaboratively since 2017 to explore a range of possibilities for digital technologies of replication and transmediation to support her art practice and broader decolonial curatorial methodologies and frameworks. We follow a "journey into form" to trace the literal and figurative threads of her practice through an iterative translation of her woven artwork through media and materials that begins with O'Brien's masterful *Sky Blanket* (which includes her hand-spun mountain goat wool), and then a series of interconnected works: our collaboratively produced digital animation *Wrapped in the Cloud*, which became a surrogate for *Sky Blanket* in several exhibitions; and then a digital-jacquard woven robe (Untitled) that materialises constellations of pixels and forms from *Wrapped in the Cloud* that O'Brien intends to activate as dance regalia (Oogjes et al. 2023).

Through our description of these three artworks, we show how research-creation methodologies and curatorial practices aimed at challenging colonial legacies of collecting and exhibition can harness the affordances of transmediated art to enable belongings to be returned to community while also highlighting inextricable connections between the digital, land-based material practices, and human relationships, including ancestral ties.

2. JOURNEY INTO FORM: FROM SKY BLANKET TO WRAPPED IN THE CLOUD

Jaad Kuujus's work with mountain goat wool set the stage for the weaving of one of her most well-known works of art: a Yeil Koowu (Raven's Tail) and Naaxiin (Chilkat) style woven robe titled *Sky Blanket* (see Figure 2). Made from a blend of z-twist handspun merino wool, cashmere, and her mountain goat wool yarn, *Sky Blanket*'s striking black and white design reflects the constellation of

the Pleiades; its central motif shows three interconnected ancestor faces, designed in collaboration with K'omoks and Kwakwaka'wakw artist Andy Everson and Haida artist Jay Simeon. As with the mountain goat wool itself, the design references the continuity of knowledge through Jaad Kuujus's ancestral, contemporary, and future weaving relations.



Figure 2: *Sky Blanket*. Photo Rolf Bettner, courtesy of the Haida Gwaii Museum at Kaay Llnagaay.

Completed in 2014, *Sky Blanket* was curated for exhibitions internationally and then nationally as a part of the Winnipeg Art Gallery's touring exhibition *Boarder X*, which featured the work of Indigenous artists who also had connections to skateboarding and snowboarding (O'Brien was formerly a professional snowboarder, and mountains figure prominently in her work). *Sky Blanket* was installed on a wall, surrounded by floating balls of mountain goat wool.

However in 2017, as *Boarder X* was being prepared for installation at the MacKenzie Art Gallery in Regina (SK), O'Brien began to have misgivings about *Sky Blanket* continuing to circulate in contemporary art contexts for the next several years. With curator Jaimie Isaac, O'Brien began to consider possibilities for somehow replicating *Sky Blanket* with a new work that could take its place and allow the robe to return home to Campbell River on Vancouver Island to be used in family ceremony (Turner et al. 2018). They reached out to Kate Hennessy (Irish/German descent) and Hannah Turner (Norwegian/German descent) at Simon Fraser University to explore possibilities.

Hennessy and Turner were working together at that time in the Making Culture Lab at the School of Interactive Arts and Technology, a group exploring research-creation as a methodology for collaborative and decolonial approaches to production, between art, media, and anthropology

(see Muntean et. al. 2015; Kadir et. al. 2017; Smith and Hennessy 2020). Research-creation, according to Natalie Loveless, “rather than uncritically adding one disciplinary apparatus to another... marshals new methods that allow us to tell new stories, stories that demand new research literacies and outputs” (2015). In the Making Culture Lab this has included video and documentary production, photography, virtual exhibit design and curation, digital modelling and fabrication, and contemporary art practice as methods for ethnographic inquiry into the cultural and community practices of media, museums, and archives.

While we originally had considered using scanning and 3D printing to recreate the robe, wide ranging conversations within our group took us in another direction. Rather than create a high-fidelity representation of *Sky Blanket* we instead were inspired by our collaboration with digital artist Conrad Sly and PhD candidate and photographer Reese Muntean to use photogrammetry and digital modelling to show the layered and highly technical cloud-based computational process of 3D modelling—the transmediation of *Sky Blanket* into a new form.

The final media work, a 4-minute looping video animation, highlights the emergent aesthetic qualities of the digital model and provokes questions about the nature of replication and the threads of connection that remain between the tangible and digital (see Figure 3). From a black screen, five points of light emerge, evoking the Pleiades constellation. The points of light multiply into the hundreds and then are connected by thousands of lines creating triangular shapes. The points and lines shift and take on the form of the woven blanket, morphing and shifting through different colours and states of the modelling process until a high-fidelity representation of *Sky Blanket* is reached, after which the images change and are unravelled back to the stars again.

Referencing O’Brien’s experience of processing mountain goat wool, our team’s deep appreciation of the emergent aesthetic qualities of the digital model that evoked landscape and mountains, and the cloud-based computing required to create the digital model, the media work was named “*Wrapped in the Cloud*” (2018). It replaced the original *Sky Blanket* at the MacKenzie Gallery and in subsequent installations of *Boarder X* across Canada over the next three years (see Figure 4).

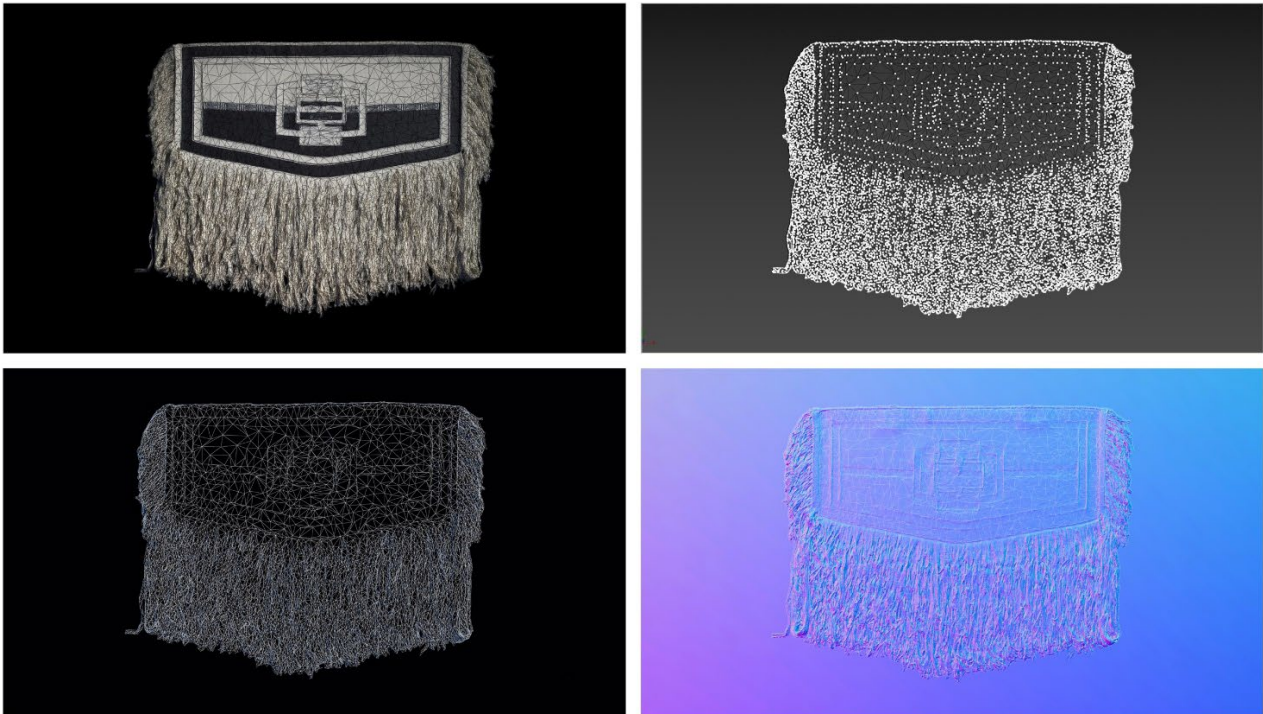


Figure 3: Video stills, *Wrapped in the Cloud* (4 mins). Jaad Kuujus Meghann O’Brien with Conrad Sly, Hannah Turner, Reese Muntean, and Kate Hennessy, 2018.

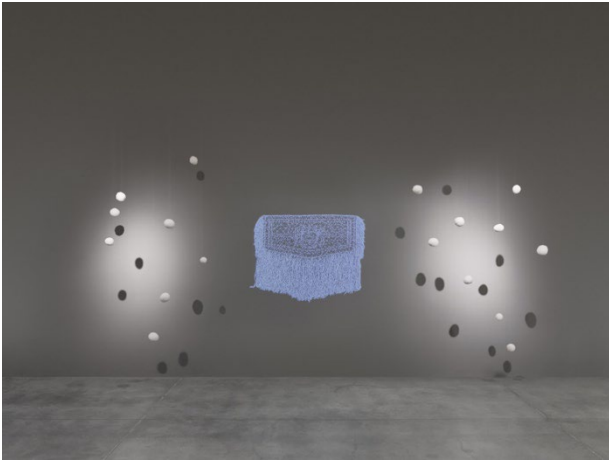


Figure 4: *Wrapped in the Cloud*. 2019. Installation view, Boarder X, Art Gallery of Alberta. Image courtesy of Rachel Topham.

It was also independently curated into a number of exhibitions in Canada, where the metaphor of weaving, threads, and connection became integral metaphors for curators articulating the importance of collaboration and relationships across technologies, cultures, and through time. For example, as curators of *Sovereign Intimacies*, Plug In Institute of Contemporary Art, Winnipeg Nasrin Himada and Jennifer Smith wrote:

Wrapped in the Cloud ... is an otherworldly video that reveals the layers that connect community and ancestral knowledge, representing the often-inexpressible depths of love and culture. *Wrapped in the Cloud* is a digital representation of a weaving called *Sky Blanket* by Jaad Kuujus (Meghann O'Brien), that reveals what our eyes cannot see when looking at the weaving. We are let into a sacred realm that shows us how every ancestor holds space in the constellations created through the process of weaving threads together. The warp and weft change the structure of the threads, making them stronger once woven together. Through collaboration with other artists, and community, *Wrapped in the Cloud* is stronger for the shared knowledge, care, and presence of each person and spirit that has had impact on the making of the weaving and the video. It all comes together through Jaad Kuujus (Meghann O'Brien) who brings this work into existence (Himada and Smith, 2020)

With *Sky Blanket* no longer committed to presence in Boarder X, O'Brien was able to return with the robe to Campbell River, British Columbia. *Sky Blanket* was danced in a ceremony in the Campbell River Big House, one of only two family ceremonies by O'Brien's family in the last 100 years (Turner et al. 2018). This was a Hilugwila Feast held for K'yuusdaa Rose Davidson; in this traditional naming ceremony a baby—O'Brien's niece—received her first name and haircut. *Sky Blanket* was danced by O'Brien's sister Avis, and in the photograph of this

moment (see Figure 5), following Avis's movement through the space, the fringe's tendrils of cashmere, sheep, and mountain goat wool reach out towards the Big House central fire.



Figure 5: *Nalaga (Avis O'Brien) dancing Sky Blanket during a Hilugwila Feast held for K'yuusdaa Rose Davidson at the Campbell River Big House. Pictured left is Grandmother Minnie Johnston with Hilda Sewid, her best friend since childhood. Image courtesy of Melanie April Graham-Orr. 2018.*

3. DIGITAL JACQUARD WEAVING AS TRANSMEDIATION

The weaving of *Sky Blanket* took almost two years, and the preparation of mountain goat wool another year before that. In our work together to date, O'Brien has expressed her frustration that her creation of new woven works does not ensure that cultural practitioners can access or afford to own them for use in ceremony and performance. While the time-intensive nature of Chilkat and Raven's Tail knowledge transmission and weaving is integral to the practice and continuity of intangible knowledge and weaving traditions, our group wondered if using digital weaving tools could be another route for exploring the threads of connections between the physical and the digital. O'Brien noted that more accessible fabric printed with Chilkat designs, such as commercially made blankets and towels are commonly seen in ceremonial contexts. Perhaps the creation of a prototype using digital weaving had potential for supporting culture and performance in practice and could remain connected to O'Brien's practice as a weaver and artist.

To this end, we began a collaboration with design researcher Doenja Oogjes (now in Eindhoven, NL) and the Material Matters Lab at Emily Carr University (led by H el ene Day Fraser) to explore possibilities for the further transformation of *Wrapped in the Cloud* and Jaad Kuujus's woven dance regalia with a digital jacquard loom (Oogjes et al. 2023). As with *Wrapped in the Cloud*, beyond the creation of replicas, we are interested in exploring how digital weaving might create "descendant

works” that retain a kinship connection to the belonging that inspired them.

3.1 Weaving prototypes as generative entanglements

Our work on the TC2 digital jacquard loom required deep reflection and compromise as our weaving team led by Doenja Oogjes worked to translate Yeil Koowu (Raven’s Tail) and Naaxin (Chilkat) weaving—which are more like tapestry or basket weaving—to the jacquard’s more rapid industrial weaving style. In the Northwest Coast weaving techniques that O’Brien is familiar with, the warp is created in groups, and yarns are twined instead of woven over and under. In jacquard weaving, the weft yarn travels either over or under the warp. In weaving drafts—the schematics used to communicate a weaving design—this system is represented as black or white pixels. Indeed, the original Jacquard loom (which the modernised TC2 we used is premised on) used binary code and punch cards to implement a weaving design, and is seen as a precursor to computing (Plant, 1997).

In our process, Oogjes prepared image files in Photoshop, where each pixel represents a warp thread. While jacquard weaving prioritises a binary system, our prototyping explorations aimed to show generative entanglements across weaving and technical approaches. As Métis scholar Jon Corbett has written, stars can be considered the very first pixels—the smallest units of light in the night sky, joining together to become recognizable constellations—and now essential artistic tools in visual art production (Corbett 2013), and perhaps uniquely well suited to transmediating *Sky Blanket*?

The affordance of the jacquard loom as a tool for mass production is clearly in tension with the time-intensive, complex, and unique techniques of Yeil Koowu (Raven’s Tail) and Naaxin (Chilkat) weaving; however our process of transmediation has been an opportunity to experience and articulate frictional spaces of new technologies in relation to Jaad Kuujus’s intercultural worldview as an artist and cultural practitioner. Our first prototypes represent generative entanglements between cultural knowledge and practice and the affordances of new digital fabrication technology.

We began with small studies: a soft box designed to hold a ball of mountain goat wool; a lightning pattern USB holder inspired by *Sky Blanket*; re-materialisations of dance leggings woven by Jaad Kuujus, all of which allowed us to explore possible patterns and techniques that highlighted the complexities of translation between form and the

limitations of the TC2 for replicating Northwest Coast weaving (see Oogjes et al. 2023).



Figure 6: Meghann O’Brien looks over some tests on the TC2. Image courtesy of Reese Muntean. 2022.

We moved on with the goal of weaving a fully realised prototype of a robe with a long fringe, based on a video still from *Wrapped in the Cloud*—a moment early in the video where points of light representing the Pleiades constellation multiplied into thousands and were just beginning to take the recognizable form of *Sky Blanket* out of the unformed space. Using black mercerized cotton as the warp, and white paper yarn and cashmere wool as weft, the image came into view as Oogjes and team, supervised by O’Brien, moved the weft shuttle back and forth under the warp.

A particular challenge in weaving the robe was the creation of a fringe integral to the design and reference to the original *Sky Blanket*. A rig had to be improvised with a floating dowel positioned a few feet away from the edge of the TC2, so that the weft could be looped around the dowel to create floats. These floats would eventually become the fringe hanging from the new robe. This improvisation was an important turning point in O’Brien’s perception of the TC2-woven robe; as she remarked at that time, “When the fringe was added, it felt so much more alive. That was exciting, because it felt like it was going to be danced” (Interview, 2023)

After the robe was completed on the TC2 loom, O’Brien hung the robe in her home and worked with team member Melanie Camman to hand finish the edges of the robe to stabilise it off of the loom (see Figure 7). A significant part of this process was O’Brien’s hand weaving of the mountain goat wool that she had procured and processed for *Sky Blanket* into the border of the robe. This wool, dyed yellow with Wolf Moss, is an electric connection back to the original woven artwork and its enduring material and kinship relations to land and culture.



Figure 7: Meghann O'Brien hand finishing the robe.
Image courtesy of Reese Muntean. 2024.

4. DISCUSSION: BEYOND THE REPLICA

When the video *Wrapped in the Cloud* first replaced the original Sky Blanket in the exhibition *Boarder X* (the MacKenzie Art Gallery (Regina); The Rooms (St. Johns); the Art Gallery of Alberta (Edmonton); the Nanaimo Art Gallery; the Museum of Vancouver, and beyond) we noticed that the dynamic animation was doing a different kind of work in the gallery. While Sky Blanket is widely acknowledged as a masterful work of woven artwork, the kinetic representation of its transmediation was provoking viewers to ask new questions: where was the original? Why was it important to be used in ceremony? How are digital surrogates made, and why are memory institutions starting to create replicas in support of the repatriation of original belongings?

For curator Jaimie Isaac, who had first prompted O'Brien to explore how to "replicate" Sky Blanket to allow its return to community, the creation of a surrogate media work "could present a layered conversation of cultural and museological colonial histories, concepts of repatriation and rethinking traditional objects and 'artefacts' as being active belongings relevant to the present while remaining significant to ancestral narratives" (Isaac 2018).

For our team of collaborators, the creation of these works has allowed us through practice to move

beyond the concept of replica to what we call descendant works: iterations of art and in the case of Sky Blanket and its descendants—regalia that carry the same essence or genetic code; works that draw from the same well of creativity that was opened up by O'Brien's work with the wool and spirit of the mountain goat. These new works remain connected to and related to the original through wool and pixel materiality (see Figure 8). O'Brien sees these descendants as being like family, related, of a similar gene pool but as new expressions giving voice to the time and circumstance of which they are made.

While Sky Blanket emerged from a desire to reach deeply back into antiquity and origins of cultural practices, this new digitally mediated work reaches into the black box of imaging and fabrication technology. O'Brien describes this process as bringing a quality of surrender of her beliefs around technology:

Surrendering my judgements towards new mediums, yet a strong desire to give voice to the intangible realms which our culture came from and emerges from. I have found a lot of healing in the weaving and unweaving of my own stories through these projects, entangled with the cultures I come from and the culture we share in the west and are embedded within to some extent.

The transmediations of Jaad Kuujus's woven artworks that we describe in this paper exist in the context of a long history of Indigenous survivance (Vizenor 2015) and resistance to colonially ordered spaces (Moser and Huard 2022). Academics, artists, and critical theorists have explored the concept of transmediation as a way to understand how artworks and Indigenous media production can open up new modes of presence and intervene in traditional artistic or museum spaces (Biddle and Lea 2018; Fricke 2019; Gameau 2018; Igloliorte, Taunton and Nagam 2016).

Legacies of collecting belongings and relocating them in institutions has resulted in what Leona Sparrow has called a "vacuum of information about who we are" (Sparrow 2021, 30-32). Indigenous activists and artists have long been deeply involved in reparative work and calls to interrogate colonial cultural heritage institutions, and were using new media to create alternative spaces for cultural longevity (Biddle and Lea 2018; Conaty 2021; Loft and Swanson 2014).

These works we have described in this paper further intervene in the dynamic through which digital imaging and even 3D modelling and fabrication has become part of normalised heritage practice, particularly for exhibits development and preservation in museums. The use of 3D printing as

a prototyping tool is common in many industries, but it has also been used for artistic experimentation and been taken up as a critique of museums who continue to hold onto material culture despite repatriation requests (Geismar 2018). Substantial ethical questions are raised when objects are replicated at increasing speeds, including questions of intellectual property, copyright, and attribution in archival practices (Anderson and Christen 2019; Hennessy 2012; Christen 2012, 2011). Some critical work in this area has taken into account ethics of care and collaborative work with Indigenous communities and their digital resources (Duarte, 2018; Wemigwans 2018).

The three interconnected artworks we have described in this paper and the critical perspectives that frame them offer a view into the potential for research-creation methods to support anti-colonial museum practices, challenges to regimes of ownership, and the representation of physical and digital belongings as relational and always already entangled rather than as being distinct and disconnected from contemporary communities, materiality, land, culture, and history. The works draw threads between past, present, and future, highlighting cultural continuity, creativity, and connection across time and generations: a representation of the transmediation of Sky Blanket as a *journey into a form*.

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Figure 8: Composite image of Sky Blanket, *Wrapped in the Cloud* video still, TC2 photoshop file, and the robe as it is taken off of the TC2 loom.

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Reimagining Living Ontologies: An immersive cross-disciplinary collaborative performance that combines biophysical data, generative patterns and improvisation

Ilze Briede
York University
School of Art, Media, Performance
and Design, Digital Media Program.
4700 Keele Street, Goldfarb Centre
for Fine Arts, Toronto ON, M3J 1P3
Canada
ilzeb@yorku.ca

Reimagining Living Ontologies is an innovative and improvisational collaborative data art performance with responsive visuals incorporating scientific and artistic approaches in data visualisation and interpretation systems. This project utilises biophysical data from the human heart, arm and wrist muscles that drive computer-generated audio-visual scenery inside an immersive 360-degree video projection dome located at York University (Toronto, Canada) in Cinema & Media Arts research location *BetaSpace*. The core research questions and objectives that drive this project are: 1) evaluate current data practices within artistic and scientific realms; 2) identify the practices and challenges that are concerned with biophysical data harnessing and interpretation; 3) develop an artistically rich and innovative data artwork that builds on mutually agreeable data transactions and innovative technologies; 4) propose, exhibit and perform creative knowledge building systems that are embedded in artistic and research-creation domains.

Biophysical sensing. Real-time performance. Generative patterns. Data visualisation. 360-degree dome projection.

1. INTRODUCTION

Reimagining Living Ontologies is a live improvisational performance delivered by two performers, violinist Dr Amy Hillis and visual artist Ilze Briede [artist alias Kavi], in which biophysical data of the heart and hand muscles get interpreted in real-time visuals and patterns inside a 360-degree video projection dome, while accompanied by improvised violin music. The goal of developing this collaborative technological piece is to explore new possibilities for seeing the human body as a complex and artistically expressive mediator of hidden processes happening within and to create a responsive performative system that co-creates with live data. *Reimagining Living Ontologies* aims to expand the notion of embodiment and data that crosses the boundaries across human and non-human spaces, such as the physical human body,

network for data exchanges, digital software tools and finally, a physical performance space that is mediated through the emerging web of connecting data, biofeedback, visuals and sounds. *Reimagining Living Ontologies* probes possibilities in creating meaningful data exchanges and connections between performers and the audience.

2. MOTIVATION AND CONTEXT

There is diverse research that applies scientific and artistic approaches to investigate biophysical data materialisation and exploration for non-medical applications. These creative approaches working with bio-sensitive information openly debate the interest and accessibility of data through artistic means compared to existing data collection practices conducted by large companies and

technological applications that are unscrupulous and concealed from the general public eye. Through public engagement and transparency, there is an opportunity to create a more meaningful and relevant data-handling practice, which is crucial in the current information age.

Swedish computer scientist Kristina Höök and her research team created a critical series of somadata workshops that explore biosensing through research creation and empirical discovery methods (Alfaras et al. 2020). Höök's team addresses a fundamental question about how to make sense of the signals captured from our body's internal processes and translate them into accessible design proposals. These workshops explore the potential of slow and thoughtful design processes in biological signal interpretation and allow data to inform the creation process. They also foreground the need to engage with data through a first-person corporeal and individual lived experience, a stark contrast to technological apps and sensors that tend to collect data in discreet ways by storing and using it that is entirely inaccessible to original data donors.

Portuguese post-doc researcher and visual artist Maria Manuela Lopes (2020) addresses self-identity questions while mediated through technological instrumentation and lens. In *Enhancing the Mind's I*, Lopes records her brainwave signals whilst drawing and answering questions about who she is. Through this process, the researcher questions the legitimacy of biosignal recordings that capture the process of her thinking and doing and asks if this brain capture is recording what could be considered a memory in retrospect.

The need to address the biophysical sensing practice from rigorous theoretical and investigative angles resonates in study of real-time EEG (electroencephalographic) sonification by international researchers (Väljamäe et al. 2013a) which concludes a significant fragmentation in biophysical sensing of brain data interpretation research objectives, investigatory practices, vocabulary and analysis of results that point to an "early stages of development of the research field" (Väljamäe et al. 2013b, p.91). Based on a critical investigation of fifty different resources, the authors could categorise four sonification techniques models based on continuous and discrete events. They are audification (EEG data is translated directly into a soundwave), parameter mapping (mapping EEG band data to the intensity of a sound), model-based sonification (using mathematical models that interpret EEG data), and generative music (the rules are created and assigned based on individual projects). Such classifications can help establish deeper understanding and build relationships across different time-based media, such as audio, visual

and tactile, especially from non-medical, empirical and artistic perspectives.

In human communication and expression, we seek external clues such as language, gestures and behaviours. However, our bodies are supported by millions of biological and chemical reactions underneath the skin that maintain our living biostructure and help construct these externalised communication protocols. Psychophysiology is a field that studies the connection between the human mind and body. It measures heart, brain and skeletal muscle activities and skin conductance through non-invasive forms to detect transient responses. Psychophysiology assumes "that human perception, thought, emotion, and action are embodied and embedded phenomena" (Cacioppo et al. 2017, p.14), and through the course of biophysical measurements, we can start to investigate the human mind and behaviour. Some of the behavioural responses can be categorised (Stern et al. 2001, pp.52-59) as arousal (a heightened state of the body that prepares for fight or flight), habituation (reduction of response due to repeated stimuli), orienting (attention to novel stimuli), defensive, startle, and homeostasis (steady state of the body that allows optimal functioning of cells). Because the electrical activity is collected from the skin's surface, it is challenging to locate the quantitative reading to a specific physiological process; thus, obtained data are "neither mysterious indices of cognitive or emotional function nor simple translations of physiological processes [...]. Rather, they are complex ramifications of the bioelectric spread of action potentials in a conductive medium, the human body" (Stern et al. 2001, p.35). These technical data peculiarities were considered when developing artistic and functional elements of the *Reimagining Living Ontologies* system.

The psychophysiology field has been expanding and flourishing cross-disciplinarily due to the advent and accessibility of sensing technologies. In the last two decades, there has been a significant surge in the technological development of low-cost biophysical capturing sensors, leading to many sophisticated artworks using biophysical data. Artworks like *Eunoia2* by Lisa Park (2014), *MINDtouch* by Camille Baker (circa 2010), *Face Visualizer, Instrument and Copy* by Daito Manabe (2008), *Exhale: Breath Between Bodies* by Thecla Schiphorst (2003-2005), and *BrainPort* by Paul Bach-y-Rita (1998) look for ways to articulate biophysical data readings in alternative and creative ways by giving them visual, sensory and acoustic shapes, more readily accessible and engaging to our perception using affordable and consumer-grade sensors and technologies. Artistic interventions might offer unique forms and expressions to biophysical data that might not be considered an option in stricter scientific domains. The cross-disciplinary

methodologies bring scientists and artists closer and broaden both participating fields. In tune with UK researcher Barbara Maria Stafford's inclination about art that "nudges us away from mere information acquisition and toward knowledge of what we don't know" (2019, p.60), the *Reimagining Living Ontologies* project aims to explore the biological processes from a highly artistic and collaborative angle, inviting technology to interpret, visualise and express data as they emerge and happen in actual temporal presence. No matter how vague or imprecise and sacrificing "some degree of immediate biological exactitude" (Stern et al. 2001, p.4), these data are crucial in constructing the visual emerging abstract narrative of a physical presence and actions performed by the artist's body.

3. BUILDING PERFORMANCE STRUCTURE AND WORKFLOW COMPONENTS

The technical design and data materialisation for the *Reimagining Living Ontologies* piece are supported by several pieces of hardware and software communicating across hard-wired and wireless connections. The primary data collection units, *Biopak MP40* Control Unit with three electrode leads and signal interpretation and transmission module *PACIS Pak*, are used on a performer's body (Figure 1). *BIOPAK* Systems, Inc. is an American company that creates scientific tools for physiological measurements and interpretation. *MP40* unit is part of the student research kit that captures various readings: heart, muscle and brainwave activities.

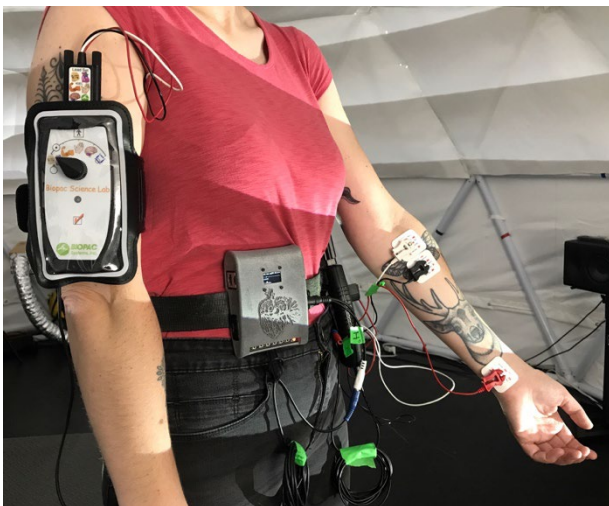


Figure 1. Biophysical sensing hardware: two Biopak MP40s with electrodes and Pacis Pak.

For this project, we capture both heart and hand muscle activity simultaneously. *PACIS Pak*, a custom module consisting of hardware and software developed by researchers Mark-David Hosale and Alan Macy (Hosale et al. 2019), allows electrical

signals from the *MP40* unit to be interpreted as meaningful and usable data for further implementation.

In the next stage, after data has been gathered, it flows through a wireless network from *PACIS Pak* to a standalone application, *TouchDesigner* (Figure 2), where it gets interpreted into responsive visuals and events. Briede's developed architectural system routes incoming data to different building modules with specific tasks in different live performance stages. The visual *TouchDesigner* output is directly fed into a 360-degree video dome projection system consisting of 3 video projectors stitching up the video feed and seven surround speakers. The dome space naturally amplifies and reverberates violin sound, making it a unique audible performance from each seat. The surround multi-channel speakers playback sonification of biophysical data.

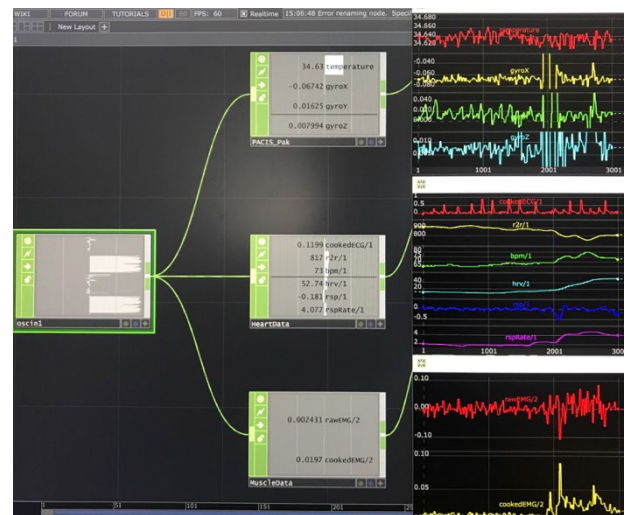


Figure 2. Incoming data signal flow from PACIS Pak inside the TouchDesigner application.

The *Reimagining Living Ontologies* performance, a total length of 20 minutes, consists of three main parts. The first part identifies and introduces every data stream from the violinist's body as visualisation and computer-generated sound. Due to difficulty in recognising sensed data within the improvisational part of the performance's visuals and sounds, it was essential to represent incoming data from Hillis' body, such as heartbeat, respiration, respiration rate, heart rate variability, muscle tension and relaxation as individual strands of perceivable visual and sonic elements that could be recognised later in more complex compositional parts of the performance. The performance enters the second stage after introducing single data streams. The movement of geometric forms informed by Hillis heart activity data radiates from the centre of the dome's ceiling. It flows downwards, creating blurry hues of rectangular overlapping shapes based on muscle tension and relaxation (Figure 3).



Figure 3. Amy Hillis performing the second part of the performance with visuals informed by her hand muscle and heart activity data, a photo by Joel Ong, used with permission. 2023.

The third and final part of the performance reintroduces back acoustic elements of biophysical data mixed with patterned visuals in a three-dimensional tunnel that extends inside the dome. The visual aesthetic of the final part was not introduced at the beginning, thus creating an entirely novel exposition of biophysical data activity. Both performers actively contribute to the performance output in the final and third parts: Hillis with her biophysical data and on-the-fly violin improvisations, and Briede exploring different para-metric structures in *TouchDesigner* Network that generate visuals and sounds. The full 360-degree video recording of the performance can be viewed by following this link: <https://www.ka-vi.com/#/360-dome/>.

4. BIOPHYSICAL REAL-TIME SENSING AND DATA FLOW

Biophysical data processing is complex due to the diversity of biological processes that, in conjunction, make up not a single but multitudes and floating states. “Biosignals are time representations of changes in energy production in the body. These changes correspond to energy variations of different origins such as in electrical, chemical, mechanical and thermal processes” (Alfaras et al. 2020, p.2). When designing computational algorithms and the architecture of their behaviours, we often try to predict and plan what interactions we would like to see and expect. All that needs to be factored into crisp functions and flawless syntax. Nevertheless, “the digital world is too often thought oversimplistically in terms of zeros and ones, and not enough in terms of signal processes, functions in operation, folding and unfolding, in short, in terms of durations and algorithmic events” (Murphie 2013, p.6). When connecting biophysical data from the human body to complex algorithmic architecture that generates specific visual outcomes, it is important to

encapsulate the full range of incoming signals and their peculiar behaviours as part of algorithm architectures.

This project focuses on biophysiology as a living event capture, allowing data to inform and animate geometric shapes and their behaviours. The abstract and yet carefully mediated landscapes were a testimony of the living body and hidden processes behind the skin's surface. Figure 4 displays the data flow and logic used to construct patterns and their behaviours. Two unique pattern-building algorithmic systems were designed in *TouchDesigner* that used heart and muscle data from Hillis's body, thus creating unique parallels between the performer's body, unconsciously constructing visual scenery and thoughtfully improvising violin music in response to the surrounding data visualisations.

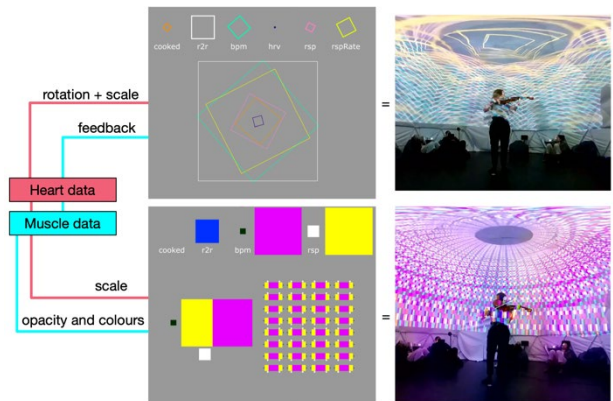


Figure 4. Data flow and pattern design in *TouchDesigner*.

Reimagining Living Ontologies infrastructure considers different temporalities and expressions of each signal. For example, the muscle data is more immediate and recognisable because we can also see the hand in motion when playing the violin and the feedback effect corresponding to different intensity hand gestures. The heart activity is less obvious and more abstract when interpreted in visualisation and expresses itself over various time durations. Audibly, the heartbeat is the most familiar and recognisable sound, but the respiration and heart rate variability sound like slow and extended drone-like patterns that are difficult to associate with anything we know immediately. Therefore, differentiating and grouping specific signals to achieve an affordable visual space for their unique expressions and temporal characteristics are essential for the design. For example, the heart activity has five different signal readings (distance between R-waves (*r2r*), beats per minute (*bpm*), heart rate variability (*hrv*), respiration (*rsp*), and respiration rate (*rspRate*)), each with a similar visual geometric aesthetic but different behaviour. When displayed together, they represent the heart as a

whole, with individualised mechanisms and unique temporalities working and expressing collectively.

In the present day, we are enmeshed in technologies and signal trafficking between devices, and our relationship to information constantly changes. For live coder and performer Andrew Murphie, we already live, in part, “in a culture of ongoing convolution of signals” (Murphy 2013a, p.2), thus becoming signal senders and signal receivers at the same time. Live performances using signal processing allow us to question signals from a performative angle. Murphy's methodology of convolution (folding of signals into each other) as a way of thinking looks at signals as “tendencies and intensities, rather than [...] liveness, presence or narrative, message or theme.” (Murphy 2013b, p.3). This theoretical approach borrowed from live coding practice was significant in deconstructing biophysical data in the *Reimagining Living Ontologies* performance. Devoid of suggested or cohesive narrative, it was about expressing the liveliness of biological processes and actions that translated a physical presence through abstract and changing visual and sonic forms.

5. COLLABORATIVE PROCESS AND SCOPE FOR IMPROVISATION.

Reimagining Living Ontologies is a complex collaborative work involving live biophysical data streams and human performative participation with a pre-programmed system that allows real-time improvisational changes and adjustments during the performance. It also affords multiple cross-connections and bio-feedback loops between the performers and the audience that actively share and witness the unfolding of experiential performance, unique and utterly unknown to the performers themselves. Because the data has an impactful role in shaping and defining temporal visual and sonic behavioural changes and intensities, each performance is unique and unrepeatable. In addition, improvisational audio-visual changes explore multiple scenarios that the pre-programmed system can deliver on the fly, thus creating an opportunity for Briede and Hillis to co-create in a collaborative and improvisational way with the computerised system and immediate output that everyone can see and hear.

Another exciting phenomenological aspect that happens in the minds of spectators, as well as the performers, is called synchresis. In the field of cinema, synchresis (a combination of two words, synchronism and synthesis) is defined as a “spontaneous and irresistible weld produced between a particular auditory phenomenon and visual phenomenon”, a “join that results independently of any rational logic” (Chion 1994,

p.63). When presenting biophysical data at the start of the performance, a particular visualisation and sound are generated from incoming data. Originating from the same source, it is expressed as two unique sensory data streams the spectator combines in their perception as a singular event. According to Chion (1994), synchresis is not an automatic process but acts as a “function to meaning, and is organised according to gestaltist laws and contextual determinations”. This aspect is essential when reinforcing biophysical abstract data through multiple forms of sensory information, such as sound and image. Because there is no meaning presented in data per se, except a record of fluctuations and changes in its flow, an alternative way of “knowing” is introduced by giving this data a perceivable body and form. By combining both elements, image and sound, there is an anticipation that the data will feel more familiar and recognisable to all participants, the audience and performers alike, throughout the delivery and conception of the performative piece.

Biofeedback is “information concerning the functioning of internal organs, usually obtained through electronic recording equipment” (Stern et al. 2001, p.264). Therefore, a biofeedback loop is a part of the improvisation delivered by violinist Hillis. During the *Reimagining Living Ontologies* performance, everyone, including Hillis herself, observes the heart and muscle activity from Hillis's body in real time. Hillis can confront her body activity as enveloping visuals and sounds while feeling and generating the signals in situ with changing scenery around her in exchanging biofeedback loops. The audience also observes a physical manifestation and the source of the signals right in front and around them, creating a unique body extension into the space and air via images and sounds. Since Hillis is responding to a sonic and visual unravelling of her biosignals inside the dome, she is also creating improvisational violin music that responds to and complements her biophysical activity. As Hillis is playing her violin, the muscle data from her right hand also creates a visual backdrop that ultimately becomes an inspiration and a record of Hillis's presence and movements of her physical body. This enmeshed experiencing and generating of biological data sets offers a unique methodology and perspective in working with data in real and extended time, forcing us to reimagine and speculate the ontology of the human body.

6. CONCLUSION

Reimagining Living Ontologies was developed as a prototype and series of performances that used real-time biophysical data from the performer's body to generate visuals and sounds. Several essential features explore collaboration possibilities between

live data, the human body, improvisational play, and technological systems, which all come together and influence each other in delivering complex and information-rich performances. The technological system was custom-designed for this particular intervention, including the venue, specificity of biophysical data, and nature of collaboration between violinist and visual artist, allowing the imagination of new and alternative ways of perceiving, experiencing, and knowing. Visually rich and sonically intense, this performance co-joins improvisational violin with computer-generated sounds and visuals originating from the same performer's body. Concise data usage protocols were developed through discussions and implemented, stating that no data will ever be recorded or stored and used only in real-time through artistic interpretation methods. Briede developed *TouchDesigner* infrastructure using her biophysical data and later tuned it to correspond precisely to Hillis's data set. The visuals are generated by data and algorithmic systems and improvised by visual artist and system designer Briede during the second and final stage of the performance.

Reimagining Living Ontologies is a complex and challenging work that took many months to develop and refine. The 360-degree video dome offered a geodesic space requiring tailored visuals for seamless mapping. Different visuals were tested to create exciting synergy between the roundness of the space and the versatility of geometric form and pattern, adding an illusion of the continuous space that extends further behind visual graphics. The location was very suitable for an exposition of biophysical data and improvised performance because it created another type of bodily structure that allowed everyone participating to be gathered inside. The projections and sounds enveloped and surrounded everyone within, resonating with the concept of inner body activity that was creatively reflected on the walls of the dome structure.

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Shape Theory in Animation, Pedagogy, and Practice

Oliver Gingrich
University of Greenwich
Stockwell Street, London,
SE10 9LS, UK
O.MagGingrich@greenwich.ac.uk

Julie Watkins
University of Greenwich
Stockwell Street, London,
SE10 9LS, UK
J.Watkins@greenwich.ac.uk

Ryan Flynn
University of Greenwich
Stockwell Street, London,
SE10 9LS, UK
R.D.Flynn@greenwich.ac.uk

Sara D Papp
University of Greenwich
Stockwell Street, London,
SE10 9LS, UK

Dev Saxena
University of Greenwich
Stockwell Street, London,
SE10 9LS, UK

Thomas Lum
University of Greenwich
Stockwell Street, London,
SE10 9LS, UK

While satirical cartoonists, illustrators and character designers have long embraced design practices that link recognisable shapes including platonic solids to character traits, there is no single theoretic work of animation theory that reflects on this golden rule of animation and character design practice. Commonly known as Shape Theory, this set of conventions in both 2D and 3D character design stems from a set of norms and conventions closely linked to but not limited to children's cartoons. Often taught as part of the academic canon of character design, this set of conventions has informed both industrial, commercial and artistic animation practice since Emile Cohl in the 1900s. Ascribed to an early article by Solomon Ash, Shape Theory now forms part of the canon of Western character design pedagogy. This paper critically reflects on theoretic foundations of Shape language, its applications in animation pedagogy as well as examples of animation practices.

Shape Theory. Character design. Animation. Pedagogy.

1. SHAPE THEORY AS EVASIVE THEORETICAL CONCEPT

1.1 Gestalt Theory as precursor of Shape Theory

Shape theory dates back 70 years, with its origins often traced back to an article by Solomon Asch from 1946 entitled 'Forming impressions of personality' on the impact of body shapes on character design impact:

"Body shape has a tremendous impact on the overall impression of the character. If you ever looked at a cartoon character and though they seemed confident but didn't know why, you probably were not aware of the character's shape language!" (Asch 1946, p.258)

Over the last decades, shape theory has influenced animation practices by example and application, not at least fuelled by pedagogy. Presented as fundamental, however reductive character design practice and animation pedagogical strategy,

'Shape Theory' borrows concepts from psychology, gestalt theory, and aesthetics. The focus on simplicity is indeed a key principle of 'Gestalt'. The German word 'Gestalt' literally translates into 'Shape' or 'Form', with the key difference that it encapsulates the idea of something representational and recognisable. This recognisability oftentimes relies on simplification and generalisability. In its focus on simplicity, Shape Theory shares with Gestalt one of its pedagogical strengths, and also one of its biggest conceptual weaknesses. Linking simplified visual traits to characteristics of a protagonist and their design, can result in oversimplification, and can be regarded as inherently reductive in its superficiality.

Indeed, the same criticism can be traced back to the beginnings of Gestalt Theory, and was first pointed out by its pioneers: "By using this term for spatial and tone — Gestalten, Mach had been wishing to [aim] their simplicity" (von Ehrenfels 1890 in: Guberman 2015). Both concepts have long shared the signature trait of generalization, which can be linked to the generation of meaning attributed to one of the

many laws of Gestalt the principle of ‘*Praegnanz*’. This principle was first proposed by one of the pioneers of Gestalt, Wertheimer (1939) and describes the idea of grouping in order to understand a perceptual reading of a group as a single emergent whole. Generalisation and simplification can be seen as defining principles of Gestalt, and feed into both the potency and the persisting critique of Shape Theory as pedagogical practice.

1.2 Shape Theory, psychology and archetypes

Just as its precursor ‘*Gestalt Theory*’, shape theory rests on a set of perceptual phenomena that builds on cultural norms, empirical, lived — experience and design principles. Importantly, ‘*Shape Theory*’ relies on a factor of culturally — coded visual tropes, that have continuously influenced Western character design practices. The origins of Shape Theory can be traced back to the early days of character design, which have been heavily influenced by the history of cartoonists, often in the form of political illustrations and comic strips. The history of sequential political illustrations dates back to the Bayeux tapestries and later William Hogarth (1697—1764). And yet character design conventions are based on cultural visual language that has evolved since early political cartoons, which first came to prominence in the 1850s with cartoonists such as John Tenniel in the UK, or Thomas Nast in the United States, who were themselves often inspired by German Realism.

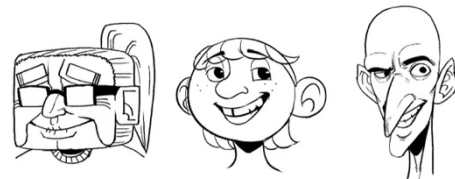
While there is a direct relationship between political illustrations and the evolution of the comic strip, character designs in early animation were heavily inspired by the former. In this sense, there is a degree of linear progression between political illustrations and early character design in animation, which notably manifested in highly problematic racist subtexts attributed J Stuart Blackton’s ‘*Funny Faces*’ (1906) or later in Fleischer Animation’s ‘*Snow White*’ (1933). Stereotyping which builds on simplification and generalisation, and bias remains one of the key issues within the pedagogy of ‘*Shape Theory*’.

Both psychology and character design theory points to the close link between archetypes, and visual representations (Tillman 2011) and its uncomfortable relationship with stereotyping (ibid). The concept of archetypes was studied and made prominent by the Swiss psychologist Carl Jung. Jung understood archetypes as patterns that repeat themselves in the collective consciousness (Jung 1885), a concept that influenced storytelling in its introduction of recognisable archetypes, typical of their narrative behaviour. Shape theory assumes an inherent link between such archetypes and their visual representation. Such phenotypes i.e. their visual counterparts or observable characteristics

can themselves be traced back to our collective cultural heritage.

As a visual trope and narrative tool, oversimplification or in the terminology of animation practices, ‘*exaggeration*’ (Johnston and Thomas 1981) can help to convey key characteristics in storytelling, in particular to a young audience. Some of the most successful examples in character design history lean heavily on such phenotyping through shape theory for instance the iconic, recognisable round shapes of Disney’s Mickey Mouse, the square shape of SpongeBob SquarePants, or the stylisation of Nintendo’s Super Mario as round and likeable — versus his archnemesis Wario, who is presented through pointy, triangular shapes. Be it as a suggestive storytelling device, as a means to an end in a design world that is often characterised by the functional design principle — ‘*Form Follows Function*’, or as an ostensible signifier that conveys readability, Shape Theory permeates industrial practice from Pixar’s *Up* (2009) to Disney’s *Inside Out* (2015) and *Inside Out 2* (2024), and has found its way into Animation curricula across the West. Yet Shape Theory cannot be discussed and taught without a lens of criticality, to ensure that the limitations of the concept are just as evident as its pedagogic potential.

1.3 Aesthetic, formalistic and psychological co — factors



Thomas Lum

Figure 1: Tom Lum — *Expressions, Graduate Project 2023*

At its core, Shape Theory can be reduced to the attribution of three principal two — dimensional shapes — the triangle, the square and the circle (see Figure 1). The immediate appeal of the concept relies on its connection with an embodied level, which can be accredited to their geometrical, physical and optical attributes: a square is defined by its four sides, on one of which it typically rests. Within this representation, a square is oftentimes perceived as both static, passive and immobile, but also as balanced and grounded. In 1886, the aesthetic philosopher Heinrich Wölfflin differentiated between the visual impression of different squares stating that

“empathetic, embodied responses to gravity, making tall, thin rectangles unstable but elegant; squares heavy and bulky; and wide, flat rectangles relaxed and dissipate.” (in: McManus 2013 p.1).

Carl in Pixar’s *Up* (2009) is depicted with square glasses from a young age, a representation of what he will become, whereas in contrast, Ellie is always represented in circular shapes. Indeed, while geometrically, and architecturally stable, the square is a rare form in nature and frequently symbolises the man — made, the constructed, the domestic, stability.

In a similar vein, in the West, a circle is frequently associated with bounciness, playfulness, friendliness, the nurturing, the female; but also symbolises the transcendental, in its allusion to the planetary as well as ideas of unity for instance in liturgic, communitarian or religious symbolic contexts; The downward facing triangle is frequently associated with the unbalanced, the unstable and sometimes with threat: Research suggests that the perception of the *“downward — pointing ‘V’, which is similar to the geometric configuration of the face in angry expressions, is perceived as threatening”* (Larson et al. 2007, p.1). Whereas the upward facing triangle can be perceived as more stable and robust. In his classic oeuvre ‘Art and Visual Perception: A Psychology of the Creative Eye’, aesthetic and perceptual psychologist Rudolph Arnheim noted that

“Vision is highly selective, not only in a sense of concentrating on what attracts attention, but also in its way of dealing with any one object” (Arnheim 1960, p. 28).

The concept of universal face expressions (Ekman 1972), as put forward by Paul Ekman is in itself contentious, as demonstrated by research into facial expression recognition (Wang 2010).

The interpretation of a shape, a face, an object is fundamentally subjective, and culturally coded. While the dominance of these shapes across cultures has been assumed by Rosch (1973) and other Gestalt theorists, their meaning and contextual significance is of course culturally coded. The Himba of Northern Namibia for instance are known not to possess words for either of these shapes (Roberson et al 2002). While the above tacit knowledge that converges into what we now understand as ‘Shape Theory’ is frequently understood as basic, fundamental to cultural readings of character designs, this set of norms, conventions and principles appears often artificially constructed, culturally — coded, simplistic and evasive. So why is this shape theory so pervasive in animation pedagogy, and remains so popular among students? While the concepts are simple to grasp, they consist in an effective communication device, a

visual trope that is easily communicated across ages. In particular, young children find shape theory a helpful vehicle to understand a story. Furthermore, shape theory helps to provide visual contrast in storytelling, as it introduces a mimetic element — showing rather than telling. Shape theory is intuitive to use and decipher, and yet there is a real danger in equating shape and form with meaning, in perpetuating stereotypes, oversimplifying characters that could be complex in their personality traits rather than reductive to their outer form and appearance. It is for these reasons that a critical stance in teaching of shape theory remains so very important.

2. SHAPE THEORY AS FUNDAMENTAL PEDAGOGICAL PRACTICE

2.1 Shape Theory in 3 dimensions

As his final major animation research project ‘Expressions’ by Thomas Lum was designed as a character study and exercise in shape theory, consisting of:

“projecting characters animating within the confines of the three commonly used shape theory geometries. The circular character will be animated in 2D and projected onto a sphere 3D shape, the square and triangle characters will also be animated in 2D and projected onto their 3D shape counterparts.” (Lum 2023)

The student, a skilled 2D and 3D illustrator, chose to translate his character designs from a two — dimensional plane into the 3 — dimensional space. While conceding the limitations of shape design, and the fact that implementations are — in the student’s own words ‘often done very badly’, Tom Lum exchanged the confinements of the 2D plane for the limitations of a 3 — dimensional shape, implanting fixed forms into the spatial environment of his graduate exhibition.

Ever since Bauhaus, both architecture and design embraced the translation of simple shapes into three — dimensional space, not merely as minimalist visual statement, but as storytelling device, to convey messages to and as signifier for underlying values. Following research into the Kiki / Bouba effect (Fryer et al 2014), the student employed techniques pioneered by artist Tony Oursler, who playfully embraced parallax, distortion and perspective in projecting faces onto objects. Using a sphere, a cube and a pyramid polyhedron, three animated faces were projected onto these opposing surfaces, resulting in a triptych composition, full of conversational tension — an endless of discursive ambivalence between the character designs and their representational shapes.

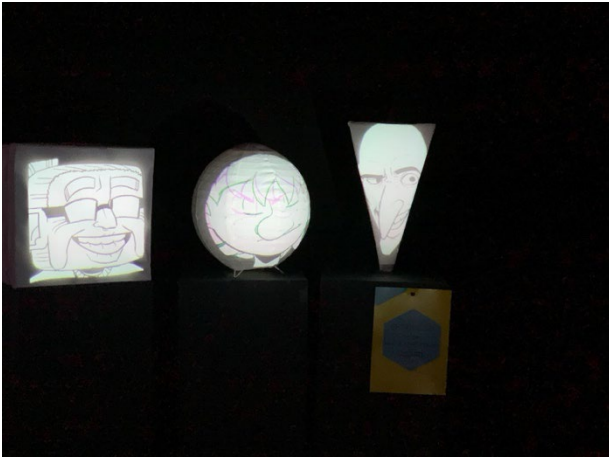


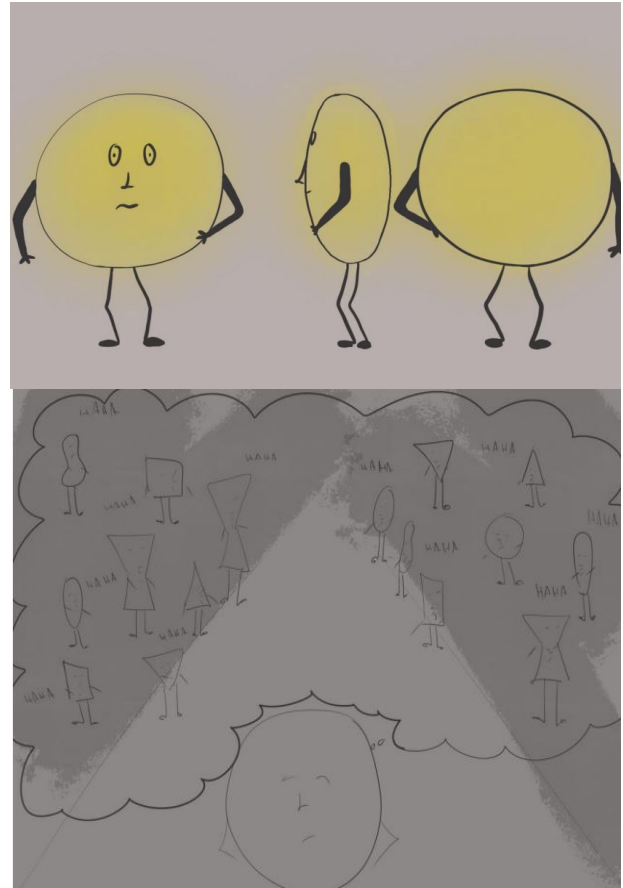
Figure 2: Tom Lum — *Expressions*, Graduate Show 2023

The project was ambitious in expanding from fixed screen animation into projection onto 3D shapes in the real world. He discovered opportunities and challenges of projecting 2D onto 3D shapes whilst preserving the essence of the 2D shapes. Nominated for the prestigious University of Greenwich, School of Design — Head of School Award, the work succeeded in highlighting the restrictions of Shape Theory, both as a design concept and application. Reflecting on his learning on animation theory and practice including the fascination and frustration with Shape Theory. The resulting artwork (see Figure 2) playfully critiqued superficial, dogmatic and reductive tendencies of the concept.

2.2 Subverting stereotypes

As second example, illustrating the effect of shape theory on students' creative practice is a project by Level 6 student Sara Papp. Her 2D animation is heavily influenced by Disney's *Inside Out* (2015) and Garret Rhea's animation and children's book 'The Story of Circle and Square' (2016). Sara's narrative is set in a world where everyone is conforming to a single shape, and one day, our protagonist, Zia, is looking in the mirror, realises that she is different:

"Zia had been unhappy with her shape for as long as she could remember. Every day she looked in the mirror and saw someone she did not like. She wanted to be thinner, to have longer legs, to have a smaller waist. But all her wishes had never changed her shape. Zia finally reached a break point and decided enough was enough. She was going to learn to accept her own shape, no matter what anyone else said. Zia started by taking a long look at herself in the mirror. She looked at all her curves and contours, and she started to find things she liked. She liked her wide hips, and her full lips, and the way her eyes sparkled."



Figures 3 and 4: Sara Papp: *Zia* — Character design & storyboard frame

In the case of Sara's Final Major Project, shape theory serves as a point of departure, for a discussion of stigma, conformism, and societal expectations. In this case, the notion of a shape remains a surface structure, a symbol, a signifier, rather than signified meaning (see Figures 3 and 4). The critique here concerns not so much the theoretical construct, but the societal norms that preconditioned it. In Sara Papp's narrative, characters respond to their own body shapes, coming to terms with an 'expectation of norms' in what can be seen as a form of body dysmorphic disorder:

"Zia's biggest fear is her own body image and round shape. The biggest desire Zia has is to change her own body shape but deep down she is learning to love herself. She feels guilty about not accepting the way she looks."

In a society where superficiality, and surface norms reign supreme, shapes stand for something absolute, a perfect ideal, that sometimes jars with perception of self, expectations and representation. In her critique, the student takes a fundamentally human — centred stance, with the profound message not only can we never judge a book by its cover, but appearances can also be deceiving. As

individuals we are not always in control of our 'shape', appearances can be deceptive.

The final case study, by final year student Dev Saxena, centres around a story in two parts: Whereas in one story, the protagonists are depicted as round, innocent looking mushrooms, they are revealed to be mass murderers (see *Figure 5* and *Figure 6*). In the second story the monstrous villainous looking protagonist, turns out to be philanthropic, caring and kind despite their outer appearance. Applying shape theory, and principles of animation such as exaggeration and appeal, this project is designed to 'smash the expectations', to subvert the ideas of shape theory that 'what you see is what you get'; Here, the student is playing against stereotypes, actively confronting ideas of oversimplification, and generalisation, thereby fuelling narrative moments of suspense and surprise.



Figure 5: Dev Saxena — Character design

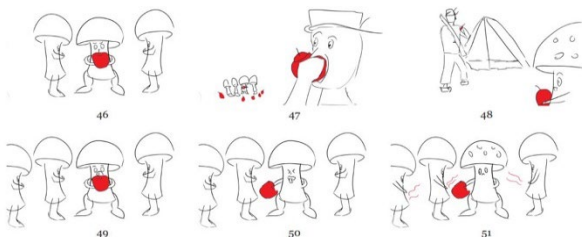


Figure 6: Dev Saxena — Storyboard frames

3. CONCLUSION

In all these examples, shape theory is applied as a fundamental animation and character design device, but its use and application are underpinned by a critical lens that elevates the message. Experientially we have found that a thoughtful approach to Shape Theory gives students practice at countering a well — known but over simplistic theory and thereby develops their critical thinking and confidence.

Shape theory is a useful pedagogical tool because it builds on ideas students have already been introduced to explicitly in animation or design curricula, or implicitly via films and illustrations. Additionally, Shape Theory links to and makes relevant to animation historic design pedagogy such as the Bauhaus movement and theories such as the Gestalt. Students approach Shape Theory with more confidence, as a known entity, and this makes it a fruitful area to help contextualise a wide variety of students' research, as seen above.

Contemporary popular animation walks a fine line between clear visual coding, and representational messaging as in *Inside Out* (2015) and *Inside Out 2* (2024) and a more nuanced stance adopted in recent films *Nimona* (2023) or *Elemental* (2022) in which not all is at it appears to be. Pedagogical animation practice will need to ensure that teaching about shape theory continues to critically reflect on questions of representation, so as to call out stereotyping and encourage the development of complex and multidimensional models of character design.

We propose to follow up this study by sharing this paper with future students to encourage more work that critically evaluates theories through practice. As part of this process, we will be screening student work mentioned in this paper, as well as student work being developed across the degree, in public facing venues, with the implication that further development will come from these endeavours.

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A Technological Approach to Well-Being in the Music Industry

Gavin Lawson
7 The Courtyard , Lower Trewylan
Llansantffraid, UK
audysseyibiza@gmail.com

I subscribe to the eloquence of Plato's moral law 'wings to the mind, flight to the imagination' a gestalt if you may when one feels complete in the frequencies and tones of musical composition, synchronised to the rhythms of flicker light, and creativity as a whole. Rhythms, melodies, harmonies and frequencies are the nuances of supportive change each working in matrimony to bear the weight of mind. Yet as much as I value the precision and rigour of quantitative analysis, I also recognise the power of intuition and inspiration in creative expressionism. Engaging in creative activities provides an outlet for emotions and helps relieve stress and anxiety. Whether it is writing, painting, or playing an instrument, being creative can provide opportunity for musicians and artists to express their feelings, reducing the potential of burnout and stress. This research aims to investigate new approaches with music production software and flicker light technology, exploring the creative process as a useful tool for improving mental health quality and potentially lowering stress levels. The evidence put forward shows how composing electronic music might be used to ameliorate mental health by interacting with photic stimulation, spatialisation, digital composition and personal development. As a result, a deeper significance hidden inside the creative process will become clear and apparent, enabling the composer to constructively focus on the use of sonified data, binaural audio, music technology, and altered states of consciousness.

Stroboscopic. Electronic music. Sonification. Entrainment. Isochronic.

1. INTRODUCTION

The research employs production methods and techniques associated with electronic music production rather than traditional instrumentation, however, it is not restricted to electronic producers. Thus, these methods may be applied by composers in general or by musicians who want to employ these procedures to improve overall wellbeing. My background is deeply rooted in electronic music and holistic practice including meditation, mindfulness and breath-work. For many years as a creative practitioner, I have been navigating numerous sub-genres in electronic music, from Bristol's space dub suburban symphonies to Detroit's techno looking for the link between sound and mindful practice for the purpose of task positive creativity and to support artists, performers and industry professionals who suffer from stress related conditions. With the current findings this led to understanding how music production software 'Ableton Live' and stroboscopic light 'Roxiva RX1' supports a new methodology in electronic music and brain wave entrainment, exploring the realms of altered states of consciousness and creative expression.

2. AUDIO SONIFIED ENTRAINMENT

In the world of electronic music there exists a unique fusion of art and science, where the technical aspects of sound and real-world data sets are brought to life in a symphony of auditory experiences. "Sonification and musification explores the concept of sonified data as a compositional tool in digital music production. This introduces the idea of musification, which involves organising sonifications based on musical structures, essentially creating sonifications organised by musical principles." (Coop 2006). Incorporating sonification into music production provides an innovative approach to composition, allowing producers to abstract from traditional music production techniques and experiment with new creative processes. As more electronic musicians compose using sonification, the aim is to reveal the underlying patterns and structures that give rise to changes in mood and emotion. "Sonifying DNA and recognising familial relationships as shared motivic content" (Mermikides 2022).

The use of Generative Pre-Trained Transformers as a function of AI convert real world .json data from weather to mono neucleotides into notation for musical expression combined with isochronic tones or binaural beats, the beat frequency fused with musification communicates the sound of data and brain wave frequencies. Max for live functions as a plugin format exclusively in Ableton Live where developers can build devices including sonification tools, this “allows data to be inputted manually, generated randomly, or copied and pasted from various sources such as text documents, websites, Google Sheets, CSV files, or Excel spreadsheets, in order to represent a series of numerical values denoting change over a specific period. Subsequently, musicians have the flexibility to manipulate the data as desired” (Manifest Audio 2023.). The use of max for live plugins in this way opens up the opportunity for dialogue with the machine in digital compositions using music production software in this case Ableton Live, revealing the intricate bindings between creativity and technology, unlocking new methods of understanding that can enrich the lives of artists and musicians expanding on the current knowledge.

3. SPATIAL AUDIO

As we augment our reality and step closer to AI infusions in creative media, we can use spatial technologies to support a new wave of industry specialists that focus on well-being.

“Spatialised audio is a more immersive and dimensional approach that mimics the way people hear music and sound in real life, and scientific studies like these are demonstrating that this new evolution of spatial audio could be good for consumer wellbeing as well” (Fitzpatrick 2022). Planner magnetic technology supports an almost real-life experience in binaural spatialisation with the Audeze LCD-X open back headphones and the use of SPAT max for live plugins designed by IRCAM, “Spat is a software suite for spatialisation of sound signals in real-time intended for musical creation, postproduction, and live performances” (IRCAM 2023). Producing the effect of 3D space combined with generative music and isochronic tones can elicit a change in perception. Deemed ‘harmonic health’ the introduction of ‘Spatial Audio’ has been well received in the music industry with Apple Music leading the way in ‘Spatial Computing’, research from the Pollen audio group has shown encouraging findings within spatial audio concerning its impact on wellbeing. “Outside pure music listening, there are obvious applications of the combination of spherical audio with head-tracking in areas like gaming and VR to simulate realistic environments, which can now easily extend to mobile and A.R – but I feel it’s worth considering a more nuanced, and ultimately

more beneficial - use case, that of spatial audio for wellbeing” (Pollen Audio 2023.). Recent investigation has demonstrated that spatial sound could positively affected homeostasis, leading to improvements in both physiological and psychological states. “Reaching out into the clinical domain, approaches like this have the potential to revolutionise mental wellness outcomes and clinical conditions like Post-Traumatic Stress Disorder (PTSD), anxiety, depression, and schizophrenia. In fact, spatial audio has been found to be effective in reducing symptoms of PTSD in military veterans by redirecting their attention away from negative thoughts or triggers via immersion.” (Pollen Audio 2023).

Experimentation in the field has indicated that spatial audio technologies possess the capacity to modulate brain wave patterns, elicit emotional responses, and evoke feelings of positivity. These findings suggest a role for spatial audio in wellness. The incorporation of spatial audio into ‘digital health’ and wellbeing presents a new model for listening experiences, mitigating cognitive stressors, and potentially augmenting overall wellbeing through the provision of immersive sound environments. To support these finding Fitzpatrick highlights the expanding body of research directly influencing spatial audio in wellbeing. “When we look beyond the edges of the trending spatial spotlight, we can envision potential improvements in our leisure-based music listening and extensive exposure to voice processing. We can begin to unveil new possibilities in which audio content (music, video, spoken word, wellness content, phone calls, etc.) and personal sound reproduction products (earbuds, headphones, speakers, VR, hearing aids, etc.) deliver audio in a way that naturally reduces stress and improves well-being, all while making the actual listening experience more dynamic, immersive and pleasurable” (Fitzpatrick 2022). This raises a valid point for inquiry regarding spatial audio to benefit listening experiences, while simultaneously alleviating stress related conditions. I propose further enquiry into spatialisation in audio production for the benefit of musicians and creative practitioners.

4. PRACTICALITY IN WELL BEING

The combination of electronic music, sonified data, isochronic tones, and audio-visual entrainment (AVE) are technological support systems for the creative industries, this could be further developed for use with individuals who are impacted by stress-related conditions. Although the intended combination of modalities could be recognised in a wider context, I concentrated on attempting to support personnel in the music industry and creative sectors during my time in Ibiza. For the benefit of the

creative sector, my examination of the possible advantages of combining stroboscopic light with electronic music supports a reduction in artists feeling self-critical, more at ease, less stressed and thus increases creative output. As, Magee & Burland posit, “the use and benefits of music technology remain under-reported, contributing to the limited uptake of available technologies within clinical settings. Using these tools is suggested to benefit both the client and the therapist” (Magee et al. 2008, p.3). Studies suggest a positive impact with audio visual entrainment on depression because “outcome measures revealed either a significant decrease in Hamilton Rating Scale for Depression ‘HAM-D’ scores and gains in cognitive functions only for participants undergone to the experimental treatment” (Pino 2022, p.1).

As we delve deeper into this fascinating realm of inquiry, it’s important to explore the possibilities with music technology and stroboscopic light in wellbeing. Thus, expanding on the research and continued studies with AVE, isochronic tones, sonification, and spatial audio as a whole. Exploring how the brain reacts to auditory and visual stimulation provides a new perspective on the dynamics of sensory inputs and neural processes. “This research could lead to further investigations into how external stimulation shape perception, ultimately advancing our knowledge of brain function and cognitive processes” (Pari 2021). I am particularly fascinated with the investigation of meaning-making and creativity in musical entrainment “instead of separate independent processes, different levels of entrainment are components of the same phenomenon that can be measured in different ways.” Consequently, “tapping into one level of entrainment triggers the others” (Trost et al. 2017). In the brain, entrainment refers to “the temporal alignment of an observed neural process with the regularities in an exogenously occurring stimulus.” (Schiavio et al. 2024) exploring the intrinsic creative and rudimentary forms of musical entrainment. This posits such entrainment not only facilitates but also nurtures the emergence of further creative expressions. This is anchored in an individual's capacity to construct associations with their auditory, cultural, and musical expressionism. The line of inquiry amalgamates insights from the realm of creative cognition, the essence of the groove or beat, music's communicative and affective dimensions, and the foundational meaning of creativity as impulsive.

5. PSYCHOSOCIAL CHARACTERISTICS

The creative industry, more specifically the music sector is known for increased pressure, extensive touring and a lifestyle of excess, leading to a number of stress related conditions “We know that working

in the electronic music industry can be very rewarding and offers many opportunities, however it can come with a set of unique pressures. These include long hours, high stress, a higher incidence of drugs and alcohol abuse, isolation and insecure work” (Santiago et al. 2020 p.3). A growing number of well-known electronic music performers, DJs, producers, composers openly struggle with mental health difficulties. “Not only are we losing talented artists to suicide and overdoses, but the lives of many more musicians are being made miserable by anxiety, depression, addiction and other psychiatric conditions.” (Musicians Union 2023). Sadly we have lost some great talent in recent years due to the mental health crisis including Keith Flint of the Prodigy to suicide and EDM music producer Avicci who suffered from burnout, emphasised in the documentary ‘Avicci - True Stories’. “The past decade has seen a number of academic studies suggest that, whilst music-making is joyful, fulfilling and even therapeutic, the psychosocial characteristics of a musical career might be damaging for the emotional wellbeing of musicians” (Musgrave 2022, p.4). Therefore, I feel it appropriate to find a new approach to support this sector, given my background as a DJ, music producer, educator, and performer with vast understanding in sound design, performance and composition expanding 30 years, it is crucial that electronic music and flicker light are a focus of enquiry.

There is growing evidence to support the use of sound and light as complementary interventions for well-being as seen with the success of Brian Eno’s work at Montefiore Hospital, Hove. “The Quiet Room is a tranquil space where Eno’s ambient tracks play out under panels of soft changing light. The room gives cancer patients and their families a place to sit, reflect, and have a human moment in the midst of hospital visits and treatments” (Hunt 2022). Electronic music and light can play a role in providing a soundtrack for these practices, and has the potential to shape the future by offering a diverse range of sounds and light rhythms as stimulation for the brain and by inspiring new and innovative approaches. A study on the effect of audio-visual entrainment on pre-attentive dysfunctional processing to stressful events in anxious individuals presents the potential of AVE to mitigate dysfunctional processing “it is clear from the study results that AVE intervention is capable to affect dysfunctional automatic appraisal to stressful information. This is relevant to cognition and emotion research as well as to AVE research since this approach encourages experimental manipulation to widen our understanding on mood disorders” (Treviño et al. 2014). The research shows evidence that audio-visual entrainment could be used as a means to offer support for anxious individuals. The findings have the potential to transform therapeutic approaches by offering novel

insights into the effectiveness of audio-visual stimulation in alleviating stress related conditions.

6. CONSCIOUSNESS AUGMENTATION

Through research and personal development my creative practice involves using the Roxiva RX1 and Ableton Live to navigate the inner realms of the mind and express these experiences into sonic compositions exploring the field of enquiry and subsequently releasing the album *Audyssey - Geom* on Bullet Dodge Records. Track 7. (DNA) supports the concept of using sonified DNA sequences in F# minor pentatonic scale, middle tuning system I and II developed by Maria Renold and a series of unique Max for Live devices supplied by Isotonik Studios. The development of a new Max for Live device by 'Phelan, Kane. MSc' sends OSC data packets to the Roxiva RX1 from Ableton Live in real-time controlling the stroboscopic light frequencies synchronised with audio and midi sources. We have completed beta testing and aim to share our developments later this year. This is a pivotal analysis for electronic music producers who could be interested in making their soundtracks and visual content to counteract the effects of stress. Under the guidance of Professor Carl Hayden Smith and support from Roxiva Innovations, I am currently developing a new system designed for the purpose of combining electronic music productions with Ableton Live, binaural & transaural audio, sonified data, Max for Live and the Roxiva RX1. This led to a welcomed opportunity to showcase my work with stroboscopic light and electronic music at the 'Museum of Consciousness, Baliol College, Oxford University'. "The structure of the museum is centred around recipes for consciousness augmentation." (Smith et al. 2021). The audience give feedback of their personal experience, including a significant comment from one of the audience members, "I felt like I was entering and listening to my own body". My research continues to expand on the possibilities of using light and sound in wellbeing with new technologies developed for creative practices.

In the world of electronic music and visual entrainment, there exists a unique fusion of art and science, where the technical aspects of sound and image are brought to life in a symphony of sensory experiences.

7. A FLICKER FOR CHANGE

Brain wave states and frequencies have been studied including but not limited to "alpha oscillations 8Hz to 12Hz" (Pari 2021, p.1) and the use of electroencephalogram (EEG) to monitor brain activity in participants, combined with heart rate variability. For instance, working with stroboscopic light in both sine and square waves, have been

reported to entrain the brain, reducing activity in beta and alpha frequencies range. "The results from this single person case study suggest that the Roxiva stroboscopic light can entrain brainwaves based on the frequency of the light flicker" (Neuro Meditation Institute 2024). The Oxford Happiness Questionnaire, Perceived Stress Scale and Watts Connectedness Scale could be used for qualitative analysis before and after sessions and research purposes. This is unique and has not been studied in the field of music technology or therapeutic practice (Ral 2022.). I extend my offering on this approach because as Siever stipulates, "Neurotechnology serves as a way of combating stress and depression and is often an extremely effective way to recover and restore us back to a healthy state of well-being" (Siever 2010, p.3) The audio-visual entrainment (AVE) music production system will not only provide a unique and immersive experience for participants but also collect data for potential analysis. Similarly, the data will explore the possible advantages of AVE paired with electronic music for aiding relaxation, stress reduction, and potentially increase productivity.

As we explore this mechanism for change, developed with Ableton Live, Max for Live and the Roxiva RX1, a correlation of data potentially exists with the Dreamachine, developed by Unboxed, Professor Anil Seth and Dr David Schwartzman with music composed by critically acclaimed musician Jon Hopkins. "The Dreamachine, was crafted with a purpose to explore emotional connections, the experience provided sound and light where individuals could collectively share a moment, the audiences could rediscover themselves and forge new relationships with others in the most unexpected of ways." (Dreamachine, 2023). The Dreamachine was meticulously designed to offer creative expressionism through drawing and dialogue, combining technology with physical art. The immersive experience provided a platform for creative minds and scientists to work in collaboration, delving deeper into the study of introspection and self-discovery. Astonishingly, a staggering 74% of participants reported being overcome by feelings of love, compassion, or an intensified sense of connection. "Dreamachine celebrated four sell-out shows across the UK: at Woolwich Public Market in London, Temple of Peace in Cardiff, Carlisle Memorial Church in Belfast and Murrayfield Ice Rink in Edinburgh – running 7 days a week, for 5 months. A 5* reviewed, critically acclaimed 'must see', each city experienced a 200% demand for tickets. Conjured entirely by just white light, audiences were fascinated by the similarities and the differences in their experiences, all viewed behind their closed eyes. Tens of thousands of colours were reported, with many witnessing colours they had never seen before. Some blind and partially sighted people even reported seeing colour

for the first time. Over 15,000 people created reflections of their experience, producing one of the largest collections of publicly generated artworks in the world” (Dreamachine 2023).

Stroboscopic light can produce geometric and colourful images from behind closed eyes, leading to altered states of consciousness, “Stroboscopic stimulation caused substantial increases in the intensity and range of subjective experiences”. (Schwartzman et al. 2019, p.1). “Light brain entrainment is an effective technique for brain neuromodulation, enhancing cognitive and emotional states. These techniques have therapeutic benefits and can be used to treat various conditions” (Teixeira 2023). The results could effectively support the development of practical applications in electronic music, particularly in the context of creating a new model in mental health for the creative industries. As the research suggests, “during stress the brain assumes the body needs blood in the core to prepare for flight or battle, which is just the opposite of what the present-day student needs” (Siever 2012, p.115). Electronic music is evidently a genre of music that can be used creatively in compositions that support the concept of music from the mind for the mind. Altered states phenomena impacts short term alterations in consciousness with flickering light, sensory inputs and alterations in human cognition and awareness. Bartossek’s study exhibits the capacity to deepen our understanding of the phenomena associated with altered states. Visual flicker light stimulation’s effects on consciousness not only brings to light the need for investigation but also the potential for external flicker stimulation to shape cognition and subjective phenomena. “Participants scores on the personality trait of Absorption positively correlated with the extent of their experienced alterations in consciousness. As hypothesised, distortions of participants’ time perception, as well as certain mood alterations, were among the effects of FLS.” (Bartossek et al. 2021).

8. ETHICAL CONSEQUENCES

“The global percentage of photosensitive adults who are not epileptic is estimated to be around 0.03%-3% of the population, this affects a small percentage of individuals who are not epileptic but are sensitive to visual stimulation that can trigger seizures”. (Tychsen & Thio 2020). Seizures triggered by light stimuli are estimated to occur in about 1 per 10,000 individuals, or 1 per 4,000 among those aged 5–24 years. People with epilepsy have a 2–14% chance of experiencing seizures triggered by light or patterns. During a Pokemon cartoon showed in Japan, 685 children were hospitalised due to seizures caused by red-blue flashes on TV. Surprisingly, only 24% of those who had a seizure

during the cartoon had a history of seizures. While light or pattern stimulation can provoke seizures in susceptible individuals, it’s unclear if such stimulation increases the likelihood of developing epilepsy later on. Certain intensities of light, ranging from 0.2–1.5 million candlepower, and frequencies between 15–25 Hz, although the range can be extended to 1–65 Hz, are most likely to trigger seizures. Additionally, light-dark borders and the colour red can also induce seizures in sensitive individuals. Seizures can be provoked by various sources including TV, cinema screens, video games, natural phenomena like sunlight reflecting on water, public displays, and more.

“To address the risk of seizures, recommendations have been put forth by agencies in the United Kingdom, Japan, and the International Telecommunications Union, which is affiliated with the United Nations.” (Baulac et al. 2015).

“The Epilepsy Foundation of America has also developed guidelines based on the consensus of medical experts and scientists, detailed in accompanying literature.” (Fisher et al. 2005). Although these are rare events with flicker light stimulation there are ethical consequences including vulnerability, loss of physical and conscious control and distress for the participant and those who witness the seizure. There are ways to minimise risks including a questionnaire, screening, sessions developed below the frequency range of 15-25 Hz and a reduction in amplitude. In a meeting with Dr David Schwartzman of Sussex University, a pioneer in the field of stroboscopes, we discussed seizures, and he shared the protocol used with the Dreamachine. Screening of participants before use of flicker light and the use of frequencies below 15Hz, staying within the boundaries mentioned in the research above, over 1 million UK residents attended the Dreamachine with zero adverse reactions.

I have personally observed an adverse reaction to photic stimulation and in this situation immediately contacted the emergency services, supported the client through the experience, who previously had no knowledge of any adversity to light or sound, no medication or prior mental health issues and thus offered a critical evaluation of the use of flicker light and audio stimuli.

9. CONCLUSION

By co-operatively leveraging these modalities in research, music professionals could be afforded a comprehensive toolkit for navigating the complexities of the mind. This creates opportunity to develop new and innovative experiences while promoting mental well-being and sustainable

motivation. This new technology driven approach not only addresses the immediate challenges such as stress and creative block but also advances study into the realm of combining art and science. The implementation of rigorous scientific study and efficacy is essential before integration across the creative industries. Through continued inquiry, the pollination of stroboscopic light, electronic music, spatial audio, data and sonification holds the potential to redefine the paradigm of creative expression and well-being for music professionals.

I have personally developed this model into a working practice, supporting stress reduction, electronic music production, and synchronised stroboscopic light stimulation, thus helping to reach altered states of consciousness. For the past 24 months I have been working to produce Audyssey - Geom, a meticulously crafted body of work using Ableton Live, Max for Live, Audeze LCD-X headphones, binaural spatial audio and sonified sequential data. The process involved in making Geom steps away from the standardised model of music production and explores innovative methods in creative practice. "Cyberdelics apply ancient and modern technologies to induce altered states of consciousness that are similar to psychedelics. In other words, they create trips without the drugs. Cyberdelics include AI-generated trip simulations, VR games and experiences inspired by psychedelics, stroboscopic light therapy that generates hallucinations, and other cutting-edge technology and art." (Cyberdelic Symposium, Oxford University, 2024) It was important to find a way to reach these transcendent states without the consumption of psychoactive substances, opening a door for a new wave of artists to express their creativity and for participants to experience shifts in perception.

In essence, my life's work revolves around the transformative power of electronic music, blending artistry, education, and holistic wellbeing to inspire the creative journey.

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Performing the City in Cine VR: A collaborative spatial practice investigating the urban space of Singapore through performative acts

Ella Raidel
NTU Singapore
ADM School of Art, Design and Media
81 Nanyang Drive
637458 Singapore
Ella.raidel@ntu.edu.sg

Benjamin Seide
NTU Singapore
ADM School of Art, Design and Media
81 Nanyang Drive
637458 Singapore
BSeide@ntu.edu.sg

Ross Adrian Williams
NTU Singapore
ADM School of Art, Design and Media
81 Nanyang Drive
637458 Singapore
rawilliams@ntu.edu.sg

This paper explores the use of Cinematic VR as a tool for performative interventions in public spaces within the context of modernist architecture in Singapore. The audio-visual experience interrogates the complex relationship among bodies, memories, and the urban environment. The research explores the narrative, cinematic, and acoustic strategies the film employs to immerse, perform, or navigate urban spaces, fostering awareness of the immediate surroundings. Critical inquiries include understanding the underlying acoustics of the urban fabric, the ability to evoke memories through sounds, and the dynamics of performing in public space for a 360 camera. *Performing The City in Cine VR* serves as a contemplation on the psycho-geographic dimensions of a city, examining points of view through 360° perspectives. It evaluates how the spatial setup influences audiences' experience in the VR headset. The urban space is analysed as a textured and layered text, incorporating elements such as fragments of songs, advertisements, and announcements referencing the space as a sonic experience. This research extends the understanding of the potential of Cinematic VR, particularly in exploring digital heritage and the interconnectedness of bodies, memories, and urban environments. It highlights the transformative impact of immersive storytelling in reshaping perceptions and relationships with the urban landscape, contributing to the evolving body of knowledge in this field.

Cinematic Virtual Reality. 360° video. Audio-visual experience. Storytelling. Performing. Immersion.

1. INTRODUCTION

The study of an urban landscape has become a widely debated and interdisciplinary arena of great interest in urban studies, architecture, philosophy, and art theory in general. Many spatial theories have emerged since Michel Foucault's claim of heterotopias, places of differences, in 1967. Among them, spatial practice, raised by Henri Lefebvre, aims to regenerate the sets of relations that comprise each social formation (1991). The purpose of the practice is to create knowledge of spaces and to observe sites, ecological environments, and transcultural experiences. This method of approaching the city through a sensorial, poetic, and critical instrument has a considerable tradition developed by critical thinkers and artists such as Guy Debord, Michel de Certeau, and Georges Perec. They developed concepts for poetic urban space interventions to demystify contemporary

capitalist society through experimental research modes, including ambulatory practices (Debord 1995).

Michel de Certeau's *The Practice of Everyday Life* (1980) and Georges Perec's *Species of Spaces* (1974) are instructive manuals on walking the city following psycho-geographical maps. The most pertinent aspect is that walking, a bodily engagement, opens a cognitive process that can be researched. Observing, sensing, writing, and recording what is seen and heard in the streets encourage us to walk with a consciousness of our environment, much as humans not only yield social relations and use values but produce their own social space (Lefebvre 1974).

The concepts of *Situationists International* are still highly relevant today to understand a city as a stage for various forms of life that interact, mix, and mingle

with each other—a call for poets and artists to celebrate an imaginative visionary city. In his poetic manual for everyday life practice, *Walking in the City* (1988), Michel de Certeau observes the different perspectives we can take on a city while walking. Instead of adopting the bird's eye view, which lays out a city like a map but distances us from actual life, Certeau calls on us to immerse in the “chorus of the pedestrian footsteps” (1984, pp.97-192) on the streets. Through our movement, pedestrians create the city and define its spatiality. Walking, wandering, and window shopping represent the movements of pedestrians, which could be displayed as lines on a map. At the street level, walking is the elementary form of experiencing a city. As walkers in the city, we follow the urban landscape, reading it like a 'text,' listening to audible textures. Our movements enable the gestures of everyday life, as if we are writing a poem, a “tree of gestures” (Certeau 1984, p.101) that grows into a forest as pedestrians walk and wander around, creating the semantic density of urbanism.

As practitioners we make use of spaces that cannot be seen (Certeau 1984, p.93). While walking, we hear sounds, read advertisements, street names, and random texts, and listen to announcements, traffic, and conversations. How the body moves through the city becomes the rhetoric of walking and the pedestrians' walking becomes a speech act. The city is an anti-museum that contains the memories and histories of social interaction through signs, symbols, and street names. Through the analysis of images and sounds, the urban space, and its creation of social space, the subconscious of a city emerges. This study extends De Certeau's theories into the cinema in VR, employing 360° technology to archive disappearing spaces in Singapore's rapidly transforming urban landscape.

The intention behind using 360° technology to capture Singapore's public spaces is to archive areas on the verge of disappearing due to rapid urban transformation. In this sense, the film becomes a part of virtual heritage preservation. Virtual Heritage comes alive through the performance of a site in cinematic Virtual Reality, offering engagement with the past and present, allowing exploration through documenting and archiving urban space. Furthermore, cinematic VR enables an experience of being present in the space, looking around, sensing, and listening to the environment, creating a mirror-like “mirage”. We cannot see our bodies in the VR world, but subconsciously, we feel the experience is so real that our minds compel our bodies to be “there” (Lim & Sitharan 2022, p.56). It is crucial to archive spaces through virtual reality technology, as they are part of the memory, history, and collective consciousness of a city.

Certeau highlights three main power structures of a city that are relevant to this study of Singapore: first, the city as a space where power can be controlled and demonstrated; second, the city as a synchronic system where time can be layered upon, or where history can be traced, created, erased, and rewritten, as governments decide which buildings will remain or vanish, and which monuments and streets are built; third, the city as, once again, a space created and controlled by different groups, ethnicities, associations, and individuals. All three aspects relate to the construction of power and how the city is regulated. However cities are conceptualised by the authorities, they are lived in by diverse groups and individuals who add their own dynamics to each place. The city grows and decays, acquiring new attributes. Ultimately, a city like Singapore serves as a landmark for socio-political and economic strategies. Urbanisation is the language of power that regulates and writes its histories.



Figure 1: *The Seven Step Verse* (2022). Film poster, Ralph K. C. Wu (Design).

2. PERFORMING SINGAPORE IN SEVEN STEPS

The title for the Cine VR film *The Seven Step Verse* (2022) refers to the well-known Chinese literary poet Cao Zhi, who defied his brother in a poetic writing competition and developed the seven-step method, which refers to the ability to create a poem within a short time with wit and skill in literary

creativity. The number seven holds significant importance in Chinese culture reflecting humans' emotions and behaviour. In the film, seven female performers were selected to play upon seven iconic shopping malls, reading them like a text, pointing to the underlying ideological and social hierarchies.

The performers embody the invisible, female migrant personnel from Southeast Asian countries, such as the Philippines, Thailand, and Indonesia, who mostly work in Singaporeans household as domestic helpers. Only on Sundays, on their day off, do they become visible, populating public spaces and the old, iconic shopping malls that have turned into sites for social gatherings across the country. Malls like the Golden Mile Tower became locally known as "Little Bangkok", while Lucky Plaza on Orchard Road is known as "Little Philippines", or Peninsula Plaza is known as the "Little Myanmar". These shopping malls provide affordable goods and services for the workers. The maid agencies located in Bukit Timah Shopping Centre offer related services, promote their workers through advertisements and imagery, and serve as the first contact point for the migrants arriving with their often-oversized suitcases. These visual elements, including the colours of working uniforms, the props such as suitcases and cleaning utensils, and the gestures involved, such as rolling around suitcases and cleaning surfaces throughout the mall, were all adapted for performing the city in *The Seven Step Verse* (2022).



Figure 2: Made Agency advertisement in Bukit Timah Shopping Centre.

Several iconic modernist shopping malls built by renowned architects in Singapore are the focus of this research, such as: Sim Lim Tower in Rochor, known to be the first "Electronic and Electrical" city of its kind when it was built in the early 1980's, famous for its colourful façade in purple, red and yellow; Far East Plaza Shopping Mall, once depicted in David Bowie's *Serious Moonlight Tour* (1983), which shows the star riding on a futuristic neon-lit

escalator; the iconic People's Park and Golden Mile Tower, both built by William S. W. Lim (1932–2023), a star architect, urbanist, and cultural figure in Singapore who attempted to imagine a future Asia by compiling living units and commercial spaces into vertical cities. Once built as urban visions of social and commercial space in the tropical climate, these architectural icons have since declined and become clusters of social spaces for migrants from different Southeast Asian countries.



Figure 3: Female Performer during the Shooting of *The Seven Step Verse*, Golden Mile Tower Singapore

These now dated shopping malls are operated through the ownership structure of strata titles, which was introduced by the Singapore government in 1968 to allow for the subdivision of land and the collective sale of property such as multi-storey buildings. This ownership structure resulted in an eclectic mix of tenants but also contained its own termination mechanism: an *en bloc* sale of the development could be carried out with the majority consent of owners. Recent collective sale bids between 2021 and 2023 have stirred public

anxieties over changes to the city and its available social spaces. Many of these iconic shopping malls are now endangered, at risk of demolition.

This project aims to serve as a documentary to preserve disappearing social experiences, urban histories, and memories. It contributes to the ongoing development of a theory of the performative documentary, which shifts away from documentary based on fact and information alone, towards a playful form of documentation through play, performance, and re-enactment. Performative strategies, such as the speech-act, re-enactment, or acting-out, serve as transformative tools, expanding and subverting normative representations in filmmaking. Play becomes an exercise—an improvisation through mimicry, pastiche, and humour. The performative, as a poetic device in cinematic virtual reality, paves the way for experimentation, offering new perspectives on how we perceive and experience our lives.



Figure 4: Female Performer dressed up in the colours of the architectural space in Sim Lim Tower.

Performative strategies enable both the archiving and activation of a space. Given Singapore's stringent restrictions on shooting in public spaces after the pandemic, the film utilises guerrilla video techniques. The limitations of the camera angles result in a calculated, slapstick theatre-like performance reminiscent of early cinema's static camera angles and separate sound recordings. Despite the constraints, the space becomes habitable as the performers, symbolising the migrant workforce, modify their space by adapting their cleaning gestures and appearances to integrate seamlessly into the public spaces.

Emphasising the importance of the performative act as a narrative device, the study investigates a new cinematic language in VR based on associative principles through sounds, lyrics, and textual materials. Asking fundamental questions about relationality, the subliminal textures of society, and the poetic potential inherent in everyday practices,

Performing the City in Cine VR challenges traditional documentary norms. The focus on urban settings, particularly shopping malls, and marginal communities, provides a lens through which to understand the making of a future city and the complex interplay between culture, memory, and urban transformation. Ultimately, this research contributes to the evolving aesthetic and geopolitical meanings within the open genre of performative documentary filmmaking.



Figure 5: *The Seven Step Verse* (2022) in the making, Far East Shopping mall Singapore with 360° camera setups.

3. SONIC MEMORY

While the 3D 360° visuals capture the public spaces as temporally fixed, sound is used to render multiple temporal possibilities concurrently. Ambisonic recordings were created on location at the time of image capture, and these formed the foundation of the sound world of the “now”. Ambisonic recordings capture a complete sound field. Following conventional sound design practice, the first order recordings were augmented with foley recordings of key objects and actions to give greater depth and texture to the soundscape. This layer of the sound world is designed to be experienced as diegetic and closely aligned to the visual track, especially the actions and movements of the performers which are accompanied by sounds intended to be exaggerated and humorous in nature. The project references Jacques Tati's *Playtime* (1967), in which the whimsical treatment of the sound world reflects the absurdity of the performance in a modernist world, where furniture, shiny surfaces and slippery floors trigger a soundscape underlying the burlesque tone of the work.

A second layer of the sound world was created to represent echoes or memories of the past, and the presence of entities that once belonged to these communal social places. This is primarily achieved by using a female voice, performed as a

loudspeaker announcement echoing at various times and locations. The performed text is a tapestry of announcements, fragments of menus, dishes, beauty tips, and warnings. These various texts are gathered from advertisements, street signs, and announcements collected in the shopping malls, a method proposed by Georges Perec in *Species of Spaces* (1974), to create practice from everyday life activities and describe spaces through text. Performed almost as a stream of consciousness, the sequence of words is rendered almost as gibberish, as the disembodied voice calls and echoes through the cavernous spaces, emanating from a time past. The layering of text, words and sounds making heard the inaudible voices of the marginalised, stylistically referencing the library scene in Wim Wenders *Wings of Desire* (1987), when two angels return to earth, able to hear what people think, read or whisper.

The music score dominates the dance-like sequences, composed after these performances were captured. Technically speaking, one of the significant challenges in creating the soundscape was the difficulty of monitoring the 3D 360° video during the mixing process. While some solutions exist to enable sound mixing in the VR environment, these were not available, so an iterative process was required. Each new mix had to be loaded and reviewed in the VR headset, and then a new mix was created following review. Subtle changes in sound level, panning, and reverberation can significantly affect a sound's perceived location in the sound field. This is particularly apparent when working with 3D video as the audience's visual perspective relative to the location of sound sources is more precise than in 2D 360° video, thus requiring more precision in sound placement.



Figure 6: *The Seven Step Verse* (2022): Film still, Far East Shopping Mall

4. FILMING, POST-PRODUCTION APPROACH AND VIEWING EXPERIENCE

As previously indicated, the primary aim was to create a cinematic virtual reality film designed for immersive viewing through a VR headset. Consequently, a comprehensive stereoscopic shooting and post-production workflow was

imperative. The following section offers a brief overview of the technical methodology and associated challenges.

The process of location scouting, and principal photography involved the use of the Insta360 Pro 2 camera. Despite its initial release in 2018, the Insta360 Pro 2, while not the latest model, has retained its relevance and remains a well-established choice for capturing stereoscopic 360° content at the time of composing this text. Although the camera may evoke a sense of perpetually being in beta development status, its capabilities were deemed sufficient for our purposes.

The documentary-style shooting technique employed a guerrilla approach, demanding a minimalistic and mobile technical setup. Our strategy enabled inconspicuousness, unlike conventional 360° shooting setups which incorporate elaborate set lighting or mount lighting on or beneath the camera. A noteworthy advantage of maintaining a low profile was that the camera's form factor, resembling a black sphere with six lenses, was not readily identifiable by the public as a conventional camera; at times, it was even mistaken for a landscape measuring apparatus.

Our minimalistic setup avoided additional lighting, relying solely on natural ambient light sources to maintain our inconspicuous approach. A diminutive and agile Dedolight tripod was employed for camera support, minimising our environmental intrusion. Furthermore, our commitment to efficiency was evident in the decision to keep camera gear bags and cases to an absolute minimum. This streamlined approach facilitated unobtrusive filming within the environment, maximising flexibility. As a testament to its efficiency, we successfully captured footage in five distinct locations within a mall, each involving multiple takes, all accomplished within a single hour.

Throughout the entire production, the team executed shoots in seven distinct malls encompassing approximately 20 unique locations. It is noteworthy that, prior to the filming phase, two team members had conducted thorough location scouting using the same unobtrusive Insta360 Pro 2 camera setup. However, instead of capturing video, which would entail a time-intensive stitching post-production process, the focus was on stereoscopic 360° high-resolution photography. This approach allowed for an instantaneous review of all locations within the VR headset, enabling a comprehensive evaluation of the stereoscopic effect in each setting. Although these stereoscopic 360 high-resolution still images were not incorporated into the final film, experiencing them within the VR headset provided a captivating and highly immersive encounter in its own right.



Figure 7: *The Seven Step Verse* (2022): Outdoor rooftop at the People's Park shopping mall with 360° camera setups.

The production of stereoscopic footage, particularly for 360° content, introduces various challenges during the post-production phase. Foremost among these challenges is the considerable volume of data involved; not only is the base data size substantial for 360° 6K, but it doubles when undertaking stereoscopic processing. Additionally, the stitching process for stereoscopic 360° footage is notably more intricate than that required for monoscopic 360° footage. Another pivotal challenge pertains to rig removal, specifically, the meticulous cleanup of the tripod visible in the nadir, necessitating adherence to stringent technical workflows for stereoscopic compositing.

The film was captured using the Insta360 Pro 2 at 6.4K resolution, 60 frames per second, with each 360-eye boasting an equirectangular resolution of 6400 by 3200 pixels, resulting in a stereoscopic over-under resolution of 6400 by 6400 pixels. This translates to a data file size 20 times that of full HD. The post-production workflow, executed in a visually lossless ProRes 4444 codec, culminated in a data throughput of 1.6 gigabytes per second, exemplified by a 30-second clip demanding 50 gigabytes of storage. Consequently, storage bandwidth emerged as a critical bottleneck deserving heightened consideration.

The post-production process involved several key steps. Initially, stitching was carried out using SGO MistikaVR, followed by degrading and deflickering using Neat Video. Nadir cleanup and compositing tasks were then tackled in The Foundry's Nuke with CaraVR. In contrast to the rapid and agile shooting style employed during production, the post-production phase followed a more traditional and time-consuming approach. Despite the efficiency of the shooting process, the post-production workflow proved to be labour-intensive, spanning a considerable three-month period for footage from just a single day of shooting. This extended timeline for editing, stitching, and clean-up highlights the

complexity and meticulous nature of the tasks involved. While the result—a nine-minute Cinematic VR film—may demonstrate dedication to quality, it also underscores potential inefficiencies and challenges encountered throughout the post-production journey.

In a preceding study on *Stereoscopic Video Connecting Cultural Heritage and Media Art* (Reinhuber 2017), we undertook an evaluation of various audio-visual viewing modalities for immersive 360° content, encompassing cylindrical panoramas, hemisphere domes, and VR headsets. Our findings suggested that VR headsets, in combination with headphones, represented a notable compromise, offering a standardised user experience characterised by known and predictable parameters for image and sound reproduction. However, since that time, VR headset technology has seen significant advancements in both affordability and audio-visual quality.

These improvements have enabled us to deliver a stereoscopic 6k experience with compelling audio-visual fidelity through an accessible headset to our audience. Despite the increased accessibility of VR experiences compared to 2018, many members of our team and test viewers encountered VR for the first time. From our observations, it is evident that the photorealistic, life-size, and stereoscopic (S3D) appearance continues to be a focal point and a source of amazement.

Framed within the context of our project's objective of exploring virtual cultural heritage and serving as a documentary to preserve vanishing social experiences and urban histories, the resulting Cinematic VR film has been perceived by viewers as providing an "intimate view" into the realm of antiquated and forgotten shopping malls. Notably, one of the landmarks featured in the film has since closed down entirely, and our project effectively realised its mission of archiving "disappearing" sites. However, the perception of "intimacy" has also been a subject of contention among viewers.

Some have described the experience as bordering on voyeuristic, particularly at moments when performers or mall visitors appear in close proximity to the camera or viewer. While the film endeavours to counteract this effect by integrating instances where performers make direct eye contact with the camera, thereby acknowledging the viewer's presence, the immersive nature of 360° viewing allows viewers to potentially overlook these moments while focusing on other directions.

While our primary objective was to explore the realm of performative documentary within the cinematic virtual reality space, the observation of the experience being "too intimate" presents a nuanced

challenge. This sentiment stands in contrast to the documentary's intended purpose of preservation, raising questions about the film's alignment with its preservation objectives. In this respect, the film represents a provocative experiment, eliciting varied responses and stimulating critical discourse on the intersection of intimacy, documentation, and virtual reality within the realm of cultural heritage preservation.

5. CONCLUSION:

Released under the title *The Seven Step Verse* (2022), the final film premiered at the Singapore International Film Festival 2022, and in the exhibition "Beyond Mirage" at the SeaShorts Film Festival Malaysia 2022. The entries were among the first Cine VR films showcased by both festivals. Through the sensory documentation of multiple layers of time, memory, perception, and ideas, *The Seven Step Verse* offers a unique VR experience that reintroduces, reinterprets, and restructures the changing dimensions of everyday life in Asia beyond the conventions of cinema and performing arts (Raidel 2023). The film demonstrates the emergence of new experimentations in cinematic virtual reality that can be distributed in traditional and expanded cinema versions and beyond. It generates a new language in VR cinema through the performative act as a narrative device. The resulting film serves as a heritage document to preserve disappearing social memory, urban histories, traces of work, and labour in general, while intervening in a soon to be demolished shopping mall built in the 1970s-1980s. In the spirit of the seven-step verse, a literary witticism that exposes power structures, virtual performativity serves to encompass diverse expressions in forms, sounds, and visuals to reflect Southeast Asia's distinctive relationship with diaspora and transcend popular postcolonial tropes through hybridity and mimicry. The virtual embodiment of social space powerfully demonstrates how the rich, colourful, and symbolic dimensions of these in-between spaces often overlap and distort, to the point of illegibility.

6. ACKNOWLEDGEMENT

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The Seven Step Verse, 9' (2022)
Director, Screenplay, Producer: Ella Raidel

VR Cinematographer and VR Technical Director:
Benjamin Seide
Sound recording: Vanessa Yip, Chua Xin Yun, Yang Haolin
Sound design: Ross Adrian Williams
Editor: Benjamin Seide
Composer: Ross Adrian Williams
Performances by Nicole Phua, Veronyka Lau, Valerie Koon, Smiha Kapoor, and Gladis Ng*.
Production design: Ella Raidel
Colour correction: Benjamin Seide
Title design: Benjamin Seide

Distributed by Lemonade films Vienna:

1. Singapore International Film Festival (SGIFF), Singapore Panorama Short Film Program 4: A Virtual Reality Experience.

The first VR Exhibition at SGIFF, Singapore's most important and international film festival, Nov 2022.

2. SeaShorts Film Festival, BEYOND MIRAGE, E-gallery, Multimedia University, Kuala Lumpur, Sept 2022.

3. Festival of International Virtual & Augmented Reality Stories (FIVARS), Toronto, Official Selection September 2023

Festival of International Virtual & Augmented Reality Stories (FIVARS) is a media festival that showcases stories or narrative forms from around the world using immersive technology that includes virtual reality, augmented reality, live VR performance theatre and dance, projection mapping and spatialised audio. It is considered to be Canada's first dedicated virtual or augmented reality stories festival and was the world's first virtual reality festival dedicated completely and exclusively to narrative pieces.

4. BIDEODROMO International Experimental Film and Video Festival, Bilbao, Spain.

5. The International Alternative Media Film Festival (FICMA), Mexico.

The International Alternative Media Film Festival (FICMA) seeks to promote and disseminate the creation of films and audiovisual projects with new digital narratives and disruptive technologies made with various devices such as smartphones, DSRL cameras, GoPro cameras, Black magic pocket, drones, among others. Using techniques such as virtual reality, digital animation, artificial intelligence, and exhibition media such as projection, transmedia narratives, VR viewers, website, and streaming platforms.

6. VR Escape Room Traunkirchen, Austria (permanent June 2023–December 2024)

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Theatre and AI: A brief study of ethics in narratives and performance

Carla Capeto
Independent
London, UK
carlacapeto@gmail.com

1. INTRODUCTION

The dissemination of artificial intelligence technology has led to a widespread debate about its ethical use. Governments and companies are keen to harness AI's economic benefits, but they are also aware of its risks. According to the European Union (del Blanco 2020; Stahl et al. 2022) and the House of Lords (Tobin 2023) reports, AI can aggravate bias and discrimination, compromise privacy, spread misinformation and undermine human creativity and skills.

The debate has reached the arts and culture sector. In 2022, Jason Allen's *Théâtre D'opéra Spatial* won top prize at the Colorado State Fair and the artist was accused of cheating (Roose 2022). Boris Eldagsen also won first prize at the Sony World Photography Awards with his work *The Electrician* (Eldagsen 2023). The artist declined the award, stating that it was a mock submission to find out whether the jury could distinguish AI-generated art and spark a debate about its artistic value. More recently, the 2023 Hollywood strikes also raised concerns about the use of artificial intelligence, demanding its regulation (WGA 2023).

Considering how often artistic practices align with contemporary debates, this paper investigates the narratives of three theatre plays: *Sayonara* by Oriza Hirata (2019), *Marjorie Prime* by Jordan Harrison (2016) and *Glowstick* by Vlad Butucea (2019). It also looks at the work of Improbatics and the potential ethical implications of using AI as a creative tool.

2. BLURRING LINES BETWEEN REALITY AND FICTION: AI AND HEALTHCARE.

The plays *Sayonara*, *Glowstick* and *Marjorie Prime* are set in the near future and speculate about the use of AI in healthcare.

In Oriza Hirata's *Sayonara* (2019), a terminally ill woman is given an AI robot as a companion in her final days. The play has a melancholic tone, with both characters reciting poetry to ease loneliness. The woman, eager for connection, asks about happiness to her robot companion, a question the robot cannot answer since it is only designed to serve humans. Throughout the conversations between the two characters, there is a degree of projection of human experience onto an AI robot. Following the woman's death, the robot keeps reciting poetry, admitting it was due to loneliness. A technician first interprets this behaviour as a malfunction, but the robot is sent to Fukushima, where so many people died, and humans can no longer enter.

With a less poetic tone, *Marjorie Prime* (2016) by Jordan Harrison also revolves around artificial intelligence assistance in healthcare. A thought-provoking play that considers how AI can impact human relationships and how they deal with mortality and loss. The main character, Marjorie, is an elderly woman suffering from dementia. She is given a Prime, an AI hologram replica of her late husband Walter, to help her with her memory loss and provide companionship. The character's interactions reveal past unresolved family matters and discord among Marjorie, her daughter Tess and son-in-law Jon.

Lastly, Vlad Butucea's *Glowstick* (2019) focuses on River, a care home resident, who has been given an AI robot assistant, IDA. Despite IDA's reassurances

that it can assist River with everything, River struggles with the presence of her robot assistant and keeps asking for a nurse. As the play progresses, River seems to accept IDA and shares details of her physical wellbeing and memories from the tragic death of her partner Quinn. River also convinces IDA to break the rules and take her on a simulated journey to the lake she used to go to with Quinn.

Although these plays explore a futuristic scenario, the integration of AI in health care is already happening. The NHS already has in course the implementation of AI care programmes, which are still in experimental phase such Patient Monitoring in partnership with Docobo (NHS 2024). The main goal is to use AI technologies to measure premature health deterioration. NHS recognises ethical issues regarding patient privacy, for example. Some studies claim (Morley et al. 2020; Kleinpeter 2017) that limiting healthcare to AI data collection can affect patients' body and compromise personal relationships with doctors. This is reflected the narrative of Butucea's *Glowstick* when River requests a nurse. The play also references a nurse strikes, a relevant topic as we witness the struggles of health workers in a post-pandemic world. The introduction of AI in healthcare could aggravate this problem, pushing health workers into irrelevance, and patients getting an impersonal care. Marjorie Prime also tackles this issue. AI replaces care workers and deceased family members, which causes much distress for Tess. She is uncomfortable with the idea of AI substituting her deceased father and later her mother after Marjorie's death.

All three plays fall into the trope of AI technology replacing humans. But they are all nuanced and present a viewpoint on the impact on humans on a psychological and emotional level.

3. IMPROBOTICS: IMPROVISING WITH AI

Improbatics is an international theatre ensemble, which uses generative AI such as GPT-3 to create improvised and comedic performances.

In July 2023, *Improbatics* performed at the AI Festival held at Omnibus Theatre (2023). The performance used AI technology to create original improvisational narrative models that provided actors with textual and visual inputs. Although the system can create a steady narrative thread, it also presents actors with random and inconsistent elements that shift the narrative's trajectory. Moreover, the actor's performance becomes the binding element that provides coherence to the show, even though actors often embrace the absurdity of the narrative.

Whilst AI can be innovative creative tool for improvisational theatre, it has some caveats. A published analysis of the creative process states that filters were created to mitigate biases and potential pejorative content (Branch et al. 2021, p. 2). Other theatre artist also encountered similar issues. Theatre director Jennifer Tang, whilst working on her play *AI*, came across racist stereotypes generated by the software about one of the Middle Eastern actors (Perrigo 2021). Czech research project, THEaiTRe, also acknowledged the presence of biased stereotypes during the development of the project *AI: When a Robot Writes a Play* (Rosa 2022).

Several studies confirm the presence of biases in AI technologies such as GPT-3, a technology that is integrated into these theatre projects. Bender et al (2021, pp. 613-615) point out that using large datasets like the Common Crawl for training data does not mean more diversity. The authors claim that internet data over-represents users from developing countries and, therefore, may contain racist or derogatory views regarding minorities and marginalised groups. Huang et al (2023) also corroborate the presence of bias in AI systems that could lead to discriminatory practices, compromising fairness and transparency in the public and in criminal justice.

Whilst *Improbatics* does not incorporate ethical debate as a narrative element, they face challenges in terms of minimising offensive content and bias in their performances. However, this challenge might not be fully resolved simply by creating filters and deleting inappropriate words. It is unclear what criteria are used to classify offensive or biased content, which can be aggravated by the fact that, to some extent, all people are biased.

4. CONCLUSION

The examined plays in this paper deviate from Hollywood's dystopian narrative, but still maintain pessimistic tones. They speculate on a reality where artificial intelligence is employed to care for the most vulnerable. The healthcare sector is already experimenting with AI to design preventive health measures and reduce costs. However, the plays are also an invitation to reflect on the emotional impact of AI technology and the importance of human connection.

Regarding *Improbatics*, their work demonstrates that AI can be used as a creative tool without undermining human creativity. The performances also expose AI's limitations, which can break some misconceptions regarding AI. However, the way that *Improbatics* creates a crossover between art and

science, can transform theatre into a research lab and bring to the light the risks and benefits of artificial intelligence. The results of the work are analysed and published, and they have disclosed information regarding the presence of bias, which is one of the concerns of the industries and scientific communities working with AI.

To conclude, the artistic practices discussed in this paper contribute to bringing the ethical debate to the public sphere, allowing people to see a different side of this technology, and to critically reflect on AI and how it is shaping our future.

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A Place to Tinker and Transform: Our vision for the XR lab for health, well-being and education

Marianne Markowski
University of Greenwich
Institute for Lifecourse Development
London, UK
a.m.markowski@greenwich.ac.uk

Jonathan Weinel
University of Greenwich
Faculty of Engineering and Science
London, UK
j.r.weinel@greenwich.ac.uk

Marcantonio Gagliardi
University of Greenwich
Institute for Lifecourse Development
London, UK
m.gagliardi@greenwich.ac.uk

1. INTRODUCTION

This short paper presents our vision for our Extended Reality (XR) lab, a cross-faculty initiative for which we secured internal capital investment funding (£70K) from the University of Greenwich. The faculties involved are the Faculty of Engineering (FES) and the Faculty for Education, Health and Human Sciences (FEHHS), which will be working closely with the Faculty of Liberal Arts and Sciences (FLAS).

2. OUR VISION

The XR lab aims to be a platform for digital technology researchers to collaborate with fellow researchers, who may be experts in one or several subject topics or have specific technical skills to work on innovative XR projects. With this lab, our goal is to carry out transdisciplinary research going across the fields of health care simulation, transformative simulation (Weldon et al. 2023), health & well-being, psychological assessments and treatments, exercise and rehabilitation, leadership (Jameson 2022), professional development (Jameson et al. 2022), and community involvement (Markowski 2020). The XR lab intends to be a stimulating place for in-person and/or online experimentation, tinkering and play, yet also for focused and task-based research. It will serve as a place to attract postgraduate researchers as well as early career researchers internationally. The XR lab further aims to bring in expertise from artists and performative researchers from internal departments and external organisations.

2.1 The technological set-up

The lab's equipment has been bought with the following possible combinations of technologies in mind: Virtual Reality (VR) equipment, Augmented Reality (AR) portable equipment, adaptive virtual reality training (AVRT) equipment, Tesla suits for haptic and sensory interaction, physiological measuring equipment, cleaning equipment as well as recording facilities to capture telemetrics, video, and sound.

Part of the stationary equipment will be set up permanently in the psychology lab area at the main Greenwich campus. Portable devices are currently housed by the Greenwich Simulation and Learning Centre (GLASC) on a different campus. An online booking system, supported by the GLASC technical team, will allow lab users to book the equipment and the rooms. The technicians in the School of Psychology – where the physical XR lab will be situated – will allow the day-to-day delivery.

2.2 Inception of the lab

The cross-faculty initiative was born out of established working relationships and emerging pilot projects. The Institute for Lifecourse Development (ILD), with its structure of seven research Centres, facilitates regular activities and exchanges between researchers (e.g. talks, research cafes, review panels, and internal funding options), which allow for collaborations such as this XR lab one to emerge.

For example, Dr Weinel, Dr Weinel, Academic Portfolio Leader (Associate Professor) in Games,

and Dr Markowski, Research Fellow at the ILD, had been awarded £1996.72 internal ILD funding to buy VR headsets with the view to tinker with representations of visuals with music. They further submitted an ESRC application with external collaborators for practice-based research to educate about the history of rave music and to evaluate its impact.

Dr Gagliardi, a clinical psychologist and psychotherapist who works alongside Dr Markowski as a Research Fellow at the ILD, furthered explorations of VR in the assessment and treatment of psychological disorders (Gagliardi 2024). For this, Dr Gagliardi led an MRC funding proposal exploring AI and VR in the assessment and treatment of eating disorders. He further offered project briefs concerning the therapeutic context to 3rd year BSc Game Development students, to which students were able to respond with practical programming examples (Figure 1).



Figure 1. *The making of a VR classroom for public speaking training and reducing anxiety.*

Dr Markowski supported Professor Jorge Lopes Ramos from FLAS and ZU-UK, a disabled-led physical and digital performance theatre company, in transforming their mixed reality (MR) installation 'Good night sleep tight' (Dunne et al. 2018) into the UKRI-funded project 'Within touching distance', which investigates the use of MR and touch in scaling up the teaching of empathy in health care (Figure 2).



Figure 2. *Credit: 'Goodnight, Sleep Tight' by ZU-UK*

2.3 The structure of the lab

The diagram below depicts the two faculties (CMS and FEHHS) that have secured the funding for the XR lab (Figure 3).

By working closely with the Portfolio leaders for the BSc Games Development and the MSc Interprofessional Simulation, members of the ILD, FEHHS, and FES can reach students for practical collaborations. This allows for the exploration of project ideas, early tangible outputs, and increased experience for students, which, in turn, can further research ambitions and interest in postgraduate studies. The ILD offers its members to apply for competitive internal funding (up to £4000) together with collaborators, including members from FLAS and external partners. The ILD supports its members in developing external research funding applications with peer review opportunities and sharing of expertise.

2.4 Upcoming projects of the XR lab

Prof Jill Jameson, Lead for the Centre for Professional Workforce Development (CfPWD), has long-standing relationships with community organisations and the police force; she plans to use AVRT technology to explore collaboratively situations and training opportunities for police force members in crime reporting or stop and search activities.

Dr Markowski, Dr Weinel, and Professor Jameson are currently preparing a PhD opportunity to explore VR visualisations and body movements for relaxation and meditation. This will build on previous VR audio-visual work related to altered states such as Weinel (2021) and Deere (2022). They expect to use VR helmets and Tesla suits to capture body data.

Professor Sharon Weldon leads the simulation research group, which is a part of the CfPWD. Her primary research interest is transformative simulation, which uses simulation as a vehicle to innovate systems and challenge mindsets and perceptions (Weldon et al 2023). XR technologies will be considered to design simulations that bring the lived experience of service users or patients to the forefront, thus changing the perspectives of healthcare leaders and decision-makers on healthcare delivery.

Dr Gagliardi and Dr Markowski plan to secure ILD funding to conduct focus groups with a third-sector charity working with people with disordered eating to elicit opinions and reactions on using VR to educate about and assess eating habits. The participants shall have hands-on experiences with VR.

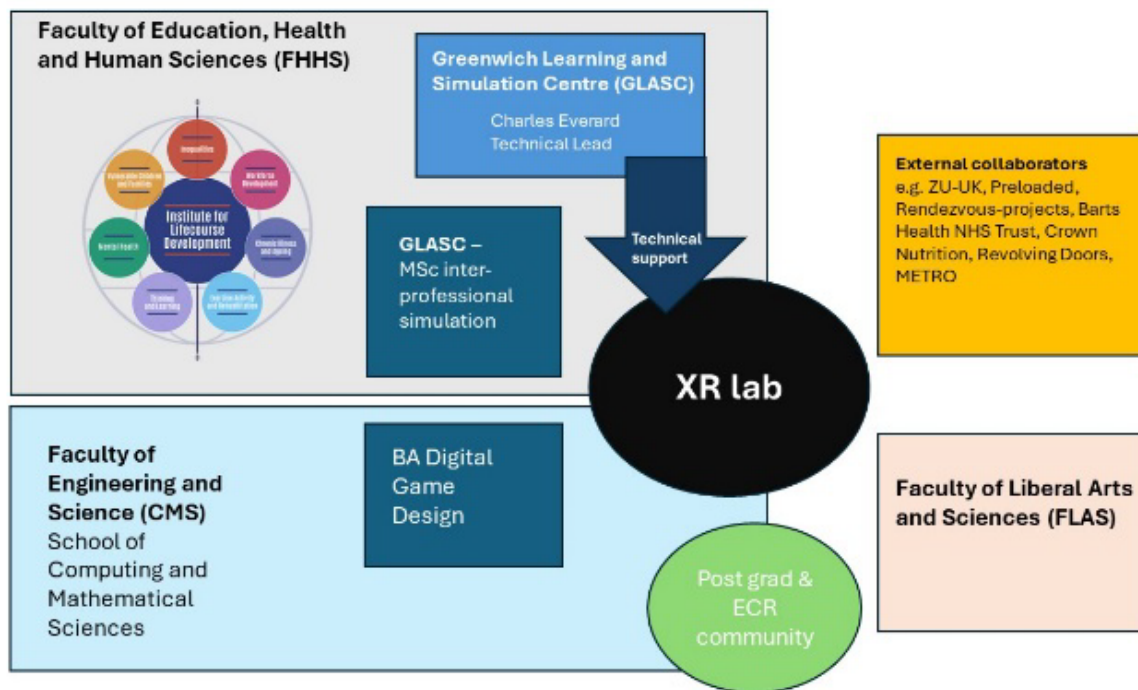


Figure 3. XR lab structure

Prof Fernando Naclerio, who leads the Centre for Exercise Activity and Rehabilitation (CEAR), has expertise in conditioning and strength training and its relationship to nutrition. His research area attracts PGR students globally, and PhD opportunities are planned to investigate the use of technology in carrying out and maintaining exercises and educating in nutrition. This is likely to involve exergames (Kappen et al. 2019) but could also develop applications in visualising exercise and nutrition relationships. In collaboration with the ILD Centre lead for the Centre for Thinking and Learning, Prof Sandhiran Patchay, they will investigate the application of VR for gait visualisation and exercises. Furthermore, Professor Patchay plans to use AR for the safe delivery of experiments concerning falls.

The XR lab is open to be visited by any researcher in FEHHS and CMS. When someone has a research idea, they can discuss it with the core members of the XR lab, who will advise on how to develop the idea and which funding opportunities are suitable.

Furthermore, the XR lab team plans to hold a yearly internal event to showcase the XR research carried out, reflect on knowledge created and experience collected as well as attract more collaborations.

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Curves and Reverbs: A Wearable to Sound Participatory Performance

Mona Hedayati
Concordia University, University of Antwerp
Brussels, Belgium
monaahedayati@gmail.com

1. CONTEXT

Taking the practice of performative atmosphere building as a departure point, this paper thinks with the concept of atmosphere, as the “tone of a place” (Roquet 2016, p.3). Particularly suited as a container for affect as an intensity prior to cognitive processing of emotions and feelings, atmosphere is diffused and unstructured as opposed to maintaining the definitive quality of a space or an environment. Drawing on more than two years of experiments with wearable biosensors and the use of sound as a sensory medium, the project aims to create an atmosphere for affect contagion beyond the structured forms of emotions and feelings.

Curves & Reverbs is part of a large research-creation project that examines different possibilities for creating such atmospheric events that are based on a range of strategies to integrate biosensor data—from longitudinal personal data collection to live and freeform ways of treating biosensor data. The project, thus, is heavily invested in representing such data not through logical sequences of linguistic communication, but embodied channels of audition and interaction. As such, sound’s capacity to induce affective state changes in the body leading to its experience building capacity that fundamentally operates on an embodied and pre-cognitive level is foregrounded (Goodman 2012; Hainge 2013). The overarching method for creating such an experience is, hence, sonification of biological signals using biosensors to measure the neurophysiological changes in the body triggered by internal/external stimuli as the closest quantifiable measure to what affect stands for. In other words, biosensors can quantify the wearer’s neural response by capturing state changes represented in the form of biosignals’ waves and troughs.

2. CREATIVE METHOD

Whereas the aim of sonification as a data-dependent sound generation “is to aid in understanding, exploring, interpreting, communicating, and reasoning about a phenomenon, an experiment, or a model” (Scaletti 2018, p.377), this project experiments with sonification of live biosignals as a mechanism that utilizes a complex mapping of the physical to acoustic parameters to create an atmosphere of affect (Salter 2014). Rooted in dynamic parametrization of wearable data to bring live participatory dimension to the project, sonification then becomes a strategy to engage audiences towards a reciprocal sonic conversation with me. While the initial phase of the performance serves to introduce the audience to the mechanism of operation and allow for a period of conditioning by engaging with sonification and visualization of my data, the second phase involves the audience in a feedback loop with me. This participatory aspect allows them to try on the wearable to have their affective markers resonate into sound as a response to mine with the possibility of aggregating signals to sonify the collective affective data. The sonification pipeline can thus integrate both individual data streams as well as collective ones.

The core of the sonification approach revolves around creating an aesthetic correlation between the accelerometer, pulse rate, and skin conductance data to create a scheme that is legible for participants. Given that increased body movement in relation to other affective data can be an indication of excited state of the wearer, I use these correlations to make the wearer aware of their gestural movements in relation to their affective state. The result showcases the authenticity of sonic interventions that combine gestural and affective

tones, allowing the somatic expressions to create a true affective-embodied participatory performance. Parallel to sonification, the live data is visualised to be projected on all walls to add a layer of legibility to the invisibility and obscurity of biosensor data and amplify the atmospheric qualities of the acoustic experience. Visualization, hence, creates a link between the abstract operation of biosensors with the resulting biosignals that are continuously evolving. On a larger scale, the conglomeration of sonification and visualization then allows participants to build a correlative relation between biosensor operation, evolution of sound and visualised biosignal waveforms.

3. TECHNICAL DESCRIPTION

The sonification pipeline relies on biosensor data collection using Empatica E4 wearable device (figure 1) equipped with 4 sensors: galvanic skin response (GSR), detecting micro-perspiration on the skin; blood volume pulse (BVP), detecting irregularities in heartbeat through its calculated derivatives; accelerometer detecting acceleration of motion; and thermometer detecting the skin temperature.



Figure 1: Empatica E4 wearables in operation. © Frederik De Bleser

The live sonification phase was designed using Max for Live platform in Ableton Live digital audio workstation (DAW) that allows for node-based programming to customize functionalities that can operate autonomously (as instruments) and/or directly control the environment (as effects). Incoming data from the wearable is pushed into the DAW using a script that sends in the normalized mapped values through open sound protocol (OSC)—an encoding for live data communication. The complex mapping approach allows for creative ways of handling sonification. For instance, in the case of accelerometer data, a reverse mapping scheme allows for the intricate movements to create fast-changing and highly textured dynamic loops while more acceleration and rate of change in movements will only result in subtle frequency changes in ambient forms. Other streams of

biosensor data that have a slow-changing nature (GSR and thermometer) are then leveraged to create a continuous acoustic foundation where scaling the data to create responsive effects relative to incremental changes still allows for evolutionary quality of biosensors to be felt.

The visualization strategy makes tangible the continuous waveforms, peaks and troughs of biosignals by showcasing the evolution of all 4 streams of data using a custom script that processes the live data for visualization. This strategy allows for participant to view the status of their biosignals in relation to their bodily sensations, e.g., elevated heart rate or perspiration which manifest as peaks at their onset.

4. CONCLUSION

Through sonification and visualization as artistic strategies, *Curves & Reverbs* make the intensities of affective fluctuations captured through neurophysiological fluctuations felt by creating a data-informed atmosphere. The project, thus, makes felt the authenticity, complexity, and emergent behaviour of neurophysiological processes captured by biosensors as an indication of such intensities. By initially allowing the participants to observe the operation and subsequently respond, the project shapes a feedback loop across participants through sonification and visualization in a participatory performance. Such an experience not only facilitates a shared exploration of affective states but also illuminates the reciprocal influence between individual and collective expressions through intermingling the physiological with the aesthetic in co-creation.

5. ACKNOWLEDGEMENTS

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Revisiting Paintings: Automated 2.5D capture for large planar artworks

Xavier Aure Calvet
Centre for Print Research
University of the West of England
W Block Frenchay Campus
Coldharbour Lane
Bristol BS16 1QY
UK
xavi.aurecalvet@uwe.ac.uk

Chatrapathi Akula
Vasthu
Puppet Place Unit 18
Albion Dockside Estate
Hanover Place
Bristol BS1 6UT
UK
chatrapathi.akula@vasthu.co.uk

Kyle Hirani
Vasthu
Puppet Place Unit 18
Albion Dockside Estate
Hanover Place
Bristol BS1 6UT
UK
kyle.hirani@vasthu.co.uk

This paper presents a practical method for digitally capturing and visualising paintings, utilising a custom 3D scanner that combines Reflectance Transformation Imaging (RTI) and photogrammetry. Focused on creating highly detailed 2.5D images, the method ensures precise data alignment and high-resolution output. The technique was applied to Canaletto's 'The Grand Canal, Ascension Day', revealing intricate surface details and artistic techniques, previously unseen. These large, high-resolution images, viewable through an online zoomable viewer, provide access to artwork details, enhancing both public engagement and scientific documentation.

Photogrammetry. Reflectance transformation imaging. Paintings. 2.5D imaging. High-resolution images.

1. BACKGROUND

In EVA 2017, the author introduced a novel method for capturing and visualising paintings in 3D (Aure, O'Dowd & Padfield 2017). This method employed a combination of 3D laser scanning technology, normal maps derived from Reflectance Transformation Imaging (RTI), and 2D images, resulting in detailed, interactive 3D models of paintings. This technique not only enhanced texture representation but also offered a computationally efficient means for online viewing, thus enabling a deeper analysis and understanding of artworks.

This project was initiated to address the need for an affordable system capable of capturing detailed textures of large painted surfaces for conservation purposes. By combining photogrammetry and RTI, the system is designed to fit easily into the existing workflows of museum photographic studios, facilitating the detailed documentation of cultural heritage objects.

The method this paper details centres on a bespoke 3D scanner that automates the combined image capture process for both RTI and photogrammetry. This ensures precise data alignment and high-resolution output, overcoming the inefficiencies of manual capture in the previous method. Moreover, we have enhanced the blending of multiple normal

maps to produce a seamless registered high-resolution map.

While 3D models are achievable with the data generated from the scanner, our focus here is on producing very large, high-resolution 2.5D images comprising colour and surface normals. These 2.5D images are ideal for generating zoomable images which are invaluable for detailed inspection and documentation of artworks.

2. INTRODUCTION

RTI is renowned for its efficacy in capturing the high-frequency details of surface relief, yet often falls short in rendering low-frequency aspects. This limitation arises from the inaccurate estimation of lighting, which does not correctly represent the light intensity falling on each point at the surface. Prior efforts (Nehad et al. 2005, Karami et al. 2022, Berkiten et al. 2014 and Zhu et al. 2019) aimed at resolving this have concentrated on merging 3D scans and photometry for small-scale 3D object reconstruction, a method less suited to larger artworks. In contrast, our approach synergises photogrammetry and RTI, two well-known techniques amongst cultural heritage digitisation professionals and introduces a practical approach to integrate multiple surface normal maps into a singular, colour-registered map.



Figure 1: Canaletto, *The Grand Canal, Ascension Day* (1731–1740). 190cm x 120cm ©From the Woburn Abbey Collection.

Our automated system is tailored specifically for capturing the colour and surface normals of planar surfaces. Its design offers an affordable and straightforward solution for acquiring image data of planar cultural heritage objects and producing digital reproductions with high surface detail. The system integrates a digital camera, a lighting dome, and x-y linear guides, marrying the geometric accuracy of photogrammetry with the high-frequency detail capture of RTI.

Controlled by user-friendly software, the scanner calculates the required number of photographs for each imaging method, based on area size and specified overlap. The images captured are then externally processed and merged using commercial photogrammetry software Agisoft Metashape.

Our aim is to combine these data sets to create accurate, high-resolution 2.5D images for online engagement through zoomable images and for the scientific documentation of artworks, capturing details such as fine brushwork and paint features.

We present results from recording 'The Grand Canal, Ascension Day' (c.1730-31) by Italian artist Canaletto, part of the Woburn Abbey collection.

3. CASE STUDY

To demonstrate the scanner's capabilities, we scanned a painting by Italian artist Canaletto, *The Grand Canal, Ascension Day* (1731–1740). Canaletto's painting is an oil on canvas measuring 190cm by 120cm. 'Ascension Day' is an oil painting from the 1730s, part of the Woburn Abbey Collection, that shows a special day in Venice. This day, known as *La Sensa*, is celebrated forty days after Easter Sunday and is a key event in Venice. The painting depicts a tradition where the city's leader, the Doge, would throw a golden ring into the sea. This act was a symbol of Venice's connection to the sea.

In the painting, you can see the Bucintoro, a magnificent and ornately decorated ship, at the heart of the ceremony. This particular Bucintoro, built in the 1720s, was the last one ever made. The scene is alive with people gathered along the shore and on various boats, including richly decorated *bissone* and other smaller boats like *batelli* and *sandoli*. Some people in the crowd are dressed in *baute*, a popular outfit in the 1700s Venice, featuring a three-cornered hat, a black cape, and a white mask.

This painting, together with 'Regatta on the Grand Canal,' stands as one of the biggest in the series. Both artworks beautifully showcase Venice's festive

and grand celebrations, attracting many visitors. They skilfully contrast the city's lively modern events with its past as a wealthy and influential Republic, now in decline. In these paintings, the artist captures the heart of Venice's culture and joyous occasions, while gently hinting at its once great but now diminished past.

The painting had recently undergone a meticulous restoration in preparation for an exhibition. The large size of the painting and its deceptively flat texture made it an excellent subject for demonstrating the scanner's ability in capturing fine surface details.

4. SET-UP

4.1 The Scanner

The scanner consists of a 1mx1m aluminium frame that supports two lead-screw linear actuators (Ax and Ay), allowing a movement range of 935mm in each axis (see Figure 2). These actuators, precisely controlled by stepper motors (Sx and Sy), provide high-resolution movement. The dome, fitted with LEDs and a central camera for image capture, is attached to the Ay actuator. The system is designed to maintain its position without power, an advantage for repositioning or adjusting angles between captures.

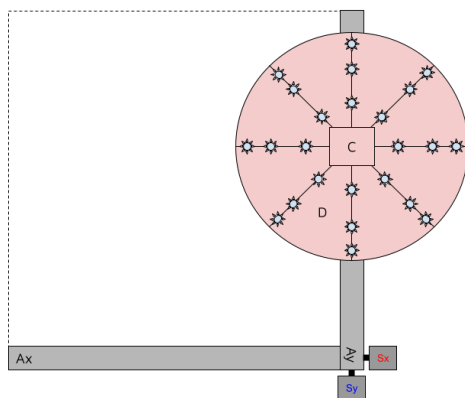


Figure 2: Schematics of scanner system.

The rig employs a Sony Alpha A7RII camera (C in Figure 2) equipped with a full-frame 42.4 MP back-illuminated CMOS sensor. For scanning the painting, we used a 50mm Sony f/2.8 Macro Lens, yielding images of 7952 x 8304 pixels. The camera is centrally mounted in the dome.

We opted for the same Cree® XLamp LEDs as in our prior custom dome (see Table 1). The dome design (D in Figure 2) consists of an extendable spoke-based structure. This setup incorporates 24 LEDs arrayed across eight spokes, each capable of

extending an additional 12 cm from an initial 75 cm to a total span of 130 cm, allowing for adjustments to accommodate artworks of varying sizes. Unlike conventional full domes, our system's spokes radiate outward, enabling adjustments not just in coverage but also in the angular resolution, tailored to the specific requirements of the surface being captured. In this case study, each tier of LEDs (top, middle, and bottom) is at mean elevation angles of 45.76°, 20.25°, and 5.04°, respectively. This tiered approach provides flexibility, from broad, low-frequency surface illumination to the capture of the finest textures and specular reflections at higher resolutions. The ability to reposition LEDs along the spokes to specific angles enhances this versatility further, ensuring optimal illumination for every project. The camera-dome structure can be tilted to align with the artwork. This combination of extendibility, adjustability, and tiered angular resolution makes this system highly adaptable.

Table 1: LEDs specifications in (Aure, O'Dowd & Padfield 2017)

Colour Temperature [†]	3852K
Luminous Flux/Radiant Flux	308 lm
Colour Quality Scale (CQS)*	94.2
D _{uv} *	0.0013
If - Forward Current	400mA
Viewing Angle	115deg
Vf - Forward Voltage	9V
*Measured at the National Gallery with a GL Optic Spectis Touch 5.0 spectroradiometer.	

4.2 The app

The accompanying app (Figure 3) provides a graphical interface for rig control, enabling users to direct the camera and lighting. The rig communicates wirelessly with the camera and is connected to the PC via a serial connection, controlled by a microcontroller. The app and controller interact through specific signals to confirm commands, such as rig positioning and readiness.

The software interface offers two modes, Photogrammetry and RTI, for surface data capture. Users can set parameters like camera field of view, origin, scan area size, and image overlap. The interface also facilitates LED intensity adjustment and camera settings, incorporating a 'shake time' wait feature to mitigate image capture vibration. Post-setup, the system automatically visualises camera positions and commences a comprehensive, automated recording of the defined surface area.

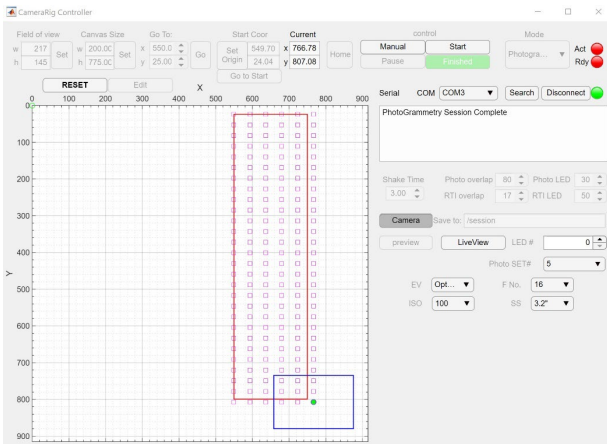


Figure 3: Graphical interface to control the scanner.

5. WORKFLOW

5.1 Acquisition

The Canaletto painting was positioned on an easel within a controlled, dark environment to prevent external light interference (Figure 4). Scale bars for 3D calibration and a custom height reference for RTI calibration were placed adjacent to the painting. In our RTI calibration process, we assess the capture of low-frequency details and shadowing effects. We compare normals generated from both photogrammetry and RTI with those of the original mesh used to mill the calibration board. Using Python for image processing, we normalise and compare the tangent space normal maps, applying a Gaussian low-pass filter to highlight differences in surface normals at lower frequencies. This method enabled us to quantify the Mean Angular Error between photogrammetry-derived normals and those corrected through RTI. We also compare the photogrammetry mesh against the original calibration board mesh to assess height differences.

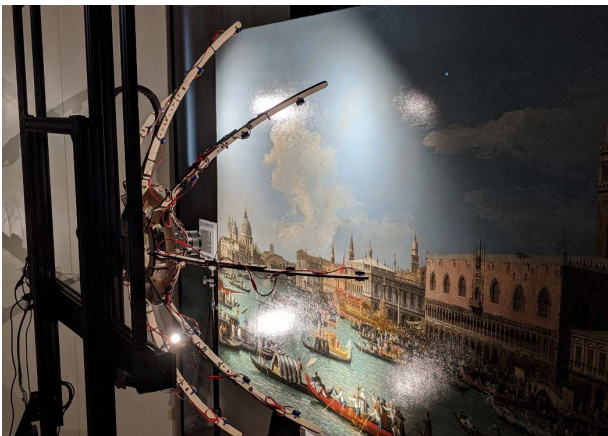


Figure 4: The painting during capture of photogrammetry set using quad-LED lighting.

For accurate colour reproduction, we implemented target-based colour correction using the widely

adopted Calibrite ColorChecker Passport. A laser distance meter, positioned on both side axes, ensured the camera's distance from the painting and maintained precise perpendicular alignment between the camera's axis and the painting. RTI calibration for light positions used a black billiard ball reference and was calculated pre-capture. Camera parameters, including distance to the object, focal length, F-Stop, and ISO, remained constant throughout the acquisition.

Owing to the painting's extensive size, recording its entire surface required six different sections. The capturing process was automatic, producing images with consistent overlaps. Two large sets of photographs were generated: one for photogrammetry, captured under quad-LED lighting for diffuse, even illumination, and another for RTI, consisting of several subsets of 24 images each under varying illumination angles. Each RTI set included an additional 'link image' shot with quad-LED lighting, incorporated into the photogrammetry set to allow registration and alignment of RTI normal maps (Figure 5). Additionally, a 24-image set was captured using a white board for flat field correction.

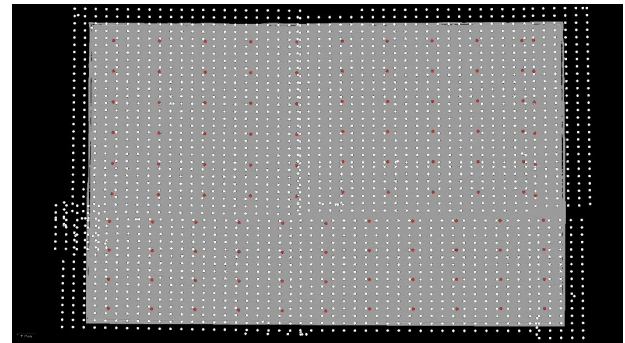


Figure 5: Camera positions for photogrammetry set (2,417 images shown as white dots) and RTI link images (110 images shown as red dots).

5.2 Processing

Photogrammetry raw image files were colour calibrated in linear tone curve against a ColourChecker Passport and were exported as 16-bit TIFF files. The RTI image sets were flat field corrected to compensate for light fall off. Due to software constraints, JPEG was the chosen format for exporting these images for normal map recovery in Relight software (CNR-ISTI VCLab 2024), and we used the hemispherical harmonics (HSH) method with a 12 coefficient setting for normal vector extraction. While we tested alternative methods, including the robust photometric stereo approach with Robust Principal Component Analysis (RPCA) as implemented by Matsushita (2019), designed to better manage outliers like specular highlights and cast shadows, we found their significantly longer processing times impractical for handling our

extensive datasets. Finally, the link images were colour calibrated and exported as 16-bit TIFF files.

In Agisoft Metashape, we processed the photogrammetry image set, including the RTI link images. A total of 2417 images were aligned with an ultra-high-quality setting, and the resulting sparse cloud was filtered to remove reprojection errors larger than 0.3 pixels. Post camera optimisation, we produced a dense point cloud with 2,995,875,369 points, exhibiting a reprojection error of 0.241 pixels (Figure 6).

To generate the colour and normal map orthomosaic, we first created a mesh with an extremely high polygon count; in this case, a mesh with 150 million faces was produced. This large mesh served a dual purpose: as a surface method for orthomosaic generation and for exporting the normal maps that would correct the low-frequency components from normal maps obtained through RTI.

The colour orthomosaic was produced using all images, utilising the mesh as a surface and selecting the mosaic blending mode as parameters. The process for correcting and blending the normal maps prior to generating the high-resolution normal map orthomosaic is detailed below.

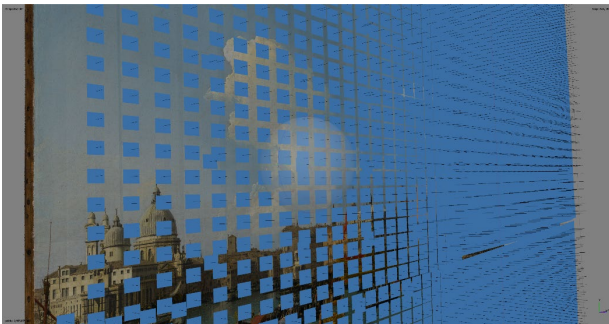


Figure 6: Dense point cloud with camera positions.

5.2.1 Correction and Blending of Normal Maps

Initially, we exported the normal maps from the high polygon mesh for each RTI link image using Agisoft's Render Depth Maps option, selecting solely the normal map option (Figure 8). A custom Python script was then employed to correct the low-frequency distortions from the RTI-generated normal maps using the exported mesh normal maps. This script processes pairs of normal maps, applying Gaussian blur to extract and subsequently blend the low-frequency content of both maps (Figure 9).

Firstly, pixel values were normalized to a range of [-1, 1], diverging from standard image processing practices that typically scale values between 0 and 1. This approach, standard in normal map processing, facilitates accurate representation of 3D vector directions. The script also incorporates a

vector normalization step, ensuring each vector in the normal map maintains unit length, crucial for accurately depicting surface orientations in 3D space. Following this, a Gaussian blur is applied to both sets of maps, effectively isolating their respective low-frequency components. These components are then merged through linear interpolation, according to the formula:

$$\text{Blended} = \alpha \times \text{less detailed low freq} + (1-\alpha) \times \text{detailed low freq}$$

where α is the blending factor, adjustable between 0 and 1. This equation enables a seamless integration of the low-frequency data from the less detailed map into the detailed map, with the extent of blending dependent on the value of α . In scenarios where α is set to 1, the script ensures that the low-frequency content from the less detailed map completely supersedes that of the detailed map. The script systematically applies these operations to each corresponding pair of detailed (RTI normals) and less detailed maps (mesh normals) and saves the corrected maps in a designated output directory.

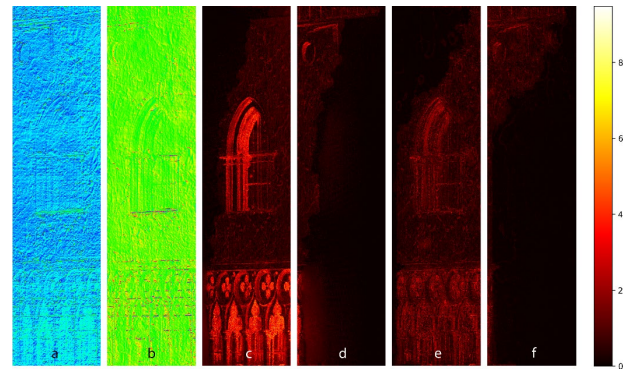


Figure 7: HSV visualisations of surface normal directions and angular difference heatmaps. HSV images (a pre-correction, b post-correction) show shifts in normal orientations, with hue changes from blue (horizontal) to green (vertical), indicating adjustments to more vertical orientations after correcting low-frequency distortions.

Heatmaps (c and d pre-correction, e and f post-correction) display angular differences for a merged overlap section, scaled by global min and max values for consistent angle change visualisation.

After correcting the normal maps, the colour link images in Agisoft software are replaced with the corrected normal maps. Because the naming, size, and bit depth of the images are maintained, the software processes the new link images without issues. The normal map orthomosaic is finally generated using only the new link normal map images. We use the same mosaic blending mode used for the colour images. According to Metashape's user manual (Agisoft LLC 2024), mosaic blending uses a dual-step approach to seamlessly combine overlapping images, blending the low-frequency components to mitigate seam

lines through a weighted average, where the weight is influenced by several factors, including the pixel's proximity to the centre of its image, while the high frequency component is selected from among the overlapping images based on quality. Although the specific algorithms behind the software are not fully disclosed, the mosaic blending mode seems advantageous for our purposes. Its approach to handling different frequency components aligns well with our method for correcting normal maps, suggesting it effectively addresses the challenges we aim to overcome.

The effectiveness of our correction process was quantitatively assessed through comparisons that revealed Mean Angular Errors (MAE) of 0.95 and 0.26 degrees for left vs. merged and right vs. merged normal maps, respectively, before correction of normal maps. Post-correction, the MAEs were reduced to 0.62 and 0.17 degrees (Fig 7). This significant reduction in MAE after applying our correction methodology, demonstrates the effectiveness of our approach. However, the remaining small errors primarily concentrate in areas of high frequency detail within the images. This phenomenon can potentially be attributed to the way Agisoft's mosaic blending mode handles the merging of high frequency detail.

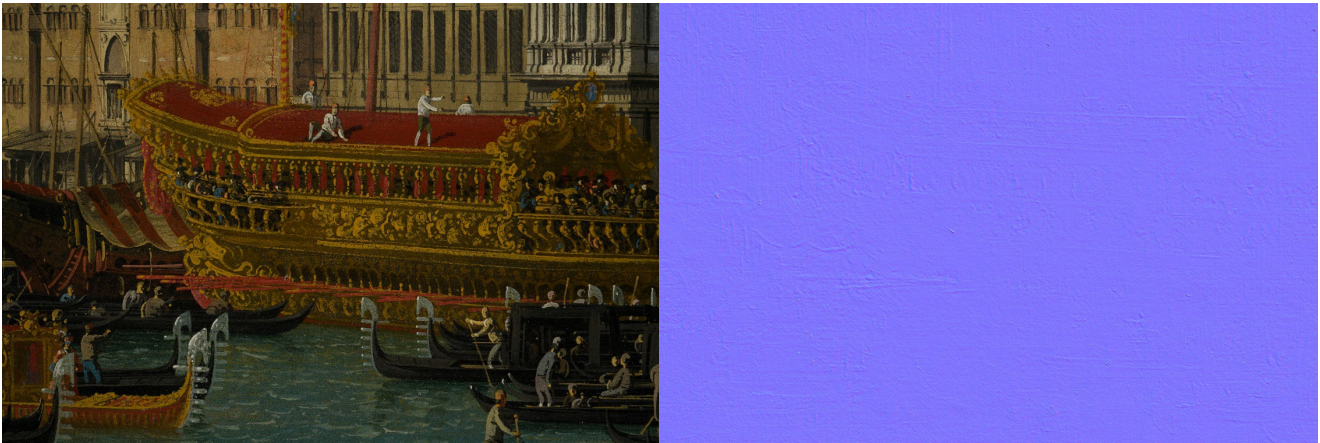


Figure 8: Colour 'link image' and its correspondent normal map exported from the high-polygonal mesh.

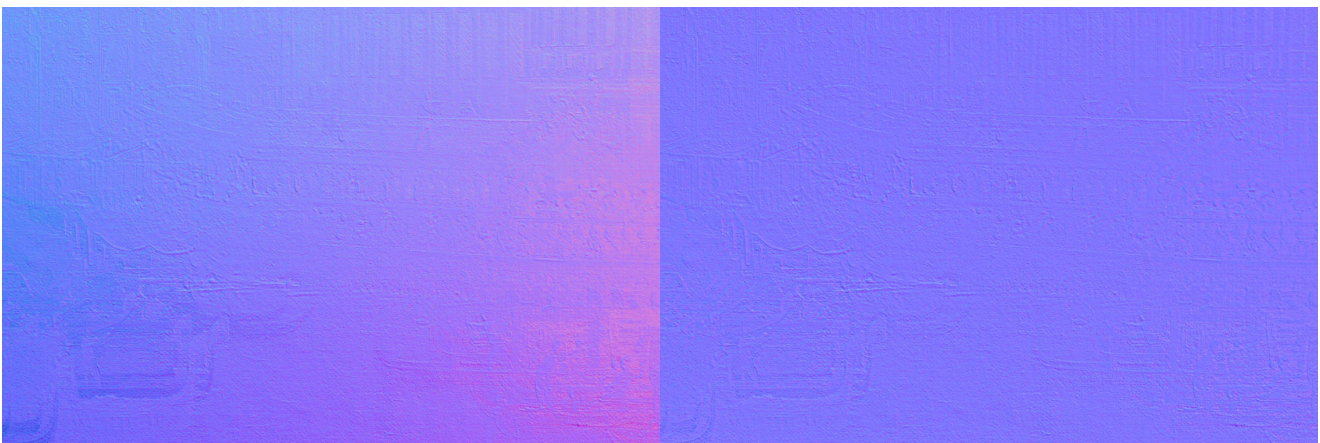


Figure 9: RTI normal map before and after correction of low frequency component.



Figure 10: Resulting colour and normal map details of the painting (10cm²).

6. RESULTS AND CONCLUSIONS

Our methodology yielded two high-resolution images, each measuring 69,386 x 44,290 pixels, with a Ground Sample Distance (GSD) of 0.0277 mm/pixel. This equates to an approximate resolution of 917 DPI. Crucially, both colour and normal data are perfectly registered in these images. However, to further refine our methodology and reduce the small errors observed in high-frequency detail areas, future work will explore the use of milled surfaces with known normals as calibration tools. By testing against these controlled surfaces, we aim to enhance the accuracy of our normal map correction process, potentially leading to even lower Mean Angular Errors.

The resultant dataset offers great insights into Canaletto's artistic techniques, particularly his method of incising and outlining architectural elements in the painting. Shaded renderings (Figure

11), derived from the surface structure information, distinctly reveal the incision lines made while the paint was still wet. These lines were a technique employed by the artist to accentuate architectural details, now made visible through our scanning process. To digitally exhibit the artwork's images, we have utilised an online viewer (V&A Museum 2024) originally developed by Erdmann (2013) for the Bosch research and conservation project. The painting is accessible at The Centre for Print Research (2020). This viewer is equipped with a zoom function, allowing users to examine the artwork's intricate details intimately. Additionally, the viewer offers various modes including singular views in either colour or 3D render, along with interactive features like a curtain mode and a synchronisation function for an enriched, immersive exploration of the artwork. This technological application not only enables a detailed presentation of artworks but also significantly enhances viewer understanding and appreciation by revealing every fine detail previously unseen or inaccessible.



Figure 11: Shaded render of Ducal Palace showing incised lines on architectural elements.

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The Grotesque Hand and Other Stories: Using AI as a creative collaborator

Jon Malis
Loyola University Maryland
Baltimore, MD, USA
jdmalis@loyola.edu

1. INTRODUCTION

As access widens to generative AI technologies, especially text-to-image models such as Dall-E, Midjourney, Stable Diffusion and similar platforms, much has been made about the technology's impact across creative sectors, and how such technologies have the potential to seriously disrupt, if not replace, traditional creative practices.

In my own creative practice and research, I personally view generative AI tools much more as a collaborative studio assistant than I do replacement for the artist's voice. AI has not changed my work, but rather, its tools and processes have expanded my overarching themes of visualizing 'the unseen hand' of digital tools within photographic imagemaking practices. My creative practice is centred in asking the question: "if I take a photograph and remove the content, what are the (digital) structures left behind that define its existence as an image" – such notions as pixel, colour, resolution, base sensor noise, and other defining characteristics of digital images. In expanding this research question into commonly used image editing tools and processes, Photoshop becomes an integral link in the digital photography chain.

My two most recent projects – *Low Five* and *Automatic Photoshop Paintings* – use AI not as the endpoint, but as a creative intermediary designed to illustrate some of the many ghosts in the machine: *Low Five* as an autocritique of AI's ability to render human forms – especially hands – and *Automatic Photoshop Paintings* utilises inbuilt, AI-trained algorithms commonly used in image resizing to illustrate the tool's ability to distort content.

2. AI AS A FLAWED ASSISTANT: LOW FIVE

First installed in summer 2023, *Low Five* illustrates unintended surreality in AI – the subtle flaws and errors it imparts into photorealistic reproduction that create an uncanny valley of representation. As an installation, the artwork resolves into a wall of AI-generated sculptures of human hands, outstretched as if awaiting a high five.

Through a collection of hauntingly surreal images, the series unveils AI-generated hands with missing fingers and subtle deformities, serving as a poignant critique of the inherent limitations that persist in our quest for algorithmic flawlessness. (Malis & OpenAI 2023)



Figure 1: *Low Five* (2023). Installation @ Julio Fine Arts Gallery, Baltimore, MD, USA

Using Adobe Photoshop's Generative Fill tool, I asked Photoshop to create a series of images responding to the prompt: "an outstretched hand, as if waiting for a high five, against a neutral background". As digitally generated photographs, these resulting images held power in their flawed representations of the human form, but from my standpoint as the artist, proved to be too referential to themselves and their genesis without providing space for the viewer to discover the digitally induced deformities for themselves. Rather, by subsequently tracing these photographs into silhouetted forms, and then laser cutting these shapes, the deformities were preserved alongside the recognizable anatomy of the hand, but without the photorealistic referent. This abstraction allowed for the viewer to discover the anatomical errors for themselves. Not wanting to lose all references to photography, the finished sculptures were painted in 18% grey – the photographic ideal reflectance (Eastman Kodak 2021) and were installed in a chaotic fashion to mirror public perceptions and discourse of Generative AI technologies at the time the work was made.

Installed in a University gallery context, I was honestly surprised at how many visitors who viewed the exhibition did not notice the flaws in the hands: they simply thought the exhibition was playing into a post-COVID want for human connection, overlooking the anatomical flaws to satisfy their alternate reads of the work.

3. AI'S DESIRE FOR PATTERNS AMID CHAOS: AUTOMATIC PHOTOSHOP PAINTINGS

An ongoing body of work, *Automatic Photoshop Paintings* highlight the ways pixels change shape, structure, and colour as AI algorithms interpret and restructure images to fit the demands of different viewing platforms.

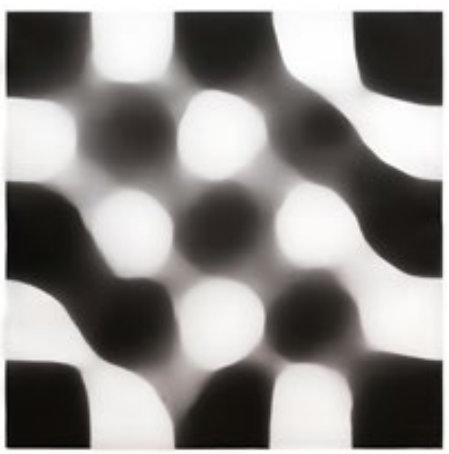


Figure 2: 5x5 Checkerboard, Preserve Details 2.0 (50% reduced noise). 36" x 36" Digital Inkjet Print on Canvas, 2023.

Beginning their life as microscopic grids or geometric patterns of individual pixels, these works rely on the AI-powered image resizing algorithms built into Photoshop's core functionality to iteratively grow and morph pixels from discrete dots of information into nebulous and almost-organic shapes, waves, and rhythms of tone and colour. Traditionally used throughout the image-processing pipeline and 'trained' on a wide range of photographic content, the comparatively controlled environment of monochromatic grids and simple patterns brings the usually transparent algorithms into focus, demonstrating that the fundamental tools that photographers and digital artists rely on are more nuanced than many believe them to be. While not all image resizing algorithms rely on AI models, Adobe's use of AI in the development of new models provides a unique opportunity to investigate how our quests of 'photorealistic perfection' often fall short when interfacing with digital machine-learning technologies.

4. CONCLUSION:

As the development of these projects remains ongoing, I find it hard to define concrete takeaways of how audiences view the role of AI in my work. Early conversations and exhibitions of these works seem to illustrate that viewers initially tend to look past the inherent flaws introduced by generative AI within the work, rather relying on their own experiences and understandings of their innate humanness in seeking connections in interpreting these works.

Ultimately, while my work could not have been created without AI, it also could not have been solely created by AI; AI has become an intrinsic creative collaborator – a modern-age studio assistant – within my practice. Much as Delaroche exclaimed that "Painting is Dead" (Quennell 1972) upon the birth of photography, my work demonstrates the necessity of the conscious artist's voice in light of Generative AI's technical revolution.

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The Role of “Accidents” in My Digital Art

Stuart Smith
Departments of Music and Computer Science
University of Massachusetts Lowell
Lowell, MA 01854, United States
stu@cs.uml.edu

1. INTRODUCTION

Painter Francis Bacon’s characterization of the role of “accidents” in his art will likely sound familiar to digital artists who see their own practice as a form of painting. This paper briefly outlines Bacon’s view of accidents in painting and shows how it applies to my own work.

2. BACON’S APPROACH TO ACCIDENTS

Speaking about his art, Bacon stated that “I want a very ordered image, but I want it to come about by chance.” The word “chance” is doing a lot of work here. One would like to know *how* chance could produce Bacon’s unquestionably “very ordered” images.

I think the explanation can be found in another of Bacon’s observations: “All painting is an accident. But it’s also not an accident, because one must select what part of the accident one chooses to preserve.” This immediately brings the artist back into the picture in a key role: selecting from whatever may occur when, as Bacon expresses it, he or she “splashes the stuff down” on the canvas. All of the artist’s knowledge, experience, and skill come into play in making such selections.

3. ANALOGY TO BACON’S APPROACH

Where Bacon the painter is looking for unpredictable effects due to the peculiarities of specific brushes, paints, canvas, and manual gestures, the “accidents” in digital art are generally based on a digital source of uncertainty, typically a random number generator. The output of a random number generator can be used to generate “accidents” in several different ways, among which are

- (i) creating random images of different kinds (e.g., Figure 1)

- (ii) randomly modifying some aspect of an image, e.g., color, geometry, texture, etc. (e.g., Figures 2-6)
- (iii) randomly selecting which of several deterministic processes will be used to modify an image.

In my own work, I mostly use the first and second approaches. I’ve written an app that has 24 algorithms for generating random images and 56 functions for modifying images. Each of the algorithms and functions takes one or more random inputs, which provide the opportunity for accidents in the sense that the exact nature of the output images they produce cannot be known in advance. As with Bacon’s approach, the selection of what is to be preserved in an image is up to me. Such images thus have the same dual nature as Bacon’s accident-that-isn’t-an-accident images.

Figures 1-6 illustrate the cumulative effect of transformations of an initial image. Each transformation alters the image in a partly unpredictable (i.e., accidental) way. Note that the fourth transformation did not produce any interesting new accidents. At this point I could have backtracked to the third transformation and continued working from there, but I decided to see if a different transformation could rescue the image. The result was Figure 6.

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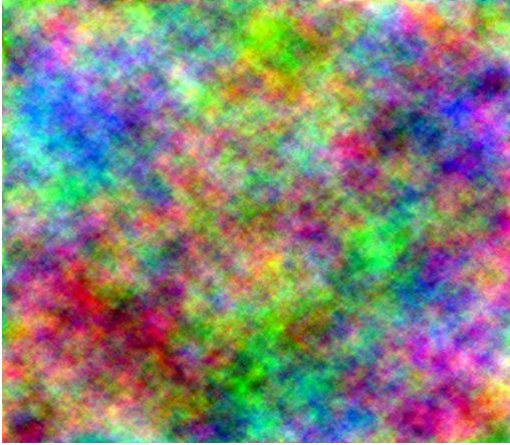


Figure 1: Colored perlin noise

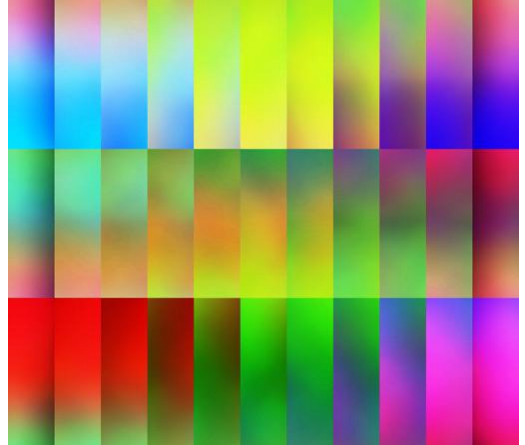


Figure 2: First transformation

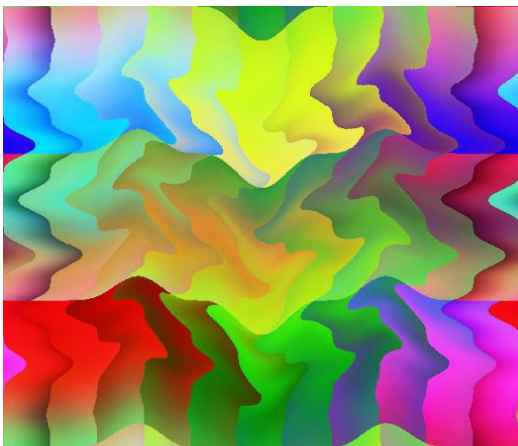


Figure 3: Second transformation



Figure 4: Third transformation



Figure 5: Fourth transformation



Figure 6: Final transformation + recoloring

Eve 3.0: Stories of our extreme selves

Margherita Bergamo Meneghini
Université Paris 8
Paris, France
margherita@compagnievoix.com

John Desnoyers-Stewart
Simon Fraser University
Surrey, BC, Canada
desnoyer@sfu.ca

Daniel González-Franco
Omnipresenz
Barcelona, Spain
daniel@omnipresenz.com

Veronica Boniotti
Seesaw Project
Riva del Garda, Italy
seesawcompany@gmail.com

Eve 3.0 is a participatory contemporary dance performance that pushes the boundaries of Virtual Reality (VR). This cutting-edge layered performance unfolds through the integration of physical interaction with a live performer, stereoscopic 360 video, interactive motion-captured dance, and ends with mixed reality passthrough where the participants dance freely. A dancer brings the audience into the embodied stories of 6 characters affected by addiction, anxiety, depression, obsession, jealousy, and paranoia. Each story is told simultaneously through 6 VR headsets. The performer's dance facilitates the tactile and embodied experience, producing a multi-layered performance across virtual and physical. Audience members are encouraged to express themselves through movement becoming co-creators of a rich multisensory aesthetic and affective experience. Moments of physical interaction with characters in the stereoscopic video coincide with the dancer's tactile interactions. This immersive interactive performance invites participants to experience the unseen challenges of the embodied mind revealed through dance. *Eve 3.0* presents an innovative form of participatory artistic expression that promotes a positive vision for immersive technology to facilitate empathy and self-expression through co-present physical interaction between moving bodies.

Virtual reality. Immersive performance. Interactive performance. Touch. Dance. 360 video.



Figure 1: Performance of *Eve 3.0* at PAN Festival 2023 in Riva del Garda, Italy. Photo ©2023 PAN Festival. Visit <https://compagnievoix.com/en/projects/creation/eve-3> for trailers and more information.

1. INTRODUCTION

Eve 3.0 is an interactive immersive experience that pushes the limits of current virtual reality (VR) technology and encourages participants to reflect on the unseen challenges that shape our experience. Six stories are told synchronously through the VR headsets. The immersive experience features stereoscopic video, motion-capture, synchronized real-time visual effects, and performer-facilitated and mixed reality modulated through sound and movement. *Eve 3.0* is inspired by a long line of experimentation with interactive live performance. We build upon BeAnotherLab's multisensory installation "The machine to be another" (2012), Rhizomatiks' participatory performance "Border" (2015), and Jeffery Shaw's immersive approach to expanded sounds and visuals in pieces such as "PLACE – Turkey" (2010). Growing from these inspirations integrate choreographic language, audience participation, and immersive technology to produce an interactive performance across several layered realities.

2. AN INNOVATIVE IMMERSIVE PERFORMANCE

This immersive performance presents the hidden challenges that affect many far more than we might realize. The goal is that those who experience the performance come away with a renewed empathy for themselves and those around them as expressed through collective movement. The project supports nonverbal communication and expression (Martin-Juchat 2020) invoking the mediating role of dance in somatic education (Homann 2010). Dance is gradually brought in through the performer's physical body, then the virtual bodies, and finally manifests through the participants' bodily expressions and empathy with their character's emotions (Fuchs 2014).

Embodied emotional expression is a fundamental element of the conscious awareness we have of our own body. It is vital to our capacity to communicate with others and understand ourselves. The body in motion materializes our psychological experience (Fuchs 2010). The lived experience of the body, its emotions and physical movements, and the social context are all deeply intertwined, mutually influencing one another (Di Petta 2020). The body's movement in dance can thus create metaphorical visions and open paths to understand diverse lived experiences. Immersive and interactive technology providing tools that augment, guide, and encourage participants' movements. This technology guides the experience from both proprioceptive and social points of view.

2.1 Eve—a gateway across layered realities

In *Eve 3.0*, the protagonist, Eve, becomes the mediator between the real and the virtual, providing

a narrative anchor. She ties the dramaturgical line as the experience moves from realistic recordings to abstract interactive images, to mixed reality that gives the participant full control as they return to the real world while still wearing the VR headset.



Figure 2: Six dances were motion captured representing six different characters. Photos © 2020 Audrey Planchet.

Eve meets six characters affected by different mental disorders. Fiona: anxiety, Desirée: addiction, Meredith: depression, Amir: paranoia, Lohan: obsession, Jonas: jealousy. Each character's lived experience of their condition and how it evolved from childhood through adulthood is shared through a narration of their diary. Their emotions are simultaneously expressed through dance. Participants are invited to reflect on the complex experiences behind each character's struggles.

2.2 6+1 synchronous narratives

The main character, Eve, is thus in seven places simultaneously: in the physical space shared with the general audience, and in the six virtual stories with the VR participants. Each participant has a different overlapping experience. These narratives are also observed externally, forming a seventh perspective for the audience: a meta-narrative of those characters whose stories overlap fused with the emergent choreography that arises between guided performance and self-expression.

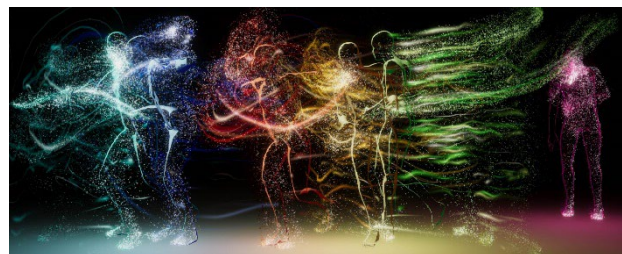


Figure 3: The six characters' internal monologues visual representations. Teal: Desirée, Yellow: Lohan, Magenta: Fiona, Red: Amir, Blue: Meredith, Green: Jonas.

2.3 Layered roles and 3 modes of participation

Throughout the performance there are different roles adopted by the audience. For clarity we refer to the live performer as the dancer. Character always refers to virtual characters seen in the VR

headset. The audience can take 3 different roles: Travellers, Performers, and Observers.

Travellers wear a VR headset and are fully immersed in the embodied story. The virtual journey takes place through the character of Eve, a gateway body who allows you to travel through time, space, and into the soul of another person, embodying moments of their life through their diary.

Performers enter the experience near the end/ This role helps the Travellers on their virtual journey by providing a tactile body that aligns with the virtual avatar, making physical contact and following the movements of the Traveller.

Observers watch the performance, witnessing the Travellers' and Performers' interaction and the interwoven narratives guided by the dancer. This role experiences all the stories told by Eve from a different perspective. Two projections show what is seen by the Travellers along with abstract visuals.



Figure 4: *Eve 3.0 progresses from 360° video (left) to motion-captured dances rendered in real-time (centre) ending with responsive passthrough visuals (right).*

2.4 Multi-modal mixed reality performance

Within the headset, *Eve 3.0* delivers an experience across multiple modalities. As shown in Figure 4, beginning with stereoscopic video, *Eve 3.0* progresses from realistic visuals towards the abstract while the experience moves from fiction to physical reality. *Eve 3.0* begins with stereoscopic video that requires Travellers to move along with their character, limiting their agency and requiring them to directly follow the choreography. While the visuals are highly realistic, they are the most removed from the Travellers' physical reality. This progresses to real-time stylized graphics that respond in part to the Travellers' movements. Despite being more visually abstract, this part of the experience is modelled after their actual bodily movement. Finally, in the last stage, passthrough cameras are used to produce visuals based on the real physical surroundings responding directly to the Travellers' movement and encouraging them to dance. The visuals are the most abstract, yet most directly rooted in reality. In this way, participants simultaneously move from being carefully guided through choreographed movements in virtual reality towards free and open expression in mixed reality.

2.5 Performer facilitated embodiment

Participants' embodiment in the immersive experience is facilitated through physical interaction with the performer. This technique was first used in *Eve: dance is an unplaceable place* (Bergamo Meneghini 2019) which *Eve 3.0* evolved from. The dancer coordinates her interactions by dancing to the music in a carefully timed choreography as seen in Figure 5. This multi-sensory alignment immerses participants in the reality of the narrative experience (Desnoyers-Stewart et al. 2024).



Figure 5: *The dancer kneels in sync with the virtual character. Following the music, she touches the immersant's hand in time with the visuals.*

2.6 Reality capture and synthesis technology

Hybrid 360° Video. *Eve 3.0* integrates a variety of technology to capture and create the alternate reality presented in the VR headset. We used a combination of a 180° stereoscopic camera with a 180° monoscopic rear camera to capture the depth of the characters while focusing attention and eliminating typical 360° stereoscopic artefacts.



Figure 6: *Left: Dancers on the set of 360 filming in Laval, France. © 2022 Pietro Lepore. Right: Motion capture of the hug interaction. Photo © 2020 Audrey Planchet.*

One-Shot Motion Capture. Perception Neuron 2.0 was used to motion capture six 8-minute dance sequences that correspond to each character's choreography. The performances were cleaned up in Axis Studio and Blender. They were then incorporated into the performance to produce real-time visual effects in Unity. The visual effects' aesthetics disguise imperfections in the motion capture, making these one-shot recordings with simple hardware and minimal cleanup possible.

Immersive Environments from Traditional Media. Watercolour artist Amira-Sade Moodie and graphic designer Kirstin Huber produced six icons representing each character. The paintings were digitally scanned and edited in Photoshop to produce the icons seen in Figure 7. These icons were used directly in each diary as shown in Figure 4. The icons were also used to create the immersive environments for the CG segment. VR participants enter the imagined space of the diary, going from seeing the icon on the page to being surrounded by it. The original painting is shown next to the resulting environment in Figure 8.



Figure 7: Watercolour icons. From top-left to bottom-right: Fiona, Lohan, Desiree, Amir, Meredith, Jonas.



Figure 8: Watercolour painting and resulting scene. Watercolour image ©2021 Amira-Sade Moodie.

To transform watercolour paintings into immersive spaces required a series of transformations applied to each icon as seen in Figure 9. The icon was rounded to create the shape of the virtual stage and inverted to better suit the dark aesthetics of the virtual experience. The original colour scheme was reproduced by rotating the inverted hues 180°. The image was then recoloured to suit the aesthetics of the virtual space. For example, colour was added to Meredith and Jonas which had substantial areas of white that would have been distracting. To create the overhead environment the image is converted from polar to equirectangular coordinates. Finally, those equirectangular images are separated into layers based on the colours. Those layers are then overlaid onto different size skyboxes, creating a sense of depth through parallax.

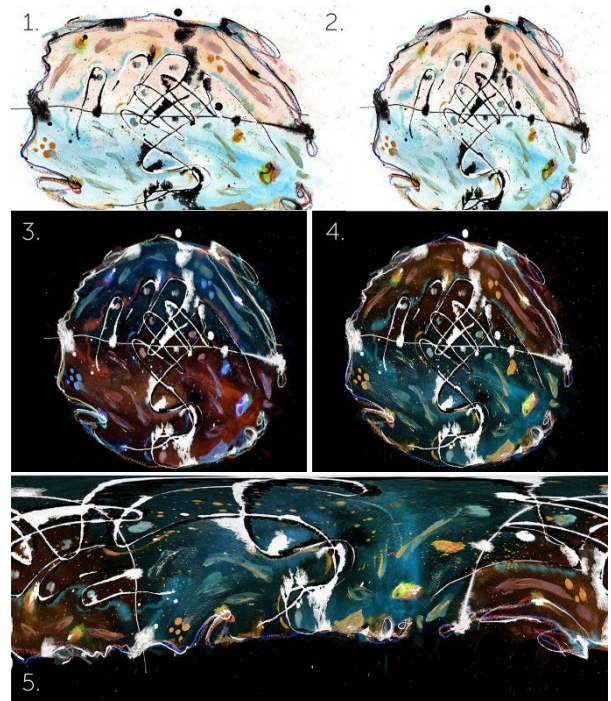


Figure 9: Converting original watercolours into VR environments. 1. Original; 2. Rounded; 3. Inverted; 4. 180° hue correction; 5. polar to equirectangular.

Visual Effect Design. The characters in the motion-captured segment are generated using Unity 2021's VFX Graph and Shader Graph. They use the character's colour scheme to produce a neon-digital, ethereal particles and outlines to help them stand out in front of the watercolour background. The visual effects evolve over the course of the performance. Initially, they create a dust-like trail that fades over time, accentuating the poses that the dancer moves through. Along with the narrative development, the trails begin to follow the dancer in space, reinforcing expressive movements. These are also projected onto the stage floor, referring to the characters changing over time. They paint a new image as they learn to adapt and face the challenges from their childhood integrating their past and present selves into an evolving painting.



Figure 10: The 6 CG characters each in an environment generated from watercolour imagery. Top-left to bottom right: Fiona, Lohan, Desiree, Amir, Meredith, Jonas.

VR Headset. This performance was designed specifically for Meta Quest 2. This headset incorporated hand tracking and passthrough into a low-cost portable package that facilitated free participant movement. The hand tracking provided seamless interaction while the passthrough cameras immersed participants in another view of their own reality allowing them to dance freely in front of an audience.

Synchronization. Open Sound Control (OSC) is used to synchronize the six headsets, soundtrack, and video projections. A PC-based controller broadcasts its timestamp and clock time on a Local Area Network (LAN). Each VR headset aligns its timeline to the PC and responds with the time received. The round-trip time is used to synchronize the clocks, synchronizing within approximately 10 milliseconds of the PC. The headsets each transmit their position relative to key moments and can be recalibrated by pressing a button on the PC. The PC controller is used to play 1 or 2 projections and plays the music and some audio. Each character's audio is played locally on the headset allowing for six different stories to be heard simultaneously. An Android phone-based controller can also be used to synchronize and play music only when projections are not needed.

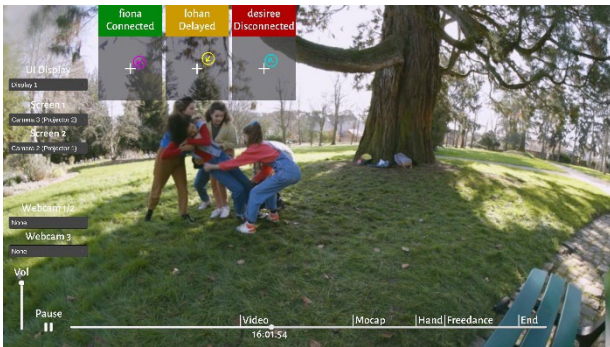


Figure 11: PC Interface. Left: display and webcam controls. Top: network connectivity indicators show participant alignment. Bottom: timeline controls.

3. PERFORMANCE STRUCTURE

Each narrative begins with finding the diary of a character facing extreme states of consciousness: addiction, anxiety, depression, obsession, jealousy, and paranoia. The performance unfolds through physical interaction with a live performer, an interactive motion captured dance, and progresses towards ending with the participants dancing freely.

3.1 Scenography

Eve 3.0 takes place in an open exhibition space or theatre with up to one hundred spectators. In the performance space, six chairs, equipped with six VR headsets, are arranged in a circle. The six chairs are the starting point for the virtual experiences: the life

stories of six characters affected by different extreme states of consciousness. Screens around the space relay some of what the participants see in VR to the general audience. The six VR experiences, which focus on the stories of six characters, together form a unified work. Participants are encouraged to stand up, move, and ultimately participate freely in this shared choreography.

3.2 Prelude

In some performances, the dancer begins with a short prelude wearing headsets with the passthrough enabled. This is done to lead the audience to the performance space and attract attention either in open public spaces or in the lobby. For example, at Recto VRso 2023, the prelude began with two dancers performing in front of a large projection outside the exit of the Laval Virtual awards ceremony as seen in Figure 12.



Figure 12: Dancers perform wearing headsets in front of a projection of their view. Photo © 2023 Audrey Planchet.

3.3 Opening

A single dancer begins the performance with a contemporary solo dance, setting the stage for the performance. The dancer rearranges the chairs into a cohesive circle, dragging, carrying, and sliding them through careful movements—laying across them, dancing around them. The projections display text and video that abstractly introduce the characters and their challenges punctuated by recordings of the watercolour painting process that created the icons for each character.



Figure 13: The dancer carries diaries in front of watercolour projections. Photo © 2022 Julia Gaes.

3.4 Entering VR

The dancer looks for six spectators in the audience to be invited to sit on the chairs and put on the headsets. These six Travellers join in a shared choreography where the dancer moves around them and interacts through touch at specific moments. Touch and performance in front of an audience requires a careful process of consent. Participants are informed of the performance structure and only invited if they express a clear and enthusiastic desire to participate.



Figure 14: Dancer selecting a participant from the crowd. Photo © 2022 Élise Boileau.

3.5 Dear Diary

The immersive portion of the experience begins with a live-action 360° video titled “Dear Diary.” The participants each find the diary of a different character, hearing an excerpt from their character’s childhood as they hold on to the diary. Children playing in front of the participant interact and dance with them. The children tease the main character as they throw around their diary and laugh.



Figure 15: Dancer fans participants as the 360 video appears in front of them. Photo © 2023 Audrey Planchet.

The stereoscopic video includes moments of physical interaction with characters in the film that coincide with the dancer’s real physical interactions. Moments of touch include being touched on the shoulder, having the diary ripped from their hands, being helped to stand up from a chair as seen in Figure 16 and more. See Desnoyers-Stewart et al.

(2024) for a study of the effects of these moments of touch. For each active Traveller participant, these physical interactions coincide with a moment in their VR experience. Meanwhile, for the Observers, the Travellers become part of the performance.

The dancer interacts with each participant one after another in a round. This produces a layered dance where the audience can vicariously experience the immersive performance through these reinforced moments of touch. Despite being simple actions, their rapid repetition combined with additional motifs demonstrates the incredible skill and timing of the dancer, deeply engaging the entire audience. Between these key moments, the dancer performs elements of the choreography that are seen inside the headset as shown in Figure 17. Projections show two characters’ point of view in the 360° video allowing the audience to understand its’ connection to the physical performance.



Figure 16: The participant sees a character help them out of their chair at the exact same moment in the video.

3.6 Untold stories expressed in dance

The diaries are the guiding elements to reveal the intimate stories of each character. The main character holds their diary up to the participant in the 360° video revealing an icon. The icon comes to life as particles emerge from it and forms a silhouette in front of the participant. Participants are transported within the diary as the imagery from the icon fades into view surrounding them.



Figure 17: Dancer performing motifs from each character, connecting the virtual and physical performances. Photo © 2023 Damian Kirzner.

This following segment is a 6-degree of freedom real-time CG experience where Travellers see their avatar and can dance with a silhouette of light representing the aura of the character expressing their struggles. A monologue is heard as the motion-captured dance unfolds through the silhouette and particle system as seen in Figure 18. The Travellers dance in response to the silhouette, some following the motion-captured dance, while others move in their own ways. Their own bodies are represented with traces and particles emitted as they move. The Travellers take on more agency, forming part of the generative performance that evolves outside the headset for the Observers.



Figure 18: Lohan's silhouette dancing as seen in VR.

3.7 Dancing with a stranger

As the individual motion-captured dances end, the silhouette walks towards a predefined point and raises their hands. The dancer goes into the crowd to gather six Performer participants bringing the total on stage to twelve. The Performers stand in line with the position of the silhouette with their hands out. As the Travellers wearing VR headsets reach out, they contact the Performers' hands, bringing the silhouette to life through touch. The Traveller wearing the headset follows the silhouette's movements, unknowingly leading the Performer in dance through their hands.



Figure 19: "Travellers" wearing a VR headset dance with "Performer" participants. Photo © 2023 Audrey Planchet.

3.8 Hugging to return to reality

As the dance ends, the silhouette guides the two participants to hug. The virtual environment fades, and the physical world is revealed through the passthrough cameras. Stepping back from the hug, the Traveller sees the Performer they danced with fade into view in place of the silhouette.



Figure 20: The hug at Tanzahoi 2022. The visuals can be seen in the background. Photo ©2022 Julia Gaes.

3.9 Freely dancing together

The last segment allows the six Travellers to see each other, and their surroundings brought to life through music where they can dance and move together. Their hands continue to produce streamers and particles, encouraging movement. The Travellers wearing the VR headset are then asked to share their headsets with the Performer in front of them. The stage is transformed into a playground for improvised dance as Observers are also invited to join. As seen in Figure 21 this creates a unique ending every time.



Figure 21: Free dance at Tanzahoi 2022 (left) and Laval Virtual 2023 (right). Photo © 2022 Julia Gaes.

3.10 Finale

All participants are then invited to form a circle and sit. The dancer performs a final choreographic message referring to acts of sharing and helping. Some watch in mixed reality while others watch directly. The passthrough visuals continue to respond to the music in the headsets and in the projections as the performance draws to a close.



Figure 22: Participants sit in a circle watching the finale. Several remain in VR watching through sound-modulated passthrough visuals. Photo © 2023 Audrey Planchet.

4. INSTALLATION MODE

Eve 3.0 also has an installation mode as seen in Figure 23. In this version, each participant sees the same story so that the moments of touch to be synchronized are in line with the visuals in the projection. This allows volunteers to facilitate the experience for more participants in smaller venues with little training. No dance is performed outside VR, but participants are nonetheless encouraged to perform as they become immersed in the story. Onlookers are also invited to participate by standing in as Performers when possible.



Figure 23: Installation at Recto VRso 2023. Participants pick up a diary seen in VR. facilitators prepare to enact moments of touch. Photo © 2023 Recto VRso

5. PERFORMANCES AND OBSERVATIONS

Since 2022, *Eve 3.0* has been performed across Europe 18 times, including Laval, Hamburg, Rabat, Riva del Garda, Bologna, Leiden and Paris. We have solicited audience feedback after every performance and incorporated improvements to the choreographic language, audience participation and application of immersive technology. The observations collected continue to contribute to the evolution of the piece as the performance tours and a thorough qualitative analysis of participants' feedback is forthcoming.

Overall, we see considerable excitement and curiosity surrounding participants' experiences. Most issues faced by participants are related to the technical challenges typical of such an innovative narrative format with little prior experience to build from. We observe that participants' embodied experience of a kinaesthetic experience helps in identifying with the characters and becoming involved emotionally. While some remain aware of their surroundings, *Eve 3.0* immerses most participants in another reality, encouraging lively performances in front of an audience. As demonstrated by Desnoyers-Stewart et al. (2024) the combination of rich tactile, visual, and narrative experiences in *Eve 3.0* leads to a deeply embodied and immersive experience.

In all, *Eve 3.0* presents a new way to evoke rich embodied storytelling by layering different technologies and realities into a multimodal experience. By integrating performer-facilitated touch with high-definition stereoscopic video and real-time CG we can encourage self-expression and share embodied narratives through mixed reality. We hope this performance inspires others to push the boundaries of virtual and mixed reality, seeking new opportunities for participatory performance that reach across realities.

6. ACKNOWLEDGEMENTS

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Bilingual Visual Narratives Design: Exploring the creative process

Cristina Portugal
UNESP/Bauru
São Paulo, Brazil
cristina.portugal@unesp.br

Márcio Guimarães
UFMA
Maranhão, Brazil
marcio.quimaraes@ufma.br

Brendel Norato
UFMA
Maranhão, Brazil
brendel.norato@discente.ufma.br

Dandara Dourado
UFMA
Maranhão, Brazil
dandesenhou@gmail.com

Felipe Alram
UFRJ
Rio de Janeiro, Brazil
felipealram2@gmail.com

This paper presents a study on bilingual digital narratives and outlines the creation of the inaugural story for an innovative transmedia platform proposal. This platform offers bilingual narratives in Brazilian Sign Language (LIBRAS) and Portuguese, designed for both deaf and hearing children. Beyond addressing an educational gap, the project aims to bolster the cultural and educational identity of the Vale do Café region. The hypothesis posits that interactive virtual worlds, merging entertainment and learning, hold significant potential in catering to the diverse needs of deaf children, thereby fostering their social integration. Inclusive design plays a pivotal role in catering to a heterogeneous audience, particularly those with varying communicative abilities. The diverse range of media employed promises an immersive experience, augmenting content comprehension. Through interdisciplinary collaboration and the application of inclusive methodologies, the transmedia platform is poised to effectively address the unique requirements of deaf and hearing children, directly impacting their cultural, educational development, and societal integration.

Design. Technology. Education. Digital narrative. Hearing impairment.

1. INTRODUCTION

This paper outlines the production process of a story within a project proposal aimed at creating a bilingual visual storytelling transmedia platform for deaf and hearing children. The main goal of this initiative is to promote inclusion, bilingual education, and the appreciation of cultural identity, with a focus on the Coffee Valley context in the state of Rio de Janeiro, Brazil. This project is grounded in interdisciplinary research between design and digital humanities. The work carried out by Portugal (2017 to 2023) during the Productivity Research Scholarship – PQ/CNPq period provides a theoretical foundation for the research presented here. Furthermore, the research conducted during the postdoctoral fellowship at the School of Communication at the Royal College of Art (RCA) in London contributes to this article.

The underlying hypothesis argues that the integration of entertainment and education in virtual environments has the potential to comprehensively address the needs of deaf children, contributing significantly to their social integration. The proposed virtual worlds will be designed flexibly, providing both moments of fun and learning, with the simultaneous availability of Brazilian Sign Language (LIBRAS) and Portuguese, thereby facilitating bilingual education. The humanistic approach adopted in the design of the platform ensures its accessibility and inclusion, benefiting not only deaf children but also individuals with different communication abilities. A wide range of media will be used, such as books, short films, digital games, and metaverse, with the aim of providing an immersive and engaging experience for users. The partnership established with institutions such as the State University of São Paulo, the Federal University of Maranhão, with the Royal College of

Art and the Federal Institute of Education, Science, and Technology of Rio de Janeiro (IFRJ), Eng. Paulo de Frontin campus located in the Coffee Valley region, promises to enrich the development and results of the project by bringing global knowledge and perspectives to the initiative. Together, these aspects reinforce the importance and potential positive impact of the transmedia platform on the lives of deaf and hearing children, as well as on society as a whole. The collaboration between professionals from various fields, combined with the application of user – centred design methodologies, will ensure the conception of a transmedia platform that precisely and comprehensively meets the needs of deaf children, thus promoting their inclusion and integration into society. Additionally, the proposal aims to encourage linguistic development and social integration while providing a deeper understanding of the rich history of the Coffee Valley region.

The relevance of this work extends not only to its innovative proposal but also to the exploration of new models and approaches for the development of interactive virtual spaces that represent the history of the Coffee Valley in an engaging and culturally enriching way for deaf and hearing children. The platform, the subject of this study, will take the form of a digital story, standing out as a unique and distinctive entity, and aiming to redefine digital narrative, making the most of the potential of contemporary technologies.

2. THE IMPORTANCE OF DISCUSSING BILINGUAL NARRATIVES FOR DEAF AND HEARING CHILDREN

The projects can be customized to meet the unique needs and expectations of users, while considering cultural values and meanings. Authors such as Anne Burdick *et al.* (2012; 2020), Johanna Drucker (2014), Cristina Portugal (2017; 2023), Márcio Guimarães (2023), among others, advocate for collaboration between design and humanities as an opportunity to design solutions that address contemporary challenges and improve people's quality of life.

Changes in communication are not limited to media and platforms, but also to how we are redefining human languages. We prioritize the relevance of the message for each audience, adapting it to the hypermedia format. Creating purposeful content and making it available according to the medium is more crucial than focusing exclusively on the medium itself. Communication convergence gives us the freedom to choose how and where to consume content. Technological advancement and the democratization of digital media not only transform how we consume information but also offer new possibilities for the creation of interactive narratives,

considering the user experience. This redefines the relationship between user, content, and interactivity provided by hypermedia resources.

Now, it is not only about transferring content to the digital medium, but providing the reader with a new and engaging reading experience and information appropriation. Languages, whether verbal, visual, musical, or mathematical, have the power to evoke not only objects but also scenes, stories, and a series of interconnected events. They allow people to temporarily disconnect from reality, enabling recall, imagination, and simulation of other places, moments, and worlds. This ability is not limited to verbal languages alone but also extends to other forms of language, enriching the possibilities of knowledge construction.

The motivation to initiate this project arose from the team's expertise in the field of inclusive design and education for deaf children, as well as previous experience in similar projects aimed at this audience. When conducting research on story apps for children, we identified a significant gap: although many offered the option of multiple languages, none included Brazilian Sign Language (LIBRAS) as a viable alternative. Expanding our research to apps specifically designed for deaf children, we found very limited results.

In the aforementioned studies, we concluded that bilingual visual narratives play a crucial role in language acquisition for deaf children in several ways:

Multisensory Stimulation:

By combining visual, gestural (in the case of LIBRAS), and, in some cases, auditory elements (through subtitles or audio), bilingual visual narratives provide multisensory stimuli that facilitate the understanding and association of words and concepts.

Visual Contextualization:

Images help contextualize words and concepts in real or imaginary situations, making learning more tangible and meaningful.

Facilitation of Understanding: The presence of visual elements helps clarify the meaning of words and expressions, especially for children who are learning two languages simultaneously.

Reinforcement of Visual Memory:

Children have a natural tendency to associate visual information, which can strengthen the retention of vocabulary and linguistic structures.

Stimulation of Creativity and Imagination:

Images can inspire children's imagination, encouraging them to create their own stories and expand their vocabulary.

Encouragement of Active Participation:

Interactivity in bilingual visual narratives can encourage children to actively engage in the story, promoting language practice.

Promotion of Social Inclusion:

By providing stories in accessible formats for deaf children, bilingual visual narratives promote social inclusion, allowing them to share cultural and linguistic experiences with their hearing peers.

Development of Reading and Writing Skills:

Regular exposure to bilingual visual narratives can contribute to the development of reading and writing skills in both languages, promoting literacy.

Guided by these premises, the choice of setting for the development of the digital book fell on the Coffee Valley region, exploring its historical areas. The Coffee Valley is a region located in the state of Rio de Janeiro, Brazil, known for its historical and cultural significance in coffee production during the 19th century. Encompassing municipalities such as Engenheiro Paulo de Frontin, Vassouras, Valença, and Barra do Piraí, among others, the valley was one of the main hubs of the coffee economy in the country, marked by the expansion of farms and the social and political influence of agrarian elites. Today, it preserves the characteristic architecture and mansions of the time, becoming an important tourist and cultural attraction, reminiscent of the golden age of coffee production in Brazil.

We identified that this would be an excellent opportunity to address citizenship issues in the world of deaf children. During observations at the National Institute of Deaf Education (INES) and in conversations with teachers, we realized that, due to linguistic barriers, understanding time and space can be more challenging for these children. Therefore, by leveraging the geographical and temporal location of the Coffee Valley, we could contextualize historical aspects of the region.

One of the main challenges faced in the project was integrating LIBRAS and Portuguese in a complementary way, encouraging deaf and hearing children to be exposed to both languages and sparking interest in bilingual learning.

The interactive bilingual children's digital narrative, encompassing both Brazilian Sign Language (LIBRAS) and written Portuguese, assumes great importance in the education and inclusion of deaf and hearing children. This approach provides not only a reading experience but also active engagement from the audience, allowing for collaborative co-creation of stories. Through the flexibility and adaptability offered by the digital platform, new chapters and narrative elements can be added, enriching the user experience.

As Murray (2003) emphasizes, this new form of digital storytelling is not limited to a mere adaptation of traditional storytelling forms. On the contrary, it represents a complete reinvention of the act of storytelling, adapting in a unique and distinctive way to the digital medium.

The construction of this narrative involves the careful integration of visual, technological, and textual elements. The story presented on the digital transmedia platform emerges as a versatile medium, allowing for various forms of interaction and reading. The symbiotic relationship between images and written text is essential, enabling the reader to transition between both to fully comprehend the narrative.

When observing the educational context, we identified a crucial challenge for deaf children: the difficulty in situating themselves temporally and socially, often leading to a sense of isolation. This communication gap can have a significant impact on the assimilation of cultural values and the socioemotional development of the child (Galvão Filho 2012). Therefore, the interactive bilingual digital narrative emerges as a powerful tool to stimulate the active participation of the child in the learning process and social integration.

The support of hypermedia provides non-linear navigation, aligning with the natural thought processes of humans. This is especially pertinent for generations that have grown up immersed in technology, where intuitive navigation is second nature. In this manner, technology emerges as a valuable ally in expanding the possibilities for teaching and learning.

Learning, as Vygotsky (1998) points out, is a broad and diffuse process that is part of socialization and goes beyond the school environment. The interaction between individuals, mediated by technology, can be a bridge to the construction of collaborative knowledge, where both students and teachers are active agents in the educational process.

In this context, the interactive bilingual children's digital narrative is not limited to the mere transmission of content, but becomes an engaging and playful experience. It offers a unique opportunity for the child to explore, create, and interact, transforming learning into an act of discovery and meaning-making. Therefore, as we explore the potential of this approach, we are faced with a valuable tool for inclusive education and the holistic development of deaf and hearing children.

3. PROCESS

The pre – production of an animated digital book requires adaptations in the storyboard process. Unlike the conventional storyboard, configured for scene visualization through a sequence of drawings, much like a comic book, in an animated storyboard, the viewer can choose what to see around them. Thus, an effort was made to define a storyboard that could provide a broad experience to the viewer. The process of creating diagrams for application in the storyboard, considering the planning for the subsequent phase, in which a sequence of character animation and the inclusion of a frame with the Brazilian Sign Language (LIBRAS) interpreter will be applied, is presented below.

The narrative being created was based on a story about the Coffee Valley region. The research began with the search for similarities and analogies, categorizing each of them based on aspects that would help us adopt strategies for the narrative in relation to the use of color palette, typography, complementarity between written text and image, LIBRAS interpreter, and proposed interactions. From the concept of media art, the process of creating bilingual history was initiated. This form of digital artistic expression is based on three fundamental concepts, as identified by Fernandes – Marcos (2017):

Controlled Randomness – it involves the ability to algorithmically instantiate forms of (almost) non – determinism, allowing instant access to media elements that can be (re)combined and presented in various aesthetic ways (visual, auditory, etc.), infinitely, without the need for prior control of the results.

Virtuality – manifests in the transition from the physical object to the virtual or conceptual object. Understanding the work or artifact is only possible through its virtualization.

Interactivity – includes the active participation of the spectator in the work or artifact, allowing them to influence its state and create new instances.

It is observed that digital media art seeks to integrate these elements, giving balanced centrality to art objects. A crucial distinctive feature of digital media art is its creation process, which is multidisciplinary and non – linear. The creation cycle plays a central role, highlighting transdisciplinary elements in artistic development.

3.1 Characters

The development of concepts is a phase in the character design process that involves the initial conception and definition of key characteristics that will shape the final characters. To initiate this process, it is crucial to establish a solid understanding of the context in which these characters will inhabit, including the type of media, the target audience, the narrative environment, and the role they will play in the plot.

The next step involves research and the search for inspiration, gathering relevant visual references, such as images related to the story's setting and thematic elements that can enrich the conception of the characters. Furthermore, it is essential to create detailed character profiles, addressing aspects such as name, age, personality, origin, challenges, and goals, as these profiles will serve as a guide for generating ideas.

This process is followed by the exploration of ideas, where a wide variety of concepts was generated based on the profiles and sources of inspiration. Once the initial ideas were formulated, attention turned to the identification of distinctive characteristics that made each character unique, encompassing both physical appearance and personality elements. Thus, the girl, the dog, and the cat, central characters of the story, were created.



Figure 1: Character concepts. Source: authors' files.

As ideas evolved, iterations and refinements were made to create cohesive and engaging versions of the characters, including the definition of appropriate color palettes and the creation of a complete style guide to document every relevant aspect. This process was inherently creative and subject to continuous improvements as we progressed towards realizing the vision of the story.

3.2 Settings

Creating illustrations of settings involves visually representing environments in various media, such

as digital art, painting, and traditional illustration. A general process for creating such illustrations begins with an understanding of the context, including the story, purpose, target audience, and desired style.

Initially, research on relevant visual references, such as the use of photographs and paintings, helped understand the environment to be portrayed. The concepts and goals are then presented, and preliminary sketches are drafted to plan the composition of one of the settings, a waterfall in the city of Paulo de Frontin – RJ. The chosen perspective and added details, including vegetation and visual effects.

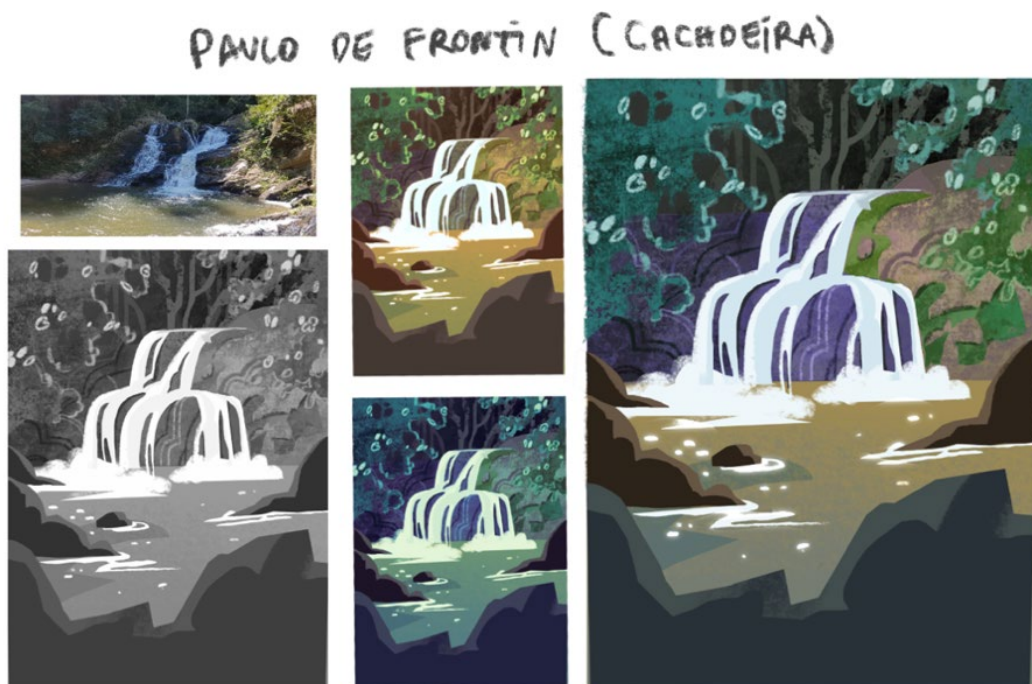


Figure 2: Setting sketch and production. Source: authors' files.

Selecting an appropriate color palette plays a crucial role in creating the desired atmosphere. For this project, textures and visual effects were incorporated to enrich the illustration, and the

illustration technique, digital painting, preferences, and style were defined to reach the intended audience.

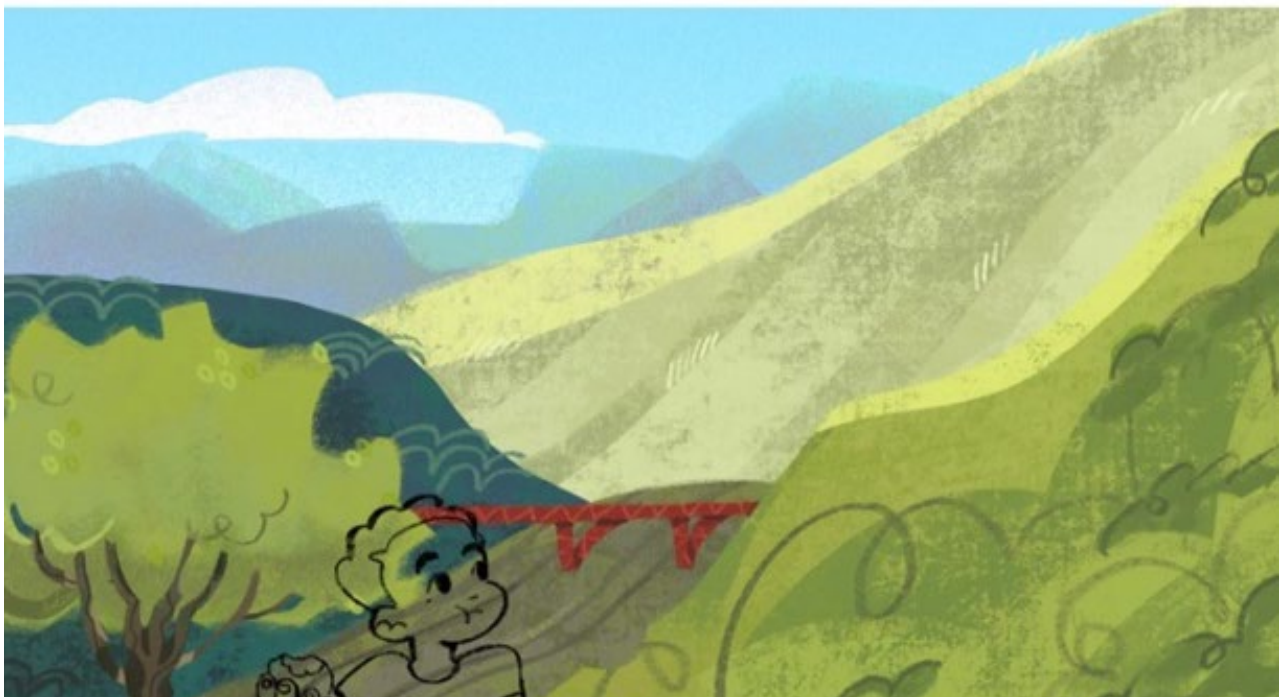


Figure 3: Setting refinement and character framing. Source: authors' files.

The final phase of production will involve adjustments and refinements, along with presentation for feedback and, upon approval, the delivery of the illustration in the appropriate format.

3.3 Storyboard

As Begleiter (2001) emphasizes, a narrative can be meticulously planned through three distinct resources: text, encompassing the script and shot list; image, including drawings, photographs, and computational images; and diagram, where images gain a concrete and representative dimension, allowing for a detailed description and the organization of continuity scene by scene within the flow.

As it is intended for a child audience, the initial phase of the story was divided into scenes that were planned to maintain the viewer's attention, promote empathy and interaction through images, animations, and sound effects that will be made accessible to the deaf child through sign language translation.

In addition to its fundamental contribution in preparing the framing and sequences, as well as observation angles, the planned storyboard also proves to be a valuable tool in financial planning, assisting in budgeting the entire production team for planning both the digital and physical versions of the book.

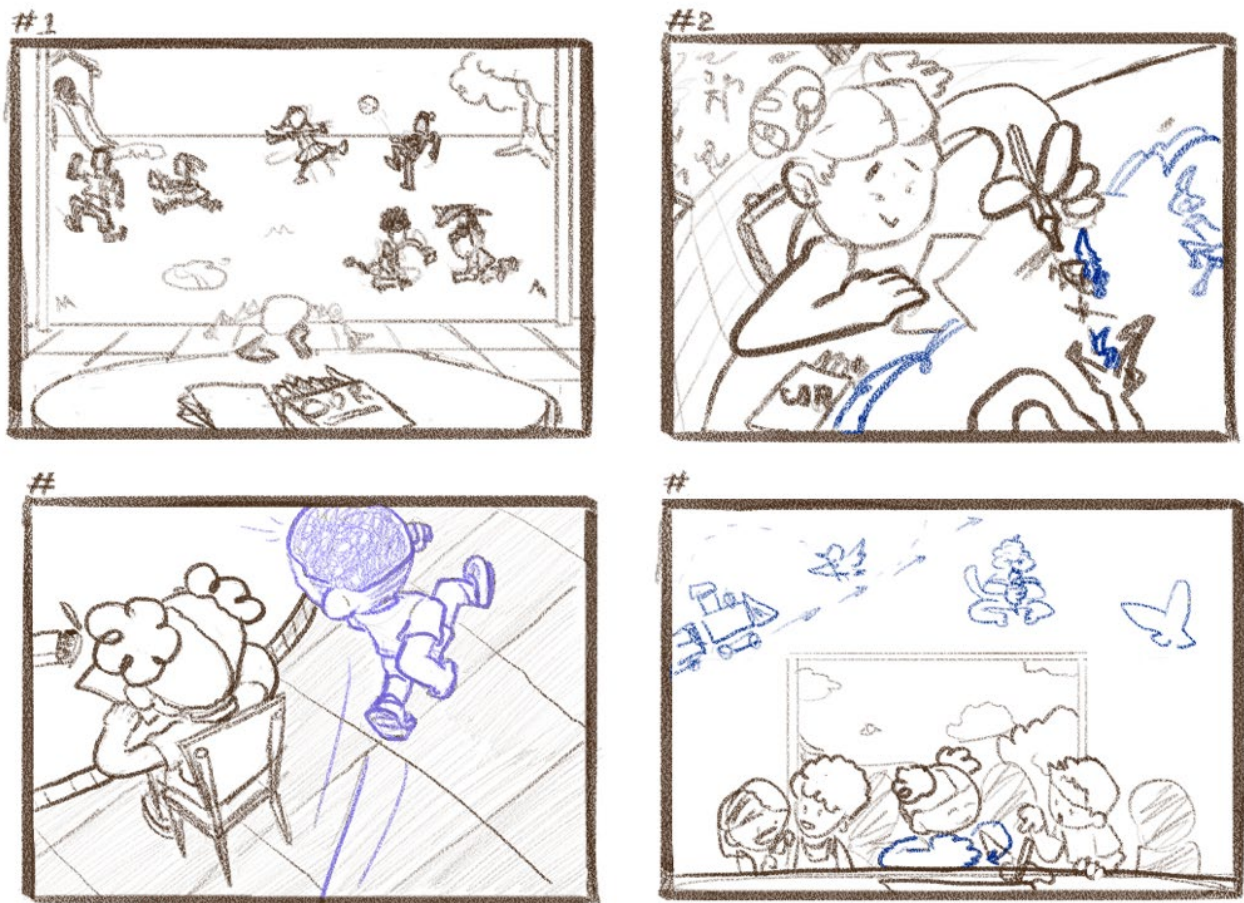


Figure 4: Storyboard – examples of framing of settings and scenes. Source: authors' files.

4. DISCUSSION

In Brazil, the National Institute of Deaf Education (INES) has adopted bilingualism as an educational principle. It is crucial to understand that Brazilian Sign Language (LIBRAS) should not be seen as a simple translation of written language. It has its own grammatical, lexical, semantic, and morphological structure, similar to oral language for hearing individuals. Effective communication also depends on facial and body expression.

The learning process occurs in a similar manner for deaf and hearing children, as long as they are exposed to language from a young age. The earlier they have access to a language that meets their needs, the more they will develop fundamental cognitive skills for their formation.

Sacks (1998), in his book 'Seeing Voices,' studied deafness and literacy trends for deaf individuals. He concluded, after observing cases of deaf children who had contact with sign language in their early years and children who were deprived of this education, that:

The essential aspect is: deaf people show absolutely no innate inclination towards speech. Speaking is a skill that has to be taught to them, and it takes years of work. On the other hand, they demonstrate an immediate and marked inclination towards sign language which, being a visual language, is entirely accessible to these individuals. (Sacks, 1998).

For deaf children, bilingualism is crucial for their integration into the society they live in. LIBRAS is recognized as the second official language in Brazil, however, its teaching is still limited to specialized institutions, despite the Guidelines and Bases Law that promotes the inclusion of deaf individuals in regular schools.

In line with this idea, we consider that the habit of knowing, listening to, or reading stories from an early age can make us more reflective individuals and can also contribute to expanding critical thinking. Digital storytelling aims to be used as a resource to engage deaf and hearing children, generating knowledge about important aspects of life in society.

In this sense, as stated by Galvão (2012), narratives, produced in oral, written, or hypermedia forms, have great educational potential. They can be used both to investigate the knowledge that people express and to assist in the process of knowledge construction.

It is important to emphasize that disability is not an inherent characteristic of a person, but a complex set of conditions, many of which are influenced by

the social environment. Therefore, solving this problem requires collective action, and it is the responsibility of society to make the necessary adaptations to enable the full participation of people with disabilities in all areas of public life. This involves an issue of attitude and ideology towards social change, and on a political level, it is a matter of human rights.

Portugal, *et al.* (2023) discuss the theme of social responsibility, inclusive design, and accessibility has been debated by design theorists and professionals, driven by humanistic approaches. Between the 1960s and 1980s, movements and debates emerged about the role of design as an instrument of social responsibility. The example of the Scandinavian socio – economic policies in Sweden in the 1960s stands out, which formalized the concept of "a society for all," with a focus on accessibility.

This concept gained global recognition when it was recommended by the Stockholm Declaration, approved in 2004 by the European Institute for Inclusive Design. This declaration established that the built environment, everyday objects, services, culture, and information should be accessible and usable by everyone in society, considering the constantly evolving human diversity.

5. CONCLUSION

Based on the research conducted thus far, it is evident that any project focused on the digital medium can become inclusive through specific decisions made throughout its development. The purpose of this research project is to encourage initiatives with this approach, both in the academic sphere and among game and app development companies.

The project to create a transmedia platform for bilingual stories for children shows promising results in language development and social integration. By focusing on the story of the friendship between a deaf child and two animals in the context of the Vale do Café region in Rio de Janeiro, the pilot story provides valuable insights into the city's history, the Atlantic Forest flora, historical monuments, and moral and ethical values. The expansion of this concept to encompass the entire historical and cultural richness of the Vale do Café region envisions offering an inclusive and enriching experience for deaf and hearing children.

Additionally, the platform will provide access to relevant cultural content, strengthening the cultural identity and self – esteem of deaf children. Educational inclusion and equal opportunities are essential, ensuring that products and services are

accessible and tailored to user needs. Technological innovation also stands out as a potential of the project, with future applications in the development of solutions for the educational inclusion of deaf children. Furthermore, the initiative aims to foster the active participation and significant contribution of deaf and hearing children to society, strengthening their autonomy and impact on the community.

This project aims to enhance the quality of life for deaf and hearing children, promoting their social integration, language development, and access to relevant cultural content. It also seeks to promote equal educational opportunities and drive innovation in the field of educational inclusion. Collaboration with reputable institutions and the potential for developing innovative technological solutions make the project an important initiative for society.

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Aeolian AI: Generative art and environmental computing

Richard A. Carter
University of York
York, YO10 5GB
richard.a.carter@york.ac.uk

1. INTRODUCTION: AI, ECOLOGY, ART

Contemporary AI, popularly exemplified by transformer and diffusion systems, is the subject of significant critique around the growing costs in energy, water, and highly refined materials necessary for sustaining its intensive computing demands (Crawford 2024). Other modes of AI, and adjacent technologies such as machine vision, have been less subjected to these concerns, but remain implicated in the critiques surrounding computing infrastructures more generally, which thrive only in the most rarefied ecological niches that we might provide (Monserrate 2022). Nonetheless, we can concurrently acknowledge that digital systems are evidently playing a critical role in monitoring and evidencing environmental and climactic degradation at a global scale (Wilkinson et al. 2023) – although, even here, the claimed future roles of AI specifically are not uncontested (Brevini 2020).

Such discourses suggest an impasse in which AI systems, in the broadest sense, can struggle to speak to ecological issues positively – that they always represent an inherently extractive, damaging proposition, no matter the intention. Given that generative artistic practices employing AI have been popularly denigrated partly due to their attachment to these ecological concerns, it could appear that even creative reconciliation, however tentative, is largely unpromising.

The developing project discussed here, *Nephoscope*, is premised on how modes of speculative media and environmental sensing, as carried through artistic research, might facilitate a different vision of generative AI, in which it stages functional and expressive dialogues with environmental processes – using worldly transformations as a means of cueing abstractly algorithmic operations. While not ameliorating technological harms, such gestures can reemphasise that specific modes of digital functioning are the product of specific choices. Technical and applicatory efficacy predominate, but, when understood narrowly, this might imply a certain inevitability behind specific strands of technical evolution that occludes other factors, economic, political, and social, shaping what is ultimately developed and deployed. We might thus speculate what generative AI would resemble if it was produced in express dialogue with the ecologies of which it is a part. That is, to be driven by the goal not of enhancing our creative perception and manipulation of human generated data, but to enrich our registers of sensitivity towards the ‘more-than-human’ processes and durations of the world – aspects upon which we rely profoundly, but that often exceed our conventional perceptual awareness. While not a direct model for future computing practice in-itself, it can encourage reflection around the ecological entanglements behind inventing, deploying, and maintaining digital technologies – and, from this, to consider explicitly whether we might find ways of having them tread more lightly upon the Earth.



Figure 1: A screenshot from a Nephoscope live sequence, taken 21 January 2024

2. NEPHOSCOPE

Nephoscope is named after a series of nineteenth century instruments used for monitoring the velocity and direction of overhead clouds. Originally employing a dark circular viewing mirror with a built-in compass, the digital nephoscope developed for this project conducts visual analyses of cloud movements using a video camera tied to a simple optical flow algorithm. The derived vectors are then used to interface with a model of textual word embeddings generated using a Word2Vec machine learning schema, trained (for this initial prototype), on a corpus drawn from an early book on atmospheric measurement, A. Lawrence Rotch's *Sounding the Ocean of Air* (1900). Word2Vec models the relationships between words in a text as spatial vectors (Mikolov et al. 2013), using cosine similarity measurements to determine clusters of interrelated words from an initial seed reference. In *Nephoscope* the spatialised wind vectors detected from the video imagery furnish compatible query vectors to this model, cueing the extraction of corresponding words. This process enables the vector map of cloud movements to prompt the creation of a semantically coherent textual map from the source corpus.

The images and text yielded are finally displayed to the viewer, with the word sequences plotted across the image at the pixel coordinates which prompted their generation. These words are framed by a series of undulating lines indicating the directional flow of movement across the detection field (see Figure 1). The result is a sequence of evolving diagrammatic poems that emerge and respond to a changing skyscape in real time. The overall gesture might be characterised, playfully, as enacting an "aeolian language model", in which the actions of

wind and machine learning combine to actualise novel ways of perceiving and reading the atmosphere above.

3. DISPLAY AND FUTURE DEVELOPMENT

Nephoscope is a project still in the initial stages of development, and further consideration needs to be given regarding future textual sources that can drive its verbal aspects, as well as the contexts in which it will be exhibited. Rotch's *Sounding* provided an apposite initial source in that it recounts the historical development of atmospheric measurement that ultimately gave rise to contemporary meteorology and climate science. The words generated capture the discourses surrounding these early efforts that presage those of today. Nonetheless, there is clear scope for other sources to be used for different effect. One possibility it to use a selection of the critical sources cited in this discussion, by way of re-articulating the contemporary ecological concerns around digital systems and generative AI – with the piece itself standing as a speculative response.

The overall goal of *Nephoscope* is to help catalyse a conversation around the greater ecological contexts in which all digital systems, AI or otherwise, operate within. The actual artwork is a component of this process, but does not necessarily function standalone. One plan is to exhibit *Nephoscope* through a series of live social media broadcasts, inviting reflection and commentary, but scope also exists for in-person live 'screenings' to function as creative-critical forums. A planned recorded video sequence and a printed book will provide additional opportunities for dissemination within an appropriate context.

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Celestial Objects and Aeriform Masses: Visualisation of RSONar data

Grace Grothaus
York University
4700 Keele St
Toronto, Canada
ggrothau@yorku.ca

Regina Lee
York University
4700 Keele St
Toronto, Canada
reginal@yorku.ca

Joel Ong
York University
4700 Keele St
Toronto, Canada
joelong@yorku.ca

Kieran Maraj
York University
4700 Keele St
Toronto, Canada
kmaraj@yorku.ca

Celestial Objects and Aeriform Masses is a generative animation project by Grace Grothaus, derived from the data collected by York University's Nanosatellite Lab, under the guidance of Dr. Regina Lee. This artwork, part of a larger initiative led by Dr. Joel Ong, highlights the roles of marginalized groups in space exploration, challenging the conventional narratives of space as an exclusive domain. Utilizing latitude, longitude, altitude, and pressure data from the Resident Space Object Near-Atmospheric Edge Reconnaissance (RSONar) nanosatellite, the project employs TouchDesigner to create an evolving lunar scape visualisation, interpreting space situational awareness (SSA) data as a generative artwork.

Data visualisation. Scientific and Creative Visualisation. Digital art. Generative art. Planetary physics. Experimental.

1. INTRODUCTION

Celestial Objects and Aeriform Masses, a generative animation conceived by the artist Grace Grothaus, visualises a dataset amassed by an interdisciplinary research team operating within Dr. Regina Lee's Nanosatellite Laboratory, situated in the Earth and Space Science and Engineering (ESSE) department at York University (Lee 2023).

Acknowledging that access to space is not uniform, the animated data visualisation and other creative works developed from the dataset are components of a larger initiative, *Space Situational Awareness and Us* (SSA). This initiative, under the stewardship of Dr. Joel Ong and Dr. Regina Lee, aspires to democratize access to space exploration. It engages communities traditionally marginalized in the history of space exploration alongside the wider general public of Toronto (Huls 2023). This work is ongoing, carried out through a series of innovative scientific expositions coupled with community-oriented science communication endeavours. Notably, these include discourses hosted at the

Ontario Science Centre and the dissemination of artworks featured in an exhibition at the McIntosh Gallery at Western University, including the commissioned *Celestial Objects and Aeriform Masses*.

2. CELESTIAL OBJECTS AND AERIFORM MASSES

Celestial Objects and Aeriform Masses is a time-based animation, characterised by looping particle waves informed by an array of geospatial and atmospheric measurements, chiefly latitude, longitude, altitude, and pressure. These data points were collected during the experimental voyage of a Resident Space Object Near-Atmospheric Edge Reconnaissance (RSONar) nanosatellite. This CubeSat was a principal component of the payload aboard the Canadian Space Agency's stratospheric balloon Gondola, launched from Timmins in August 2023. The satellite was equipped with an integrated payload designed for data collection, intended for comprehensive subsequent analysis (Lee 2023).

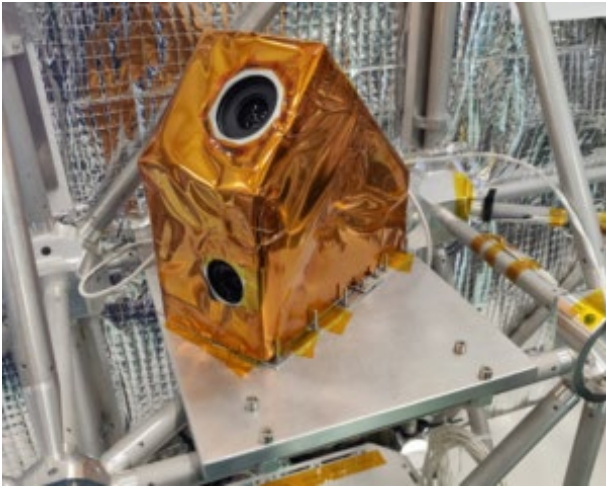


Figure 1: RSONar Payload Integrated onto stratospheric balloon Gondola.

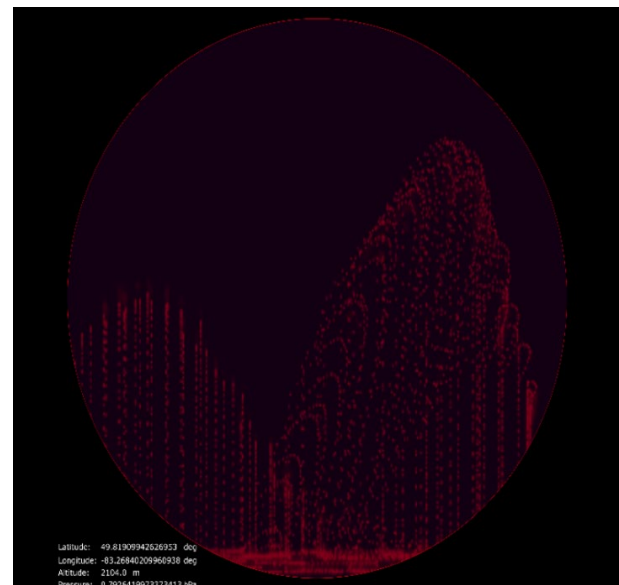
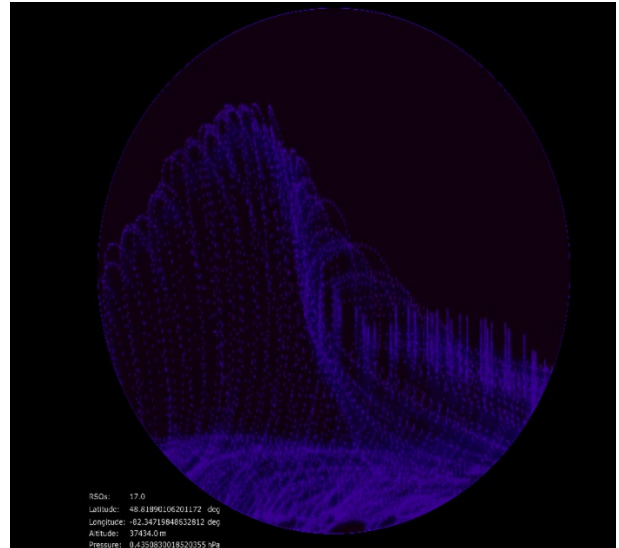
Grothaus' data visualisation manifests as a progression of waves, encapsulating periodic rhythms that subtly reference the dynamic shifts observed within atmospheric flux, stratospheric currents, and the Earth's geomagnetic field. Foregoing a direct analytical engagement with the dataset, Grothaus opts for an interpretative methodology, privileging an exploration into the poetic potentialities and multifaceted expressions inherent within the data (Levin & Brain 2021). This approach underscores a deliberate shift towards embracing the aesthetic and conceptual dimensions of scientific data, thereby aiming to foster a nuanced dialogue between scientific inquiry and artistic expression.

2.1 Data visualisation objectives

Grothaus' visualisation emerges from the dataset via a meticulous sequence of periodic rhythms, illustrating atmospheric eddies and the gradual transformation of hues. This time-based visualisation animates via a customized generative algorithm, its motion informed by the RSONar nanosatellite's span of recorded latitude and longitude coordinates. Likewise, the chromatic aspects of the animation are determined by altitude and pressure measurements, with the 'R' and 'B' colour channels merging to manifest a spectrum of evolving shades from reds to purples and blues.

Drawing inspiration from the astronomical concepts of redshift and blueshift, techniques employed to ascertain the distance of celestial bodies from Earth, Grothaus embarks on a poetic rendition of the data. She reflects on astronomy's ability to analyse colour shifts within star field imagery to map the expansion of the universe. She views these inquiries as expressions of humanity's perennial pursuit to comprehend the collective origins of matter and

derives from it a sense of wonder which she attempts to communicate to viewers through the work (Dobrijevic & Howell 2023).



Figures 2 & 3: Still images of 'Celestial Objects and Aeriform Masses' at two intervals within the multi-hour cycle.

2.2 Process of creation

Celestial Objects and Aeriform Masses was crafted in Derivative's TouchDesigner software, renowned for its robust capabilities in computational animation. Within TouchDesigner, the RSONar dataset is imported into a structured table, the values allocated to specific rendering attributes and mapped to ranges for optimized functionality. This choice of software evolves from a longer trajectory of work in the visualisation of environmental data, which also includes preliminary explorations using Processing and Isadora.

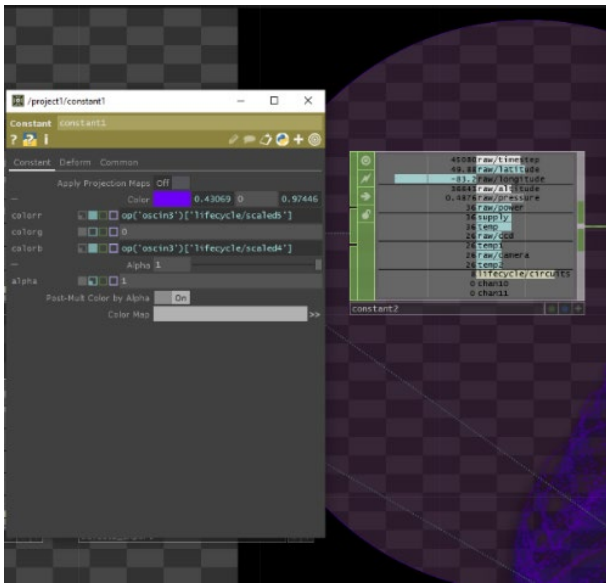


Figure 4: Screenshot in TouchDesigner. On left, altitude and pressure values assigned to red and blue colour channels, and on right, complete imported dataset.

2.3 Exhibition

The artwork premiered at Western University's McIntosh Gallery as part of The Life Cycle of Celestial Objects Pts. 1 & 2, curated by Helen Gregory and Joel Ong and exhibited from September to December 2023. Celestial Objects and Aeriform Masses was shown as part of a larger installation titled The Life Cycle of Celestial Objects Pt. 2, which incorporates decommissioned satellite parts and prototype builds from prior research experiments and displays them as constellations on a backdrop of the sky (Ong 2023). A sound artwork, a data sonification by Kieran Maraj utilizing the same RSONar dataset, emanated from a multi-channel speaker system and was time synchronized to the data visualisation through software MaxMSP.

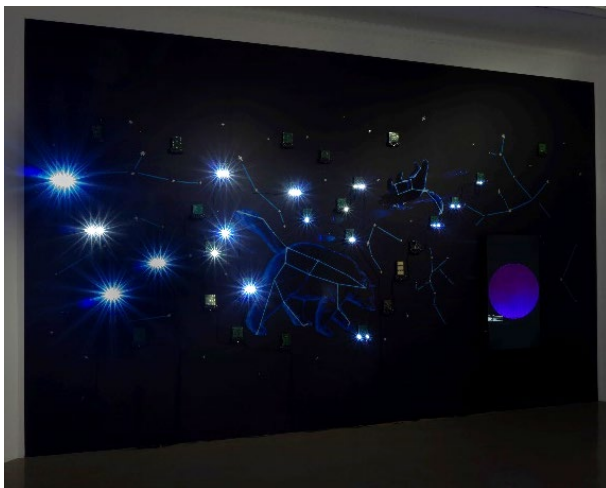


Figure 5: 'The Life Cycle of Celestial Objects Pt. 2' wall.

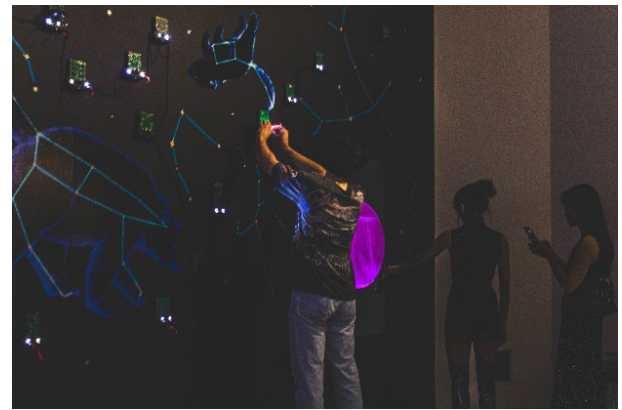


Figure 6: Gallery visitors interacting with the installation.

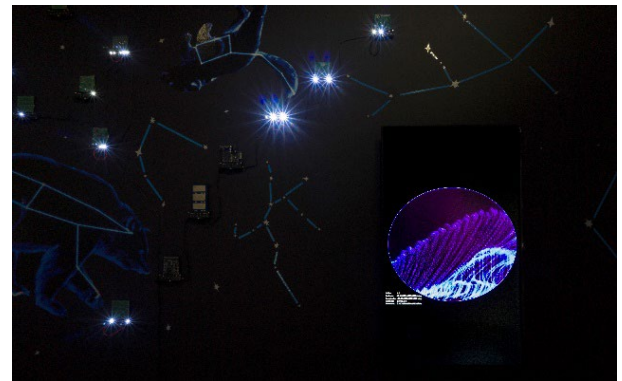


Figure 7: Cropped view of installation wall and monitor displaying animation 'Celestial Objects and Aeriform Masses'.

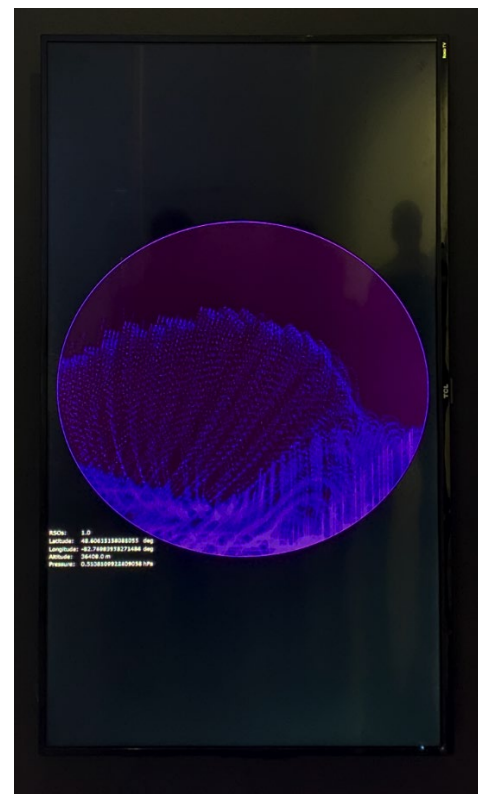


Figure 8: 'Celestial Objects and Aeriform Masses'.

3. SPACE SITUATIONAL AWARENESS AND US

The commissioning of *Celestial Objects and Aeriform Masses*, was part of a broader research initiative with the objective of democratizing access to space exploration research. Since 2021, Dr. Regina Lee's lab has been working with faculty and students from the School of the Arts, Media Performance and Design on maximizing interdisciplinary expertise and communicating lab research with the public. As a part of these efforts Regina teamed with Computational Arts Professor on a SSHRC NFRF-E entitled *Space Situational Awareness and Us* (SSA). Joel Ong and his research team (comprising Grace Grothaus, Luca Cherpillod, and Kieran Maraj) have made artistic use of data collected by Lee's lab, contributing to the development of this larger SSA initiative. Their collective effort seeks to illuminate the work of the lab while situating it within broader contexts centred on the material artifacts and social engagement of satellites and engineers engaged in the burgeoning field of SSA through RSO observation/recognition.

Collectively their approaches encompass various forms of media art, scientific models, interactive projects, and a comprehensive series of science engagement events endeavouring to uncover diverse, decentralized narratives surrounding space exploration, proposing collaborative approaches to cosmic futures. In an era marked by unprecedented accessibility and the democratization of tools, their projects challenge the notion of space as merely a 'new frontier' ripe for appropriation and extraction. Instead, they frame space as a pivotal domain for collective participation in pioneering explorations above our planet.

Their mission aligns with the quest described by Gregory Cajete as a "participatory consciousness to

the conception of the heavens" (Cajete 2000). It delves into themes of community science, citizen engagement, and education while scrutinizing the concept of wonder as an unbiased ideology in the realm of space exploration. This work has received support from Sensorium: Centre for Digital Arts and Technology, the School of the Arts, Media, Performance & Design, CRSH-SSHRC, the Ontario Arts Council, and the Canada Council for the Arts.

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Imaginatrix: School of Cyber Wizardry

Batuhan Bintas
Imaginatrix
1 Mentmore Terrace, London
E83PN, UK
batuhan@imaginatrix.org

1. INTRODUCTION

We live in the age where science fiction is becoming science fact. Imaginatrix's vision is to help create a society that lives in harmony with technology. Our mission is to educate the upcoming generations about the responsibility of technology innovation.



Figure 1: Imaginatrix logo.

2. EMPOWERING IMAGINATION THROUGH CYBERSPACE

In today's digitally connected world, the integration of artificial intelligence (AI) and extended reality (XR) technologies has opened up endless possibilities for empowering young minds. Through immersive experiences provided by XR, such as virtual and augmented reality, children can embark on fantastical adventures and engage in interactive learning like never before, while AI-driven educational tools offer personalised learning experiences tailored to their individual needs and interests.

These technologies not only captivate children's imagination but also provide a glimpse into the magical possibilities of technology, inspiring them to explore, create, and learn in ways that were once unimaginable. With careful guidance and digital literacy education, we can harness the transformative power of AI and XR to nurture a generation of digitally savvy and creatively empowered individuals ready to shape the future. text.



Figure 2: Supporting imagery.

3. CYBER WIZARDRY

In Arthur C. Clarke's famous third law, he stated, "Any sufficiently advanced technology is indistinguishable from magic." Indeed, as children explore the marvels of technology, they are essentially uncovering the secrets of modern-day magic. By educating them about the workings of technology, we are not only equipping them with practical skills but also nurturing their potential to become cyber wizards.

Just as wizards wield their wands to manifest their desires, children who understand technology can harness its power to bring their imaginations to life, create innovative solutions, and shape the world around them. Through education and hands-on experiences with AI, XR, and other cutting-edge technologies, we empower children to become masters of the digital realm, capable of conjuring wonders and shaping the future with their technological prowess. As they journey through the

realms of cyberspace, they not only discover the enchanting possibilities of technology but also learn to wield its power responsibly, becoming the architects of tomorrow's digital wonders.



Figure 3: Supporting imagery.

4. TEACHING METHODS

In our mission to educate children about the marvels of technology, we employ a multifaceted approach to suit diverse learning styles. Through online classes, after-school sessions, and weekend workshops, we provide interactive and engaging opportunities for children to explore the realms of artificial intelligence (AI) and extended reality (XR). These platforms offer flexibility and convenience, allowing students to learn at their own pace while fostering collaboration and practical application of technology concepts.



Figure 4: Twin Science logo.

Moreover, as we embark on building an online school dedicated to technology education, our vision is to create a revolutionary platform where children can access a comprehensive library of AI and XR resources.

Currently we have 6 online classes, 2 after school clubs and 1 weekend workshop.



Figure 5: Twin Science logo.

We are currently partnered up with Twin Science; an online education platform for children. We are in the process of writing their AI education content.



Figure 6: Artolution logo.

5. CYBER RABBIT

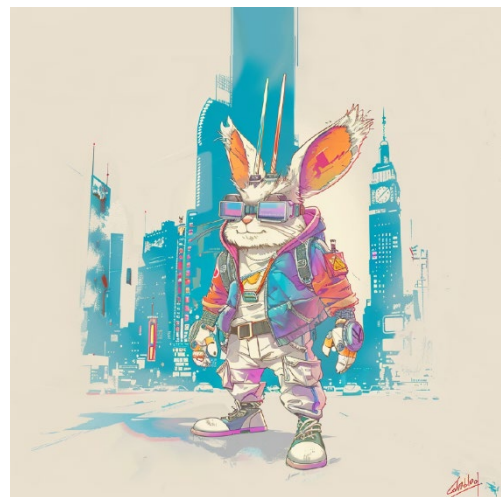


Figure 7: Cyber Rabbit imagery.

Central to this vision is our mascot, Cyber Rabbit, who serves as a friendly guide and mentor, leading children on exciting adventures through the world of technology innovation. With Cyber Rabbit's guidance, we aim to inspire a lifelong love for technology learning and empower children to become digital innovators and cyber wizards of tomorrow.

6. SHAPING TOMORROW: EXPLORING CHILDREN'S PERSPECTIVES ON TECH INNOVATION

As we engage in educating children about the responsibilities and marvels of technological innovation, we also embark on a parallel journey of exploring how their young minds are being shaped by these advancements. In our mission to instil a

sense of responsibility and awe in the face of technology, we simultaneously examine how children perceive and interact with these transformative tools. For instance, we contemplate the notion of what constitutes a "real" human in the age of AI, as children encounter game characters endowed with consciousness through artificial intelligence. Similarly, we delve into the question of reality in the era of Extended Reality (XR) technologies, considering how children define and navigate virtual environments that blur the lines between physical and digital realms.

Recognizing that the children of today are the architects of tomorrow's civilization, we understand the profound impact their interactions with technology will have on the future of our society. By fostering a deeper understanding of the implications and possibilities of technological advancements, we aim to empower children to navigate this ever-evolving landscape with wisdom, creativity, and ethical discernment. Through our holistic approach to education, which encompasses both the technical aspects and the broader societal implications of technology, we endeavour to cultivate a generation of informed and responsible digital citizens who will shape the trajectory of our civilization for generations to come.

Towards this vision is our mascot, Cyber Rabbit, who serves as a friendly guide and mentor, leading children on exciting adventures through the world of technology innovation. With Cyber Rabbit's guidance, we aim to inspire a lifelong love for technology learning and empower children to become digital innovators and cyber wizards of tomorrow.



Figure 8: Supporting imagery.

7. SHAPING TOMORROW: EXPLORING CHILDREN'S PERSPECTIVES ON TECH INNOVATION

Imaginatrix welcomes collaboration with academic researchers and partners to explore the transformative impact of new technologies on learning. We are actively seeking opportunities for joint initiatives and grant funding to assess the long-term effects of our programs on young minds. Additionally, we invite practitioners in the technology education space to engage with us, share perspectives, and exchange ideas to further enhance our collective understanding and advance the field. We welcome insights and contributions as we strive to create innovative and impactful educational experiences for children worldwide.

8. CONCLUDING REMARKS

Having presented papers on the concept of the "School of Cyber Wizardry" for the EVA Conference in 2018 and 2021 (Bintas 2021), I am proud to announce the transformation of this vision into reality. Drawing from my research and insights gained from these conferences, the School of Cyber Wizardry has materialized as a pioneering initiative aimed at nurturing young minds in the realms of technology and innovation. For further insights into the theoretical foundations and evolution of this concept, please refer to my papers from 2018 and 2021, which provide comprehensive examinations of the School of Cyber Wizardry and its implications for education in the digital age. Through dedicated efforts and steadfast commitment, what was once a conceptual framework has now become a tangible institution, empowering children to embark on a journey of digital discovery and technological mastery.

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Challenging Public Perception of Artificial Intelligence Through Crowdsourced Chess

Sarah Selby
Creative Computing Institute
University of the Arts, London, UK
s.l.cook@arts.ac.uk

Rod Dickinson
University of the West of England
Bristol, UK
Rod.Dickinson@uwe.ac.uk

1. INTRODUCTION

Much of the contemporary discourse surrounding the ethics and risks associated with artificial intelligence (AI) has been influenced by the narratives presented in science fiction literature and media. These depictions have significantly shaped societal perceptions, engendering both aspirations and apprehensions regarding the capabilities and implications of AI technologies. However, overly literal interpretations of AI tropes from science fiction, including their application in science communication, create a distorted view of the technology's current capabilities. This detracts from addressing the genuine implications and risks AI poses in reality (Hermann 2021).

Depictions of AI within science fiction are, for the most part, decidedly non-human. It is commonly portrayed as highly intelligent disembodied voices within computer systems. Even in media featuring humanoid robots such as 'i, Robot,' upon dissection, they are revealed to consist solely of cables and wires. However, the reality of modern AI is quite different from these sci-fi depictions. Instead of being purely autonomous and detached from human influence, today's AI is deeply intertwined with human input and intervention. Understanding this emerging technology as an inherently human medium is crucial for an informed society. It equips us better when tackling the challenges and opportunities it presents, which currently revolve more around issues such as discrimination, exploitation, and surveillance than conscious machines or killer androids (Hermann 2021).

This idea forms the central theme of the interactive artwork "Deep (Blue) Fake." By exploring the illusion of AI autonomy, the project highlights the essential

role of human intelligence in its creation and operation. In doing so, it challenges the notion of AI as something mystical or 'artificial,' emphasising instead the collective human effort behind its development and function. Consequently, the project encourages a more nuanced understanding of AI, advocating for a view that recognises it as a product of human ingenuity and collaboration.

2. CASE STUDY: AMAZON'S MTURK

While computers excel at tasks like storing and retrieving data and rapidly performing calculations, humans still outperform even the most advanced computers at certain simple tasks. Some of these tasks are essential for the development of AI, such as identifying objects within images - a skill that children can accomplish before they learn to speak.

As a result, much of the AI we encounter today relies on invisible human labour. A prime illustration of this is Amazon's Mechanical Turk (MTurk) platform, which, according to its website, enables 'service requesters to integrate Artificial Intelligence directly into their applications by making requests of humans'. Unlike traditional workflows, where a human worker might assign a task to a computer and await the results, MTurk reverses this dynamic. It allows computer programs to solicit a 'global, on-demand, 24x7 workforce' of human workers to execute tasks - referred to as 'HITs' or 'human intelligence tasks' - in exchange for monetary compensation.

The name 'MTurk' draws inspiration from the 18th-century automaton known as 'The Mechanical Turk', a chess-playing machine seemingly capable of defeating esteemed human chess players of its time.

However, the Mechanical Turk was later revealed to be an elaborate deception, controlled by a human chess master concealed within. Much like 'The Mechanical Turk' automaton, beneath the facade of seemingly autonomous AI systems lies human intervention.

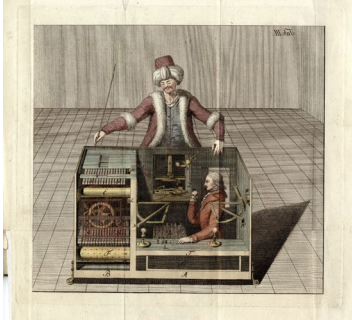


Figure 1: A cross-section of the Turk from Racknitz, showing how he thought the operator sat inside (Racknitz 1789)

3. THE ARTWORK

'Deep (Blue) Fake' is an interactive artwork that takes its cues from the historic 1997 chess match between Russian Grandmaster Garry Kasparov and IBM's chess-playing computer known as 'Deep Blue.' This monumental event symbolised the ongoing battle between man and machine, as Deep Blue's victory over one of humanity's intellectual titans suggested that AI was rapidly approaching human intelligence.

'Deep Blue Fake' reflects elements of the circumstances faced by Kasparov during the match. It features a specially designed chessboard that invites participants to engage with an apparently independent 'AI' opponent, whose pieces move autonomously across the board.

As visitors make their moves on the chessboard, their opponent's pieces will respond, strategising and countering their actions in real-time. However, behind the scenes, the movements of these pieces are orchestrated by the contributions of multiple human workers connected through MTurk.

4. TECHNICAL IMPLEMENTATION

The project necessitates a custom-made chessboard equipped with hardware for precise piece detection, a movement mechanism, bespoke software to manage gameplay states, and integration with Amazon's MTurk platform for remote worker interaction.

4.1 Custom chessboard

Traditional chess computers track the game's progress using reed switches. To accommodate potential unexpected interactions in a gallery setting, we've opted for multiplexed RFID readers for smoother gameplay, enabling unique identification of each chess piece. Furthermore, we're partnering with 'Certabo,' renowned for their electronic chessboards with automatic piece recognition.

4.2 Movement mechanism

The initial prototype consisted of a custom-made XY plotter, a solenoid magnet, and metal ball bearings for piece movement. However, it failed to convey the intended concept effectively, leading to associations with 'magic' rather than the desired autonomous opponent experience. For the second prototype, we will use a UR5e robotic arm by Universal Robots, manually moving each piece to reinforce the perception that the human participant is competing against an AI system.

4.3 Backend

To interface with remote workers, we are using Amazon's MTurk API to generate 'HITS' in real-time. To facilitate swift completion, the interface design is simple and requires no prior knowledge of chess. Workers select a piece, and the possible moves for that piece are highlighted in green. They then select the destination for the piece's move. This functionality is supported by the chess.js library, facilitating move validation, piece movement, and check detection.

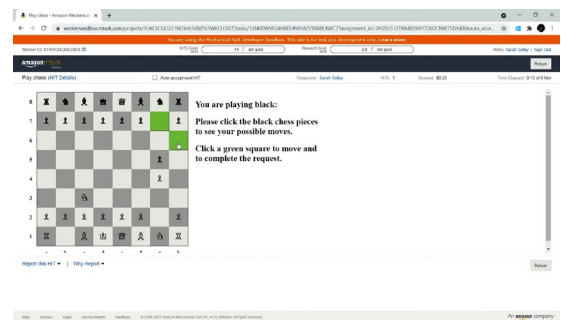


Figure 2: The simple MTurk UI design (Selby 2021)

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Advancing Curatorial Practice With Archives Using AI

Sean Carroll
Institute of Creative Technologies
De Montfort University, Leicester, UK
P2546407@dmu.ac.uk

1. INTRODUCTION

This paper explores the potential of artificial intelligence (AI) to transform traditional archives from static repositories into dynamic, interactive platforms. It is argued that AI can democratise access to archives, facilitating a multiplicity of interpretations in a shifting cultural landscape. The investigation focuses on the intersection of poststructuralist theory and AI's capabilities in archiving, aiming to support knowledge organisation and retrieval for re-creative practice.

2. LITERATURE REVIEW

The incorporation of insights from Roland Barthes, Thomas Kuhn (1962), and Jean-François Lyotard (1984) within this study's framework serves as a foundation for reimagining archival access and organisation. Barthes' concept that a text's meaning is not fixed but created through reader interaction (Barthes 1977), Kuhn's assertion that scientific inquiry is shaped by prevailing paradigms, and Lyotard's critique of grand narratives all contribute to an understanding of knowledge as inherently flexible and context-dependent. Drawing parallels between these theoretical perspectives highlights the potential for archives to evolve beyond static repositories of information. This approach advocates for a dynamic interaction with archives, where Large Language Models (LLMs) enable more personalised and context-aware explorations. Although none of the authors directly address archiving, their theories collectively justify a more open, accessible, and evolving practice towards the creation and organisation of knowledge.

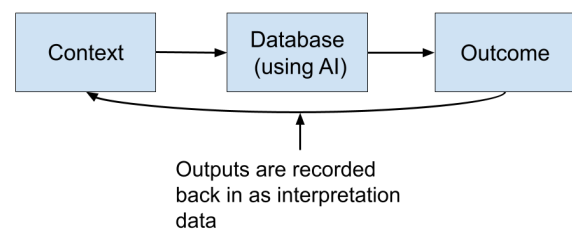


Figure 1: Example of suggested Archival Framework

3. RESEARCH FRAMEWORK

The framework presented in Figure 1 combines a traditional archival approach, augmented with an AI facilitated Database that is capable of complex two-way interactions with users. It can both deliver archival content, and receive data on the interpretation of that content back to guide its future interactions. This ability for Interpretation Data to be fed back in to support the archive to develop a broader contextual lens for itself, supports the development of the poststructuralist approach described in section 2.

'Context' reflects the diverse perspectives of archive users, shaped by their knowledge, cultural backgrounds, and creative practices, which in turn influence their engagement with the archive and interpretation of its contents.

The 'Database' leverages a trained LLM to manage archival interactions. This encompasses a Digital Archive, Descriptive Metadata, and AI or user generated Interpretation Data, with AI serving as a conduit between the archive and its users.

The 'Outcome' emerges as the tangible products of this interaction—new creations, critical writings, or exhibitions that build on original works with AI-

generated insights, enriching the discourse around them.

4. METHODOLOGY

A practice-based research design integrating workshops tasks focussed on materials held in Computer Arts Archive, observation and interviews was devised. The workshop was organised into three phases: Exploration, Interaction, and Creation. During the Exploration phase, artists received an archive overview, setting a contextual foundation. The Interaction phase involved direct engagement with the archivist, offering artists deep insights into the archives' cultural and historical contexts. Finally, in the Creation phase, participants developed new works inspired by their explorations. Observation was guided by the Flanders Interaction Analysis Categories (FIAC) framework (Flanders 1970), adapted to evaluate engagement and knowledge retrieval in an archival setting. This approach, further informed by Dervin's Sense-Making Approach (2003) and Kuhlthau's Information Search Process (ISP) model (1991), provided a structured lens to assess artist interactions. Data collection spanned over four days, focusing on participant engagement, creative processes, and the potential for AI to enhance these interactions. Semi-structured interviews post-workshop aimed to delve into participants' motivations, emotional engagements, and the cultural impact of their work. Data was thematically analysed identifying how artists engaged with and reinterpreted archival materials, providing insights into their creative processes. This data will be fed into the LLM to refine its ability to guide future interactions with the archive in a future phase of this research.

5. PRELIMINARY FINDINGS

This study's thematic analysis showed the "Process and Methodology" and "Human Elements in Digital Art" as pivotal themes recurring within the discourse on digital archiving in artistic practices. "AI in Artistic Practices" emerged as a consistent area of debate from artists although few had solid conclusions. Participants frequently reflected on the transformative potential of digital tools to both challenge and expand traditional art-making processes, emphasising the importance of experimentation, playfulness, and a continuous dialogue with technological advancements.

6. CONCLUSION

The findings highlight the role of dialogue with an LLM for archival practice to support in-depth exploration of artistic processes. Fine-tuning LLMs to address questions about the systems behind art

can help to capture core computational thinking behind works in an archive for future generations of artists. This allows not just an interview to be kept as interpretation data, but also a development log and critical analysis of the software including examples of the code developed for future visitors to examine.

The findings intimate a pathway for future research that integrates AI into a human-centred archival workflow illuminating how insights can be captured, coded, and made accessible through dialogic interfaces. The next phase of the research will concentrate on refining Natural Language Processing (NLP) technologies, such as the Retrieval-Augmented Generation (RAG) method discussed by Lewis et al. (2020). This phase aims to employ the extensive datasets provided by LLMs to enhance the contextual depth and encourage discussions surrounding archival items.

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Texture of Longing: Memories in palpable form

Ana Sofia Calixto
Goldsmiths University of London
London, UK
anasofiacalix@gmail.com

1. INTRODUCTION

Texture of Longing is research on how the experience of grief and empathy can be expanded through data retrieval and analysis, by translating memories into physical objects. It explores how human feelings could be duplicated into tangible elements. Poetically speaking, the investigation aims at a “teleportation of emotions”, a way to exist in parallel spaces.

2. CONCEPT AND PARTICIPATION

Five participants of varied nationalities were invited to the experiment. Although they haven't shared previous life experiences, they all share the common bond of grieving the loss of a beloved person. Each of them briefly shares details of the person they have lost, how the emotional experience was at the time and how they feel at the moment.

The bereaved participants were of the following nationalities:

Participant reference	Participants		
	Nationality	Gender	Bereaving
1	BRAZILIAN	Female	CHILD
2	CHINESE	Female	BOYFRIEND
3	PERUVIAN	Female	MOTHER
4	RUSSIAN	Male	FATHER
5	SCOTTISH	Male	FRIEND

Table 1: Nationality, gender, and relationship to the lost person of each participant.

While a participant retrieves a memory, they use wearable sensors to trigger a machine that will print the emotional input in resin. After that, one of the

others who have just heard the story wears the sensors while reflecting on the experience they have just heard. The output is of two distinct sculptures: one crafted with the data of the participant who directly experienced the situation, and another formed using the data from the participant who has only heard the story.

3. TECHNICAL IMPLEMENTATION

The gadget gathers data from different parts of the body. The three sensors gathering biological input measure heart rate, SP02 levels and perspiration of the skin.

The first two send a signal every time the average heart rate and SP02 levels change, triggering each one motor that controls small pumps. The motor makes a full turn, suctioning coloured resin from one container and letting it drip into another. Both outputs go to the same third container.

The data from a third sensor is connected to another motor, which controls a bigger pump. This motor gets the mixture of resin from the third container, including the colourful resin from the other pumps, and transparent resin. In short, the more emotional variation of the input data, the more intense the colours of the output.

The movement from the third motor pumps the mixture of resin to the bottom part of the structure, where it solidifies almost immediately with UV light. The sculpture has colours, texture and form defined by the range of emotions of the participants, as well as changes in the physical reaction to those feelings.

To the practical research, the following outcomes have been observed.

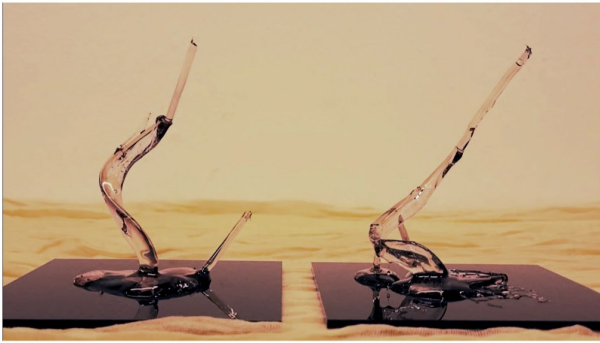


Figure 1: Collection of a particular memory in individuals 3 (left, original memory) and 4 (right, recollection of other's memory)

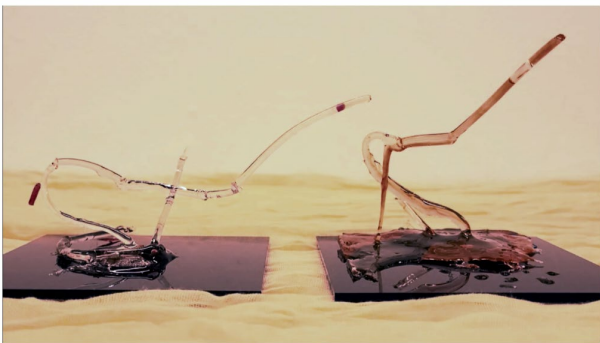


Figure 2: Comparison of the materialisation of a particular memory in individual 5 (left, original memory, depressed person) and 2 (right, recollection of other's memory, non-depressed person)

4. COLLECTIVE MEMORIES AND CULTURE

The research approaches the topic of grief and longing in a palpable way, by expanding the experience of empathy between participants through sensoriality. A similar approach is found in native performative practices in countries with a history of colonisation, in which materiality is used as an expanded body, an extension of emotions related to certain socio-political situations experienced by that community (Calixto, 2022).

Texture of Longing has a similar starting point, where the performer's emotional guts are represented by a tangible material – but this time, having technology as a mediator to generate these elements. Biological data becomes a tool for materialising non-tangible elements of the human experience, such as emotions, feelings and sensations, allowing abstract information to translate into materiality.

5. CONCLUSION

At its core, Texture of Longing reveals insights about the nature of memories and the human experiences of grief and empathy. Beyond the process of data visualisation, it suggests that memories do not only exist in rational thoughts, but superimposed to the body itself, as if we are constantly wearing layers of parallel existences.

This perspective challenges traditional notions of memory as a static repository of past events, instead presenting it as a dynamic force that shapes and reshapes the human perception of reality. In essence, the techno-ritual reveals the interconnectedness of past and present within the body, and how memories imprint themselves in various organs, as well as how empathy can create similar patterns among individuals of diverse cultural backgrounds.

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Gotham's Shadow: The unseen watchers

Kourosh Simpkins
University of the Arts London, Creative Computing Institute
5th Floor, 45-65 Peckham Road, SE5 8UH
London, UK
kouroshsimpkins@gmail.com

1. INTRODUCTION

This project aims to explore the nature of surveillance systems within society, examining the minutiae of the infrastructure that allows law enforcement agencies to observe publics and their behavioural patterns. The act of being surveilled is a part of the social contract, for better or for worse, and there is a strong divide as to whether individuals consider it a benefit or an invasion of privacy. At the forefront of this problem is the US based company Palantir; a secretive corporation that builds software for multiple governmental organisations. This secrecy has led to a situation where members of the public do not actually know how much information the government has access to about them.

2. PREDICTIVE POLICING

The concept of predictive policing is not new, it stems back to 1964 with work that was done by the St Louis Police Department to efficiently allocate police around the city (Ridgeway 2018). However, in the modern era, it has become a lot more invasive with regards to the data that police forces have access to. One of the organisations leading the charge to an all-encompassing idea of policing is Palantir, with the aid of their Gotham software.

2.1 Palantir

Those familiar with Lord of the Rings will know that the name Palantir comes from “Palantíri”, or the “Seeing Stones”, which afford a user with great power the ability to view any part of Middle Earth (Tolkien 2012). Palantir as an organisation has a similar role with respect to reality, wherein the company builds tools that aggregate massive quantities of data from disparate sources. This tooling allows organisations to comb through datasets with the promise of improving efficiency of

decision-making processes, particularly for “Defence Decision Making” (Palantir 2021).

2.2 Gotham

Where Palantir is the product builder, Gotham is the product. It is primarily designed for and sold to governmental organisations, and so is often referred to as the “Government Offering” (Neslen 2021). It has evolved out of a long-standing relationship with the USA’s Intelligence Services, and has been used as a predictive policing system from as early as 2012 (Richardson et al. 2019).

3. THE PROJECT

Gotham itself is a highly protected platform, with very little public information about how police departments are utilising and deploying it. Palantir have been careful to avoid the day-to-day usage in promotional materials, instead focusing on direct military usages. This project aims to highlight what information police departments using Gotham have access to, and how invasive this data tends to be.

3.1 The concept

The data gathering performed by certain Police departments can be highly invasive, to the point that they will have data on individuals who have never been wanted or directly observed by the department. The piece itself aims to be a creative response to the lack of information readily available on the Gotham operating system. For example, it will contain the same personal information that is known to be stored within Gotham from leaks (Haskins 2020). This data itself will be generated in real time as a viewer accesses the piece, wherein they will be given a name and a series of identifying traits, such as their address or the car that they drive. The goal being that it will help viewers to understand that their “private lives” are not necessarily private.

3.2 The visual output

Whilst the concept is heavily rooted in backend database programming, the final output that users see will aim to reflect the operating system style of output that users of Gotham would see when entering a query: A graph view that highlights and indicates certain patterns, as seen in Figure 1.

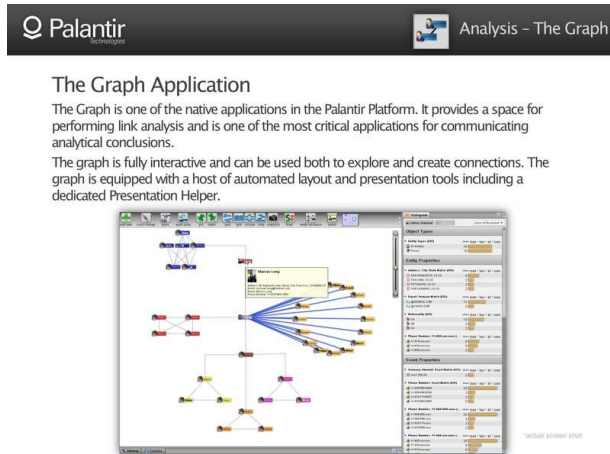


Figure 1: A leaked screenshot of a presentation given by Palantir, via wikileaks (Haskins 2020).

As Haskins notes, a lot of these potential links are presented as facts, whilst they may not necessarily be so, which will also hopefully be reflected in the final piece.

3.3 Analysing prior works

The most similar piece of work, and the one that inspired this project, is “PRISM: The Beacon Frame.” by Julian Oliver and Danja Vasiliev. The speculative design of a piece of technology is very intriguing, and highlighted the fact that doing a creative response that looked at a very secretive technical tool was an idea that could be completed with very interesting results. The artists built a series of iterations of a deployable cell tower that mimicked the same surveillance technologies that it is known that state surveillance agencies use (Oliver & Vasiliev 2014). Once installed, the cell towers would ping mobile devices within the vicinity with a text message, adding a more direct level of viewer engagement. Their work also highlights how uncomfortable the public is with the idea of having their phones tracked, as a series of complaints were made to the technical coordinator where they were presenting, thus resulting in the work being shut down.



Figure 2: PRISM: The Beacon Frame (Oliver & Vasiliev 2014).

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Using Voice Input to Control and Interact With a Narrative Video Game

Andrei Copaceanu
School of Computing and
Mathematical Sciences
University of Greenwich
London, UK
a.copaceanu@gre.ac.uk

Jonathan Weinel
School of Computing and
Mathematical Sciences
University of Greenwich
London, UK
j.r.weinel@greenwich.ac.uk

Stuart Cunningham
School of Computer and
Engineering Sciences
University of Chester
Chester, UK
s.cunningham@chester.ac.uk

1. INTRODUCTION

With the advancement of artificial intelligence (AI) over recent years, especially the breakthrough in technology that OpenAI achieved with the natural language generative model of ChatGPT (Roumeliotis & Tselikas 2023), virtual assistants and voice interactive devices such as Amazon's Alexa or Apple's Siri, have become popular with the general public. This is due to their ease of use, accessibility, and ability to be used without physical interaction (Lopatovska et al. 2018).

When it comes to the video games industry, there have been attempts to implement voice input as a core mechanic, with various levels of success. Ultimately, voice input has been mostly used as a separate mechanic or as an alternative to traditional input methods (Allison et al. 2017).

This project will investigate different methods of using voice input to control and interact with a narrative video game. The research will analyse which method is most effective in facilitating player control of the game and identify challenges related to implementation. This paper also includes a work-in-progress demonstration of a voice-activated game made in Unreal Engine.

2. BACKGROUND

2.1 Voice interaction in video games

Throughout video game history, with each technological breakthrough, there has been a rise in interest from developers to produce games that use voice interaction (Allison et al. 2018).

One major contributor in this area is Nintendo, which has been at the forefront of innovation when it comes to voice interaction. For example, the Famicom had a microphone incorporated in the

controller as an on-off switch for certain interactions such as attempting to negotiate a lower price for items with the shopkeeper in *Kid Icarus* (Nintendo R&D1 1986). Later, the Nintendo 64 had a voice recognition add-on that introduced and popularised the virtual pets with *Hey You, Pikachu!* (Ambrella 1998) by using keywords as voice input. Along similar lines, the Nintendo DS also successfully popularised voice interaction with games such as *Nintendogs* (Nintendo EAD 2005), that took the same concepts for virtual pets from earlier games, and improved on them, increasing the number of interactions, improving the voice recognition and making it more accessible by being implemented on a portable device (Kiiski 2020).

With the increase in popularity of voice chats in video games, a new wave of voice input games has arisen in North America. In Western media, most games that made use of voice input were strategy games in which the player could give orders to multiple units. The most well-received voice input system was present in *Tom Clancy's EndWar* (Ubisoft Shanghai 2008), a real-time strategy game that was released for consoles and features a Who-What-Where pattern to control the units. The system was praised for its elegant and reliable solution for the ergonomic constraints of the console format (Allison et al. 2017).

More recently, following the improvement of AI and language processing, *Phasmophobia* (Kinetic Games 2020), is a four-player co-op virtual reality (VR) game, which showed what can be done when voice interaction is incorporated in a relevant context. In this case, players are tasked to investigate haunted locations and determine which type of ghost is present in that location. The players are encouraged to utilise microphones to communicate between themselves, but also to interact with the ghost. The interaction with the ghost is done through recognition of key phrases.

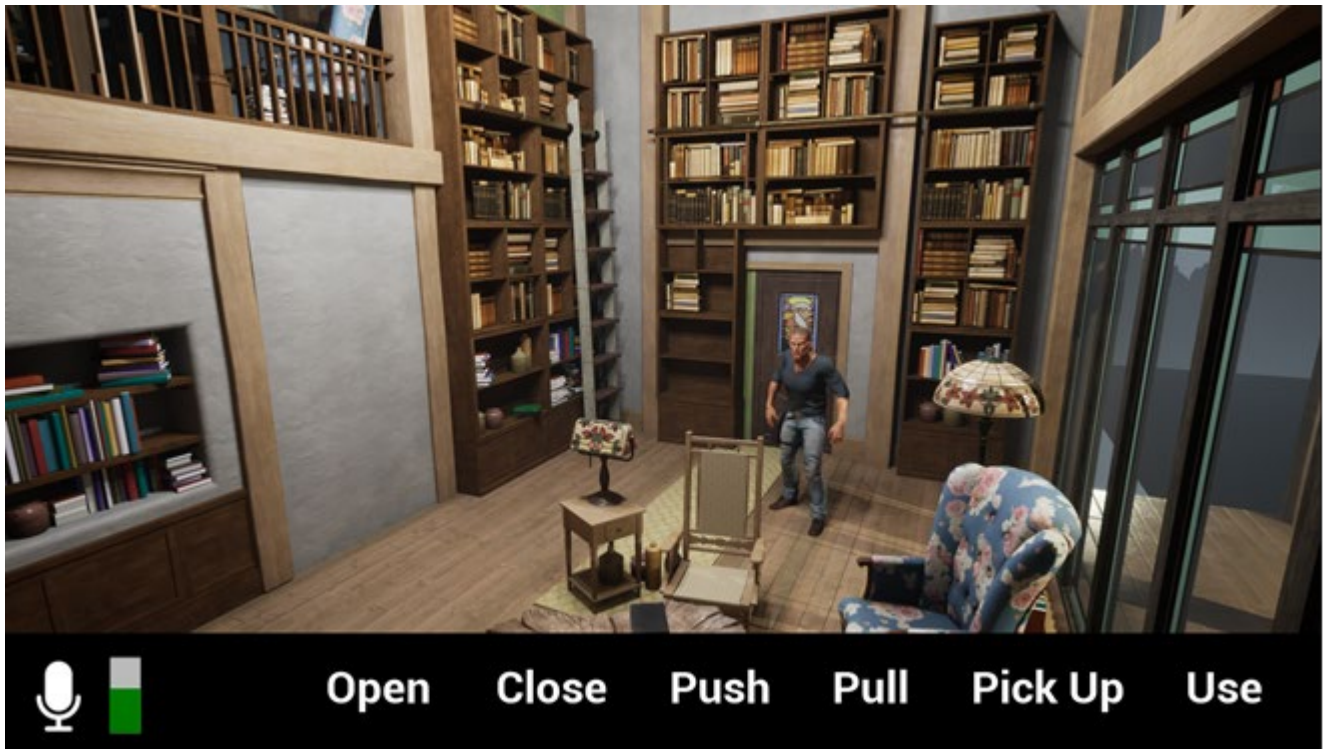


Figure 1: Screenshot from the prototype showing the voice input system listening for the keywords on display

The players can use items such as a 'spirit box', which allows them to put questions such as "Is this your home?", in the hope of a response that would help the players identify the type of the ghost. The ghost would also listen constantly to the player's communications, and would change its behaviour based on words such as "Scared" or "Hide". This not only makes the experience more immersive, but it introduces gameplay elements that otherwise wouldn't be achievable (Stanton 2020).

2.2 Narrative video games

Narrative video games feature their story as a core element. Within this broad umbrella term, the genres that put the most accent on the story, characters, and word-building are adventure games and their sub-genres, such as visual novels (Mallon & Webb 2005).

Interaction with narrative video games is often achieved through natural language, with early examples such as *King's Quest I* (Sierra On-Line, 1984) requiring the player to type text: a verb representing the action and a noun representing the target, to interact with the game.

3. A VOICE ACTIVATED GAME PROTOTYPE

The goal of this project was to investigate and analyse different methods of implementing existing

technologies for voice recognition control in a game created in Unreal Engine 5.

The game is set in a small room where the player must escape by investigating, finding clues, and solving puzzles. Interaction is solely through voice input, drawing from past adventure games like *King's Quest I* (Sierra On-Line 1984), with verbs such as "Open" or "Pick up" to trigger actions. Inspired by *Phasmophobia* (Kinetic Games 2020), players can also engage with the main character by asking questions, adding depth and personality.

Two voice input methods are employed:

- The first system contains a library of predefined keywords that represent actions or objects. The game listens to the player's voice input using voice processing and identifies the keywords to trigger actions. This system ensures reliable responses but requires extensive synonym registration to avoid player frustration.
- The second method transcribes the player's input and feeds the text to an AI for natural conversation. While this promotes fluid interaction without specific word reliance, AI responses may be less dependable, necessitating constraints and safeguards against revealing answers.

Early tests showed that the first method proved to be more reliable and efficient for actions such as investigating the area or giving orders to the character, while the second method was more engaging when interacting with the character, creating more diversity in replies and making the conversation more believable. As both systems proved to work better where the other one had flaws, a combination of the two systems was implemented in the final prototype.

4. SUMMARY

The outcome of this project is a prototype that utilises existing technologies and applies them in a narrative video game, making use of the natural language interaction that corresponds with this type of video game. The project has its flaws, especially when it comes to recognising different player accents, but it still is in its early prototyping stage.

For future development, more accent should be put on accessibility, by increasing the number of accents that the language processing can recognise, on the user interface as right now is not very aesthetic and gives away too much information, a more diegetic user interface would be ideal, and more improvements on the voice processing system as sometimes it does misunderstand the player and activates the wrong action.

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Hybrid Temporal Detectivism: The interplay of detective aesthetics, temporal dynamics, and artistic fictioning

Zidian Pan
Goldsmiths University of London
London, UK
zpan002@gold.ac.uk

1. INTRODUCTION

"Hybrid Temporal Detectivism" is a proposed artistic approach I am developing, aimed at transcending the conventional boundaries of time to unveil truths. This approach amalgamates perceptions from historical insights, contemporary events, and future explorations. It regards the type of work like detective not as a science but as a body of philosophy or aesthetic, weaving together various temporal dimensions to synthesize diverse perspectives and understanding of reality. Since the process of demonstrating this methodology is not linear, but is on the process of expanding, constantly returns to give a rise to generate sub-branches. This paper is written to explain the methodology itself and its possible implements. The details will be presented in the form of hypertext.

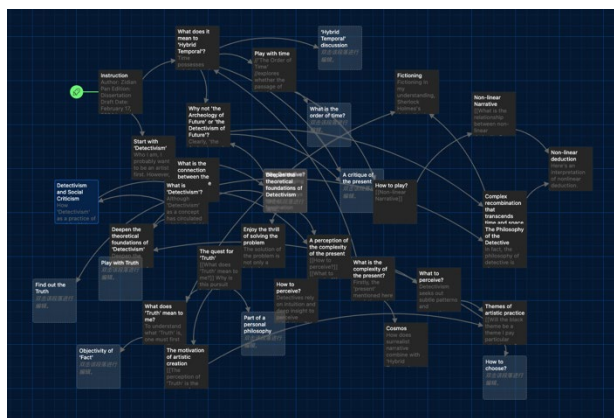


Figure 1: Hypertext Draft Snapshot Showcasing Non-linear Narrative Structure

2. DETECTIVE AESTHETICS AND THE FUSION OF TIME

2.1 Inquiry into the Hybrid Nature of Time

"Hybrid Temporal Detectivism" alleviates some of the confusion between subject and object and the cyclisation of time that occurs when I try to practice it, distinguishing it from artistic methods like "Future Archaeology". The futurity of the present is a perspective I am interested in, but it is not a way of acting that I want to promote. Unlike many futurist frameworks that lean towards utopian visions of the future, "Hybrid Temporal Detectivism" places greater emphasis on the contemporary social perception, intertwined with latent perceptions of the "past" and "future". Meanwhile, this approach fosters an epistemological investigation into the blending of factual and fictional elements within "present" imaginative constructs.

2.2 Exploring potential in detective narratives as an art

My journey with "detectivism", or "detective", began as a retrospective quest to define the investigative mindset I sought to embed in my favourites.

I have always been obsessed with literature, film and television in the deduction genre, to the point where I only play deduction games, and a detective is a fascinating role to play in an identity that surprisingly does not exist in today's society. I then returned to my passion for art, and amazingly discovered that I love that the two fields are perhaps meditatively related, as many of the characteristics of a detective can be mingled with an artist, or more justly, should

be those of my favourite artists, as art cannot be defined. For example, both possess an extremely keen and thorough observation of social facts. And they both focus on interpreting the "reality" they observed, or to say, fictioning the "truth" they perceived, albeit for different purposes. Eventually they will present this fictioning, which will end up in a conceptual vehicle.

The detective figure can articulate multiple orientations to truth, reality, and fact—a conceptual space with great potential. While "detectivism" as a concept already circulates within the field of perception studies, my particular use of the term stems from a personal interest in darker themes that enervate my artistic practice. Its investigation begins with Gilles Deleuze based on Rob Coley's study, who commends crime fiction for providing an image of thought that works against humanist orthodoxy. Yet present circumstances demand investigating a blacker kind of noir, one that operates negatively, a noir theory that can be detected in the strange realism of Francois Laruelle. This focus on crime inherently parallels the strong social commentary. Detective narratives reveal blind spots of observing societies and fractures in ideological surfaces. The detective-like character provides a compelling framework for artistically exploring the intersection between personal motivations and broader social forces. The location on the margins of society provides me with a potential unique vantage point in exposing and criticizing normative constraints. The detective mode can provide sharp artistic commentary on the constructed nature of social "truth". I am very willing to incorporate these characteristics into my own artistic creation and have always incorporated them into my system.

3. POSSIBLE PRACTICAL IMPLEMENTS

This methodology will not only be presented in the form of hypertext but will also be integrated into my future artistic practice. For its inherently non-linear state when performing. This state naturally leads me to explore and employ techniques such as montage and stream of consciousness in my future artwork. These techniques allow me to transcend the boundaries of time, stitching together pieces of the past, present and future to create a layered and dynamic narrative space.

Furthermore, the inherent contradictory elements of "Hybrid Temporal Detectivism" emphasises the co-existence of the real in different temporal dimensions. This brings me to consciously introduce and explore not only past historical events - be they historical fictions or historical facts - but also the

current state as well as possibilities of future when applying this methodology to my practice. This process goes beyond the level of simple symbolic representation or reliance on the viewer's associations and seeks to construct a multi-dimensional spatial and temporal framework within the work.

The real-time deductive nature of the work is another key feature of "Hybrid Temporal Detectivism". This dynamic interpretation means that each viewer may have a unique reading of the artefacts based on their own understanding and feelings. At the same time, it also implies that the creation itself has the potential to generate in real time, thus constantly presenting new presentations and interpretations.

4. CONCLUSION

Overall, "Hybrid Temporal Detectionism" provides a novel logical framework that allows us to infinitely dismantle and re-understand worlds, landscapes, objects and even facts themselves. The exploration and application of this methodology, like the redefinition of the concept of "world" presented by Federico Campagna, it invites a journey into underlying reasons, transcending a mere recounting of facts towards a deeper, logical exploration of the complex interconnections that constitute our surroundings. "Hybrid Temporal Detectivism" is a methodology that marries fact-finding with creative fictioning, unveiling the modes of perception through a unique aesthetic lens.

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Horror in Modern and Retro 3D Games

Christopher Folorunso
University of Greenwich
London, UK
cf8919n@gre.ac.uk

Jonathan Weinel
University of Greenwich
London, UK
j.r.weinel@greenwich.ac.uk

Nuno Otero
University of Greenwich
London, UK
N.R.PalmeiroOtero@greenwich.ac.uk

1. INTRODUCTION

Retro games are technological marvels. Programmers and artists of the late 90s and early 2000s had the unique task of creating aesthetically and visually pleasing games art and design while needing to stay within the strict budgets and allowances of the game engines of that period, these taking the form of limited geometry per object, less complex lighting and rendering power as well as small room for simulation such as hordes of even flocks of birds. These restrictions were mostly based on the game engines features, as well as the target platforms such as consoles or PCs. All of the games from the time had to deal with these restrictions until a new engines and technologies were developed.

These limitations, far from hindering creativity, created an environment where storytelling, character development, and atmospheric tension became key to delivering a truly terrifying experience. Unlike today's high-definition worlds, the low-definition textures and objects of retro horror games were less about visual fidelity and more about creating a canvas for the player's imagination to fill in the gaps.

This research explores the evolution of horror games from their pixelated past to the present day. In recent times, various horror titles have sought to revisit the styles of retro horror games, however this project questions whether modern games' attempts to evoke nostalgia through direct scares and visual filters maintains the appeal of original 90s horror games like *Resident Evil* (Capcom 1996), *Parasite Eve* (Square 1998) or *Silent Hill* (Team Silent 1999). Exploring this area, this project combines elements of retro and modern horror games in order to produce a game demo product.

2. HORROR THEMES IN VIDEO GAMES

At the heart of classic horror games was the survival aspect—players were engaged in a battle of wits and resources against the unknown. The limited graphics of the time meant that much of the fear and suspense came from the stories told within these pixelated realms and the characters that inhabited them.

Facing the technological confines of the PlayStation hardware in the mid-90s, the development team behind *Resident Evil* had to navigate significant challenges to create the game. Shinji Mikami, the game's director, said:

It was incredibly difficult to produce the game for the PlayStation hardware back then... Initially it was intended to be a full 3D production, but we had to give up on that idea and modify Biohazard (*Resident Evil*) to use pre-rendering: if we hadn't done that, it would have been impossible to properly realise my plans for the game. (Games Radar 2021)

This shift to pre-rendered environments, while enhancing graphical fidelity, required a compromise on "operability," making character movement and interaction more cumbersome due to the need to reduce polygon counts for characters.

Mikami and his team leaned into the atmospheric and psychological aspects of horror, utilising the game's environment, sound design, and narrative elements to build tension and fear. For example, the decision to use pre-rendered backgrounds allowed for a greater level of detail and atmospheric depth, setting a chilling stage for the horror that unfolds. The infamous "door-opening" sequences, a direct result of navigational and graphical limitations (Games Radar 2021), became iconic moments of suspense, amplifying players' anticipation and fear of what lay on the other side. The survival

mechanics in retro horror games like *Resident Evil* can be seen as early examples of how game design and technological constraints combined to evoke a psychological impact on players.

Furthermore, Habel and Kooyman (2014) discuss 'agency mechanics' in survival horror video games, which is particularly relevant to the development and gameplay of *Resident Evil*. The choices made by Mikami and his team, such as the use of pre-rendered backgrounds and the "door-opening" sequences, can be understood as deliberate design decisions that manipulate player agency to enhance the horror experience. This limitation of player control and the consequential amplification of suspense and fear are key elements that define the survival horror genre and were done on a technological budget. As highlighted by Thon (2019), modern indie developers have drawn inspiration from the survival mechanics and atmosphere-driven storytelling of retro horror games. Indie games often use similar methods but with the creative freedom provided by advances in technology like faster rendering techniques and better engines.

3. HORROR DESIGN AND ITS EVOLUTION IN GAMES

Older horror games capitalized on primal fears—darkness, the unknown, and survival—using limited graphics and sound to weave a tapestry of dread. The gameplay in these titles was centred around navigating fears through resource management, puzzle-solving, and combat. However, as noted by Habel and Kooyman (2014), the agency mechanics in survival horror games played a crucial role in this engagement, where the manipulation of player agency heightened the horror experience. These mechanics often revolved around directly confronting threats or strategically managing limited resources to survive another encounter.

In contrast, modern retro-inspired horror games shift the focus towards psychological experiences, aiming to disturb the player or isolate them. This shift is not just through narrative and themes but through the deliberate use of atmosphere created by visual shaders and sound design. Thon (2019) discusses how recent indie horror games explore the aesthetics of horror through a selection of indie titles, showcasing how these games invite players to "play with fear" in various ways. The use of atmosphere, narrative depth, and the psychological portrayal of enemies in games like *Amnesia: The Dark Descent* (Frictional Games 2010) and *Neverending Nightmares* (Infinitap Games 2014) illustrates this evolution towards a more immersive horror experience.

Many modern titles forgo traditional combat in favour of exploration and evasion, placing a greater emphasis on narrative and atmosphere rather than minute-to-minute gameplay. This evolution is reflected in the design of enemy encounters, which are not necessarily meant for the player to overcome but to enhance the sense of vulnerability and terror. As Perron (2004) articulates, the psychological impact of horror game mechanics extends beyond the physical threat of enemies, engaging players in a deeper, more disturbing level of horror through the anticipation of encounters and the manipulation of their expectations.

The portrayal of enemies in modern horror games as unstoppable forces or manifestations of psychological themes, rather than mere obstacles to be killed, represents a significant shift in horror game design. This approach aims to evoke a sense of unease and terror that lingers with the player, making the horror experience more profound and personal.

By examining the evolution of horror design in games, from the survival-focused mechanics of retro titles to the atmospheric and psychological depth of modern indie games, it becomes evident that the genre has undergone a significant transformation. This evolution reflects a broader understanding of horror as a genre capable of exploring complex themes and emotions, leveraging game mechanics, narrative, and atmosphere to create experiences that resonate deeply with players.

4. THE PRODUCT PROTOTYPE

The product prototype is a horror game that will present a range of enemies, each reflecting different periods in horror gaming history. Figures 1 and 2 show screenshots from the latest development build. The goal is to analyse and replicate the essential aspects that make these enemies effective in inducing fear, thereby acknowledging the progression of horror within video games.



Figure 1. Screenshot from the product prototype.



Figure 2. Screenshot from the product prototype.

Influenced by early horror games like *Resident Evil*, the game will reintroduce enemies known for their relentless pursuit and grotesque. This aims to challenge players by revisiting the concept of being pursued, a common feature in the early horror genre.

For more modern indie horror games, enemies in this game will also represent psychological fears, tying directly into the narrative's themes of isolation. Following Thon's (2019) insights, these enemies will contribute to the story's depth, embodying the protagonist's internal struggles and enhancing the game's psychological impact.

Incorporating elements of modern atmospheric horror, certain enemies will be designed to evoke fear through implication rather than direct confrontation with the player. This design is intended to play on the fear of the unknown, using sound and light for threats that may not always be visible.

5. SUMMARY

This research will attempt to examine the transformation of horror game design, using this to inform the design of a new game prototype. By analysing the survival roots of retro horror games and the psychological narrative focus of modern titles, the proposed product prototype aims to combine the primal fears and survival elements of retro horror with the atmospheric psychological horror of today's games.

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Exploration of the Reliability of Criminal Sentencing: Assessing the impact of current sentencing systems in the USA on marginalised communities

Aila Araghi
University of the Arts, London
Creative Computing Institute
45-65 Peckham Road, SE5 8UH, UK
a.araghi0120211@arts.ac.uk

1. INTRODUCTION

Criminal sentencing within the justice system has become a contentious issue, raising questions about the transparency of decisions that significantly impact the lives and freedom of individuals. Reasonable decision-making, "Ratio Decidendi," is a complex and intricate process with multifaceted layers. Therefore, achieving 'accurate' and 'just' results within the law is subjective. As judges interpret evidence and can make different decisions based on identical data, these inexplicable and inconsistent outcomes produce a 'noise' in the system (Kahneman et al., 2021). A tendency for leniency or stringency is an inherent bias that causes noise, which is a systematic error.

Addressing these challenges, the United States (USA) is exploring artificial intelligence (AI) integration to complement human juvenile assessments, building on President Obama's 2016 "Data-Driven Justice" (DDJ) initiative. This integration of AI aligns with a broader trend, where rapid technological evolution is becoming deeply ingrained within society. DDJ aims to enhance the consistency of risk evaluations and crime sentencing, combating the inherent biases in decision-making (Barabas et al. 2018). Nevertheless, algorithms introduce new concerns, since AI, like human judgement, is susceptible to biases and inaccuracies, particularly towards marginalised communities.

2. NOISY JUDGEMENTS

Psychologist Daniel Kahneman outlines the detrimental impact of inconsistent judicial outcomes which exacerbate societal inequalities (Kahneman et al. 2021). Studies reveal that seemingly unrelated factors, such as hunger or fatigue, can unintentionally introduce implicit biases into judicial decisions, leading to harsher perspectives. For instance, a 2011 study found that judges exhibited the greatest strictness just before lunch or at the end of the day, with individuals heard during these times facing nearly zero chances of a favourable ruling (Danziger et al. 2011). This variability in decision-making was also apparent in Cook County, Illinois, where certain judges were observed spending as little as 30 seconds reviewing each case (Heaven 2020). However, arbitrary factors, ideally irrelevant to rulings, can distort verdicts for individuals. U.S. records highlight a troubling pattern where inmates with Afrocentric features frequently face harsher sentences compared to those with more Eurocentric features.

One example is the case of Kalief Browder, an African American sixteen-year-old arrested in 2010 for allegedly stealing a backpack. Despite the non-violent nature of the alleged offence, Browder spent over three years at Rikers Island, much of it in solitary confinement, awaiting trial, devastating his mental health (Jones 2015). In contrast, consider the case of Brock Turner, a white male convicted three times for sexually assaulting unconscious women in 2016. Turner only received a six-month jail sentence from the judge, Aaron Persky (Vitiello

2017). The disparity in sentencing has had jurors facing criticism for cherry-picking, reflecting the reinforcement of damaging racial stereotypes and contributing to inaccurate crime forecasting data.

Overall, these discrepancies in sentencing further embed inequalities in the American legal system. Despite these challenges, Kahneman (2021) suggests the concept of "noise audits," where systematic errors can become "hygienic noise" for the system (Kahneman et al. 2021). While inherent noise exists, deliberate efforts, such as establishing transparent guidelines or regular education can address biases and enhance fairness for marginalised communities – cleaning the system's health and increasing the quality of decision-making.

3. ALGORITHMIC SOLUTIONS

In the fourth industrial revolution, society is advancing through smart and autonomous systems fuelled by data, which means machine learning can be crucial for reducing noise and enhancing the reliability of the legal system (Suryadi 2021).

Psychology professor Paul Meehl stated in 1954 that mathematical algorithms will always make better predictions than physical beings as "humans add more error" underscoring the need for objectivity in legal proceedings, an algorithmic solution (Fry 2018). Decisions must align with the fundamental values of the United States Constitution. Particularly, the Fourteenth Amendment that guarantees equal protection under the law – ensuring fair and impartial treatment for all individuals, irrespective of race, ethnicity, or other characteristics.

Utilising algorithms therefore embodies beneficence, a key ethical consideration from the Belmont Report (1979), by minimising the discriminatory consequences of noisy judgments. For instance, a prevalent AI system in the USA, affirming Meehl's half-century findings, would be the Public Safety Assessment (PSA). By processing an individual's criminal history, biographical, and psychological information, these algorithms compute a risk score, categorising offenders into different risk levels (Freeman 2016). PSA's transparent approach, publishing its factors and methods, aligns with AI accountability principles.

This transparency empowers judges, fostering informed decision-making. Techniques like re-sampling data and regular audits highlight PSA's commitment to justice preservation by mitigating biases, particularly racial bias (Belova 2021). Ultimately, PSA's strategy reflects core US principles, due process, equal protection, and the rule of law - ensuring AI positively contributes while

upholding fundamental values in the pursuit of data-driven justice.

4. THE INCENTIVES DILEMMA

However, ethics professor Hubner Dietmar emphasises how AI-driven penalisation can also demonstrate difficulties in combating bias; fuelling debates about the appropriate balance between human judgement and technological intervention in the legal system. (Hubner 2021). An example of oppressive AI is the Correctional Offender Management Profiling for Alternative Sanctions (COMPAS), widely adopted by states like California and Wisconsin. While excitingly introduced in 1998 with the intent to predict recidivism, COMPAS faced scrutiny in the 2016 Supreme Court's 'Wisconsin vs. Loomis' case. This case, surrounding defendant Eric Loomis, who was involved in a drive-by shooting, exposed a lack of statistical parity in COMPAS outcomes across different demographic groups, challenging its perceived objectivity. Loomis, marked as 'high-risk' by opaque algorithms, found himself unable to comprehend the reasoning behind this classification, leading him to argue the use of COMPAS violated his individual rights. The hidden processes within the neural networks ignited concerns of algorithmic oppression, jeopardising the rule of law. The case underscores the imperative for robust safeguards to govern the use of such tools in legal decision-making.

Yet, the adoption of tools like COMPAS in the United States raises significant ethical concerns, particularly regarding potential biases which may violate civil liberties. Criminology professor Richard Berk highlights the risks of algorithmic errors, comparing false negatives to releasing a dangerous individual, akin to a "Darth Vader," and false positives to wrongly categorising a low-risk person as a threat, a 'Luke Skywalker' scenario (Berk 2010). However, this analogy may underplay the real-world impact of such misclassifications. Mathematician Hannah Fry emphasises the dangers of relying too heavily on algorithms, noting their potential to exacerbate societal and racial imbalances (Fry 2018).

5. PANDORA'S BOX

Legal scholar Leah Wisser draws a compelling parallel between algorithmic risk assessments and the myth of Pandora's box, highlighting unforeseen consequences once unleashed. The significant challenge lies in the opacity of algorithms like COMPAS, creating a metaphorical 'black box' containing obscure internal mechanisms. This leads to public uproar due to issues of transparency and fairness (Wisser 2019).

In May 2016, Julia Angwin's analysis of COMPAS further revealed potential unreliability and racial bias. The study, conducted in Broward County, Florida, involving over 7000 individuals arrested between 2013 and 2014, exposed significant inaccuracies in COMPAS predictions. Notably, COMPAS incorrectly predicted that Black defendants who did not re-offend would do so at a rate of 44.9%, nearly twice the rate for their white counterparts at 23.5%. Conversely, the predictive model inaccurately forecasted that white defendants who did recidivate would not re-offend at a rate of 47.7%, almost double the rate for their Black counterparts at 28.0%.

These findings underscore a clear bias in COMPAS scores, systematically favouring white defendants by underpredicting their recidivism and, conversely, overpredicting it for Black individuals (Angwin et al. 2022). These biases not only compromise the reliability of COMPAS but also contribute to the perpetuation of systemic inequalities establishing a troubling feedback loop created by a biased input and output. Thus, predictions influence subsequent data and further exacerbate existing disparities.

6. CONCLUSION

In summary, upholding morality is vital in a society increasingly reliant on technology, especially within the criminal justice system. This system must inherently embody the principles of respect for persons by treating every individual with dignity, beneficence by promoting well-being and minimising harm, and justice by ensuring fairness

Different communities may have distinct perspectives on what constitutes a fair and just outcome. Thus, to mitigate the discriminatory effects of corruptive technologies and to align with President Obama's vision for Data-Driven Justice (DDJ), ongoing policy updates must ensure transparency and fairness. In this increasingly data-driven age, society should scrutinise data training processes for a more diverse and inclusive approach and equity in every decision. As the intricate design process of AI unfolds under the guidance of developers, the responsibility falls squarely on them to maintain inclusive intentions, ensuring these technologies reflect these ethical principles. Justice is not a 'one-size-fits-all' concept.

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Enhanced Squad Behaviour in Tactical Action Games

Jagunmolu Bamidele Oke
School of Computing and
Mathematical Sciences
University of Greenwich
London, UK
Jo8199@greenwich.ac.uk

Jonathan Weinel
School of Computing and
Mathematical Sciences
University of Greenwich
London, UK
J.R.Weinel@greenwich.ac.uk

Nuno Otero
School of Computing and
Mathematical Sciences
University of Greenwich
London, UK
N.R.PalmeiroOtero@greenwich.ac.uk

1. INTRODUCTION

Artificial Intelligence (AI) in games includes behaviours and the decision-making processes of Non-Playable Characters (NPCs) (Rhalibi, Wong & Price 2009). AI in video games has contributed great deal to player enjoyment and immersion, yet challenges remain to improve game AI. In particular, this project focuses on tactical coordination among groups of agents.

A single NPC spawned in play space seems to be believable but when more NPCs are spawned, choreographing NPCs as a coordinated squad in combat becomes a hard problem. Karlsson (2021) describes solving this problem by breaking it down into smaller fundamental problems including deciding what the squad want to achieve, identifying the best member for each required role, finding the best position for member relative to both enemies (i.e. the player) and their team-mates.

This project will delve into background research on AI techniques involving spatial analysis, role assignment, NPC behaviour, and tactical techniques for squad-based combat scenarios. The investigation will involve the design, development and evaluation of a prototype. The goal of this project is to uncover methods for designing and developing squad-based NPCs that can assess situations, have group objectives, and recognise individual team members' strengths and weaknesses. It will also explore how to identify the best team member for unique roles and find the optimal position for engaging, recovering, flanking, and other related manoeuvres, based on the line of fire and other environmental factors, all within the context of a game engine.

2. BACKGROUND

One of the important factors in creating believable AI characters in-game AI, especially in the shooter genre comes from how the agents act and react in the play space. They need to be intelligent and reactive to the current context of the gameplay experience, and make decisions accordingly. In what follows, two key principles that benefit this process will be described.

2.1 Spatial reasoning

Spatial Reasoning elevates decision-making and coordination by giving NPCs more knowledge of the play space through establishing a cell grid or point collection that is weighted based on important gameplay factors such as the availability of cover, open space, combat vector, and others. By examining the environment through the points or a grid, it is possible to identify the optimal location for specific behaviour (Johnson 2017), thereby surpassing the capabilities of traditional pathfinding.

In tactical games NPCs need to work together as a team and perform coordinated movements whilst maintaining their level of cohesion and adhesion. In their talk on 'Believable Tactics for Squad AI', Champandard, Dunstan, & Jack (2012) discuss mentioned how spatial reasoning helps determine which teammates should make specific movements, optimizing and maintaining their cohesion and adhesion.

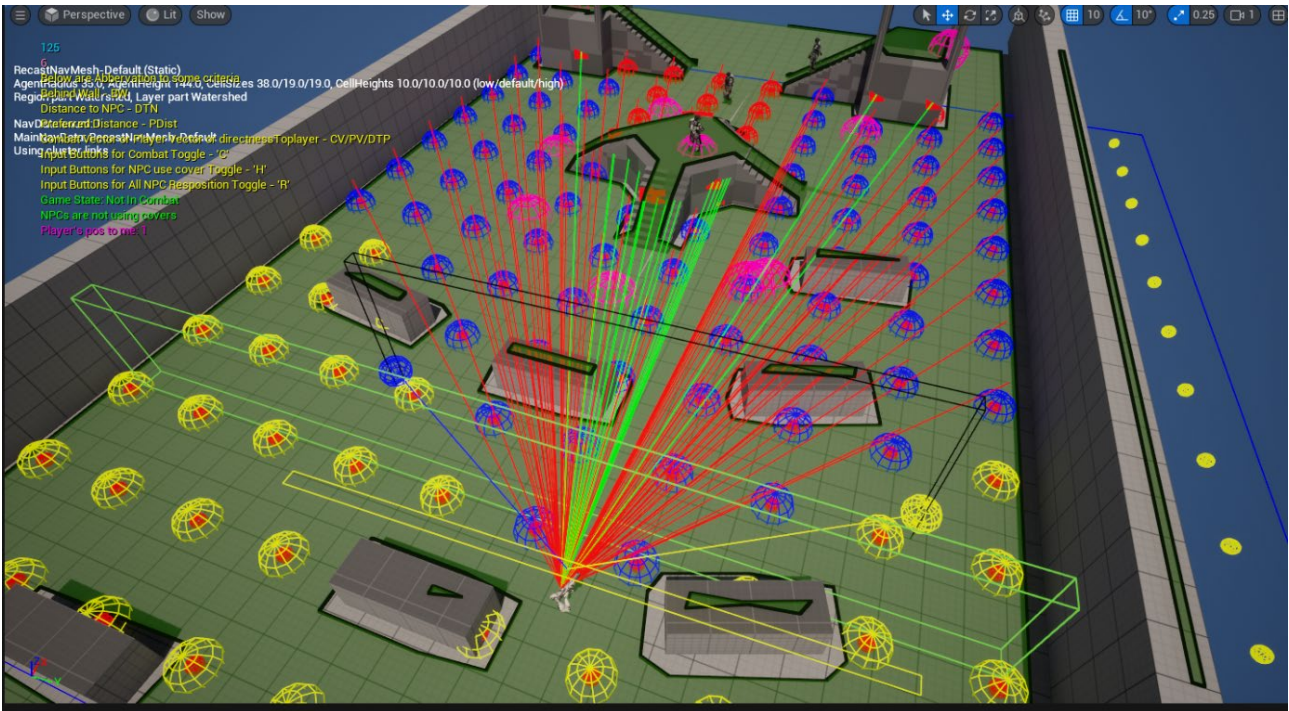


Figure 1: Screenshot of the simulation in the editor, where NPC are utilizing the Custom Spatial Reasoning Module considering the player's Field Of View (FOV).

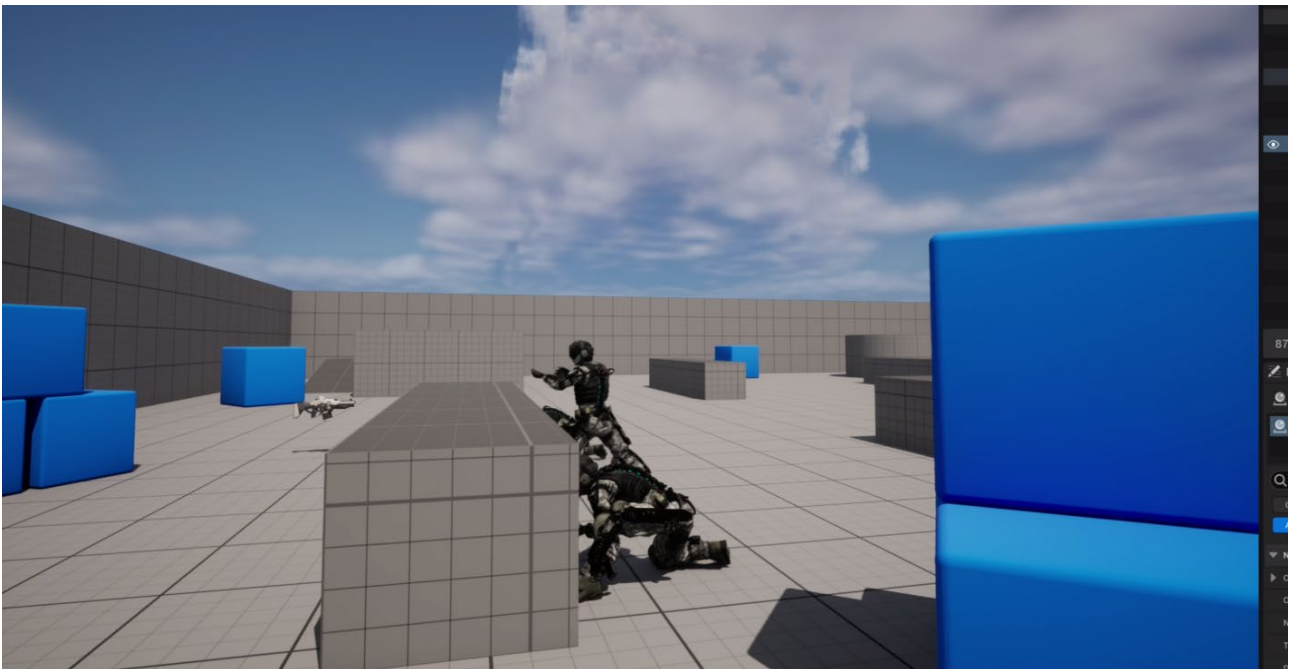


Figure 2: Screenshot in the editor, of NPC taking turn at shooting.

2.2 Role assignment

Some studies suggest that turn-taking and assignment of key roles is crucial for coordinated decision-making in video games and can improve and enhance the overall experience (Champandard, Dunstan & Jack 2012). For instance, according to Dunstan (2012) if a group of NPCs pursues a shared

goal that includes a single NPC tasked with cover posting, coordinating between NPCs becomes challenging, potentially leading to less coordination and unwanted emergent behaviours when all contend for the cover posting.

Alternately, we may consider a Combat scenario against the player in a situation where a group 'x'

NPCs are all attacking and potentially, damaging the player. As the player eliminates the NPCs, the combat becomes progressively easier, transitioning into a linear difficulty curve. For a game, this may be unwanted. However, according to Matthew (2017), this issue can be mitigated by assigning the attacking role to only 'n' number of enemies at a time, thereby balancing the difficulty level throughout the gameplay.

3. DESIGN AND DEVELOPMENT OF THE PROTOTYPE

The aim of this project was to investigate how gameplay experience can be enhanced in tactical action video games by designing and implementing enhanced squad behaviour.

The prototype is being developed in the Unreal game engine, which handles the heavy lifting of asset management, graphics etc. For the individual AI, the Unreal behaviour tree system will also be leveraged. A squad coordinator module will be designed to keep track of the play space, spatial analysis and role management.

A custom 'spatial reasoning module' (Figure 1) will generate posts at tools-times, when post-selection is queried. The system collects all the posts and filters them out based on query criteria. The remaining posts are then scored, and it returns the post with the highest score.

The 'role assignment' module (Figure 2) is a sub-module for the squad coordinator where the primary roles (engagers, ambushers and defenders) are assigned to NPCs at load time, and in unique cases at spawn time, when NPCs are spawned in level. Other roles like the 'shooter' and 'flanking' are assigned at runtime based on criteria and current gameplay context.

4. SUMMARY

The objective of this project is to gameplay experience by integrating a custom spatial reasoning module and role assignment into squad behaviours. This should be achieved without adversely affecting the overall gameplay experience (in terms of challenges, playability, and overall game enjoyment). Additionally, the performance should not be affected with a target of 60 frames per second. In case of suboptimal performance, the exploration of spatial hash or bounding volume hierarchies will be considered as options for optimizing the custom spatial reasoning module queries.

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An Investigation Into the Efficacy of Single and Multi-Sensory Brain Entrainment to Achieve Transcendent States for Therapeutic Application

Caz Coronel
Independent Researcher
London, UK
cazcoronel@yahoo.co.uk

1. INTRODUCTION

Only to the extent that someone is living out this self-transcendence of human existence, is he truly human or does he become his true self. He becomes so, not by concerning himself with his self's actualisation, but by forgetting himself and giving himself, overlooking himself and focusing outward.

Viktor E. Frankl

I propose that a transcendental experience can have significant therapeutic benefits for conditions such as ADHD, PTSD and Depression. A transcendent state refers to a state of being that is beyond a person's normal everyday experience and beyond their ordinary sense of self.

The transcendent brain state can be encouraged through various forms of brain entrainment.

The efficacy of different sensory entrainment, either in a singular form or combined can be tested both anecdotally and scientifically.

This research aims to comprehensively assess the therapeutic benefits of the transcendent state, seeking to advance evidence-based practices in mental health treatment and wellbeing.

Brain Entrainment is the synchronisation of rhythmic neural activity through external stimuli with the purpose of shifting (or maintaining) the brain into desired states.

To behold a beautiful painting and feel awe, or hear a piece of music that moves you, is to experience this phenomenon.

It is possible to reverse engineer brain states through monitoring and analysing brainwave data. With this information we can create various types of sensory stimulation to guide the brain into desired specific conditions.

This research will focus on achieving the transcendent state.

The Transcendent State is an experience beyond the ordinary. It is a state where an individual's consciousness or awareness expands beyond its usual boundaries.

In this state, people often report a profound sense of presence and an intimate connection to something greater than themselves. The interpretation of what this 'something' is may depend on a person's beliefs or preconceived ideas. Some examples of this are; a greater connection to humanity, Nature, God or the Universe as a whole.

This in turn, can bring feelings of appreciation, gratitude, bliss and elation. Individuals may also gain insights and fresh perspectives.

Neurologically, during the transcendental state there is reduced activity in the posterior superior parietal lobe. This is the area of the brain responsible for locating the self in relation to the external world, distinguishing it from everything else. This triggers

changes in the brain's default network resulting in shifts in self-awareness, perception and consciousness.

A Brain Entrained Transcendental State is particularly beneficial because it can be controlled. Unlike an ingested substance, the experience can be stopped at any point by the participant or therapist. The length of the experience and precise intensity can also be adjusted before and during the experience.

2. THE PURPOSE OF THIS RESEARCH

- (i) Whilst there has been extensive research on brain entrainment in specific areas such as audio or light entrainment, there has been limited comparison between these methods. My research aims to determine which is more effective and if their impact may be improved when combined.
- (ii) To explore the time needed to achieve results.
- (iii) To observe whether habituation impacts effects.
- (iv) To study the immediate and long-term effects of the transcendent experience on mental health.
- (v) To explore the potential applications of brain entrainment induced transcendental states.

3. MEASURING THE EFFECTS

I will compare a wide variety of the brain entrainment; focusing on the most cutting-edge technology available. Examples include:

- **Audio:** The Monroe Institute's 'Monroe Sound Science' and 'Dolby Atoms 3D Binaural'
- **Light:** The Roxiva RX1
- **Visual:** Syntropy, Bio-geometry, Geophilia
- **Olfactory:** entrainment through essential oils
- **Spatial:** The Turin pod, The Orrb
- **Geographical:** sacred spaces built on a power points such as the Giza Pyramids.
- **Tactile:** Haptic and Vitro-acoustic
- **Magnetic:** TMS
- **Electromagnetic:** PEMF

Data collection

Qualitative data from self-reports, interviews and pre-/post-intervention questionnaires will be utilised as anecdotal evidence to assess the effects of entrainment on; emotions, moods, feelings, perceived efficacy in symptom alleviation, attention,

memory, time perception, and cognitive enhancement.

Scientific data will be collected using biofeedback:

- (i) Electroencephalography (EEG): Measures electrical activity in the brain to assess brainwave patterns and states of consciousness. Muse
- (ii) Heart rate variability monitors (HRV) (Heartmath) Tracks changes in the time intervals between heartbeats to evaluate autonomic nervous system function and stress levels.
- (iii) Galvanic skin response (GSR) sensors: Measures changes in skin conductance due to emotional arousal or stress, providing insights into emotional responses during entrainment.
- (iv) Near-infrared spectroscopy (NIRS): Measures changes in blood oxygen levels in the brain to assess neural activity and cognitive function.

	TRANSCENDENT STATE				
	Feed back	EGG	HRV	GSR	NIRS
Audio					
Light					
Visual					
Olfactory					
Tactile					
Spacial					
Geographical					
Combined					
Audio/light					
Light/Tactile					

Table 1: Hypertext Draft Snapshot Showcasing Non-linear Narrative Structure

Existing neurological research will help guide experimentations.

Considerations: Population Variability; gender, age and ethnicity, personal beliefs and preferences, life experience, mood, mental health, physical health, time of day, diet, menstrual cycle, sensory impairment etc.

Contraindications: photo-sensitivity, severe mental health issues, physical impairments etc.

Limitations and Obstacles:

- (i) Preloading the experience with explanation
- (ii) Placebo effects
- (iii) Confabulating influences by confounding variables prior experiences with altered states.

- (iv) Habituation: a decrease in response to stimulus after repeated or prolonged exposure.
- (v) Replicability and subjectivity in experiences
- (vi) Ethical concerns
- (vii) Accurate measurements of biofeedback devices

4. PRESENTING AT EVA

Workshop: I will discuss my proposal, explaining the concepts of brain entrainment and transcendent states and their potential application.

I will provide a practical demonstration of a form of brain entrainment and biofeedback technology for measuring data.

This will be concluded with a five minutes for Q&A with constructive feedback.

Post workshop: I will use brain entrainment within the Turin Pod and the Orrb to collect data using biofeedback technology and use participant feedback, to assess shifts in mental states.

5. FOR FURTHER STUDY

Comparison of different methods of achieving transcendence that do not use brain entrainment

such as : meditation, time in nature, self-induced flow-state, breath-work, energy-works, massage, sex, ingestion of psychedelics or stimulants etc.

Integration with existing therapies such as any of those mentioned in the first paragraph.

Comparison of therapeutic applications of brain entrainment for transcendent states with other methods of therapy, (medication, talking etc.)

Studies related to other 'non ordinary' states.

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Capturing and Preserving Memories of Buryat-Mongol Folklore in Siberia

Margarita Galandina
Researcher & Photographer
mgalandina@gmail.com

1. INTRODUCTION

During my presentation at the Research Workshop held at EVA London in July 2023, I discussed various aspects of Buryat Culture currently available in museums and other places. Regrettably, many of these places have been destroyed, or significantly impacted, by 20th-century Soviet collectivism. As a Buryat photographer, I have aspired to document my homeland's people, clothing, music, culture, and remaining structures and rituals. Although my joint Research Workshop paper last year was too late to include this information, I am delighted to share that my project proposal was selected as one of the three awards of £10,000 by the UAL Mead Foundation. This generous funding allowed me to visit my homeland and capture many aspects of our unknown culture outside the area. Additionally, I will be able to showcase the new work at exhibitions in London, further contributing to promoting and preserving Buryat-Mongol culture.

2. TAYLOR WESSING AWARD FINALIST

I was thrilled to learn that my preliminary project, Ovoo (Timelessness), had one of its images selected among 58 portraits in the final round of the 'Taylor Wessing Awards' at the 'National Portrait Gallery' in London earlier this year. It was a great source of encouragement for me.



Figure 1: 'Self-Portrait with my brother', Ovoo series, Margarita Galandina

In Buryat-Mongol tradition, an Ovoo is a monument that symbolises sacred land. I use this symbol as a metaphor to express my feelings about my ancestral home. My interpretation is based on memories constructed from the oral histories of my family members, and from looking at our family's photographic archive. This project is a personal exploration of the history of Buryat, which I delved into through my family's photographic history. This portrait is a part of the body of work that I produced while studying at the MA Photography program at the London College of Communication (UAL). It had informed my subsequent practice and helped me develop my funding proposal for this new project to further my research and practice.

3. DESCRIPTION OF THE VISIT TO SIBERIA

After securing Mead Foundation Funding, I began to organise and plan the visit to Buryatia, which included setting up contacts with distant family members in remote Buryat sites, reaching out to community members that I was interested in documenting for the project, and the logistics of the trip.

I had considered potential risks and difficulties the journey of such nature could involve, given the current political climate, and therefore consulted with experienced professionals before executing my visit. Some local anthropologists and researchers discussed the ethics of 'working on-site' and documenting members of the community. I received more safeguarding advice from a photo/film professional with specific expertise in engaging in such projects.

I must acknowledge the willingness of all of my family to directly participate in the making of the project, by agreeing to pose for numerous portraits taken by a 4x5 plate camera, a sometimes-tiring process for the sitters, due to the complex and lengthy process of taking a photograph. Altogether, I have photographed around 25 family members, immediate and extended, for this project.

For the project, initially, six sites were chosen, each resembling a personal significance to the author, such as ancestral villages, spiritual sites, and places of worship in the Buryat Buddhist and Shaman traditions. However, the final list of locations grew to nine sites: Olkhon island, Aninsk Monastery, Egita temple, Sosново-Ozersk, Ulan-Ude, Orlik, Ust-Orda, Barguzin, Irkutsk, and Khuvsgul, of which the former one is located in the North of Mongolia.

The final images comprised of a mixture of staged and more documentary portraits, landscapes, and occasional details in still life and close-ups, all taken on different camera formats: 35mm, 120 (6x6cm), and 4"x5" large-format transparency film. Due to the richness of colours in the Buryat culture and the landscape, a conscious decision was made to execute the project predominantly in colour.



Figure 2: Buryat Suvarga, Egita Temple, Landscape, 2023

In addition to a photographic body of work, I used my phone to record most of my movements during the project, capturing video footage of the sites and documenting the entire shooting process. This will provide an added layer to the work, allowing the audience to not only see the photographs, but also engage with the sounds of the Buryat language, experience the landscape in motion, listen to Buryat folklore songs, and witness local dances performed by different 'clans' during the festival. The video will be approximately 10 minutes long and will be displayed alongside the photographs, as additional material for the exhibitions.



Figure 3: Portrait of a Soyot Girl at Ulag-Dag Festival in Sorok, Western Buryatia

On the way to two of the project sites, I was lucky enough to arrive on the day of local festivals, which I managed to capture. One festival in Ust-Orda was dedicated to the 'Buryat National Summer Games', while the other in Orlik, called 'Ulug Dag', was dedicated to the celebration of Indigenous Soyot culture. This festival is held once in two years. The Soyot are an indigenous group that inhabits the Okinsky region in western Buryatia, with a population of less than five thousand.

The festival showcased a range of singing and dancing performances from various Soyot villages, with each group donning attire that symbolised their kin. Figure 3, is a portrait of a Soyot girl, who was part of the children's performance. She is seen dressed in her village's traditional costume while performing their national dance. The festival was a rare opportunity for the Buryat and Soyot community representatives to celebrate their culture. Attendees from different regions of Buryatia, Irkutsk Oblast, and Mongolia flocked to witness the event.

4. PHOTOGRAPHY FORMATS & TECHNIQUES

Creating and preserving artefacts for future generations within indigenous cultures is paramount for their survival. When I was writing my Mead funding application, I emphasised analogue documentation of the project for several reasons. If stored and preserved adequately, the film has a superior archival quality, giving the project longevity and access for future researchers interested in this field. For the leading project's images, I have chosen to capture them on a 4"x5" slow ISO slide film. This resulted in the outstanding quality of the final image and supplied me with a physical artefact, by having a positive physical film to archive.

Conceptually, there was also a reason to shoot the project entirely in analogue; having physical files of the negatives shot from home would serve as a counter-step to preventing cultural memory-fading. A substantial number of the sites photographed that had either perished over time, or were destroyed during the Soviet collectivisation era. For example, having physical photo-files of the Aninsk Monastery, documenting the site's remains, also acts as a metaphor for reinstating the lost heritage and 'framing' its memory, into another physical object.

5. PLANNED OUTCOMES

A one-week exhibition will be presented at the Crypt Gallery, Euston, London, in June 2024, funded by the Mead Foundation Prize. The project will be showcased for the first time during this exhibition. A planned second exhibition will be held at my former university, London College of Communication, UAL in autumn 2024. The exhibition will be arranged with the help of my LCC mentor, the college's graduate engagement team, my MA course teaching cohort, and the LCC Photography Programme Director. Also, there is the possibility of setting up a future show in a Siberian gallery, targeted at reaching out the Buryat audience itself.

I am planning to create an exhibition catalogue to accompany the show and to self-publish a photo book later. I will also re-visit Buryatia and Mongolia to develop the project further and strengthen relationships with more indigenous communities and institutions. Moreover, I aim to keep in touch with a number of Ethnographic Museums in Russia.

I am interested in exploring potential connections between Buryat Culture and First American Museums in the USA. The Siberian people crossed the Bering Straits into Alaska and North America around 10,000 years ago, and there might well be some very exciting cultural parallels to uncover.

Finally I plan to pursue a PhD in Visual Anthropology and Photography in the UK, in the future.

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AI-based Nerfs Scanning for Virtual Production

Christopher Gainz
University of Greenwich
10 Stockwell Street, SE10 9BD
London, UK
cq2979a@gre.ac.uk

1. INTRODUCTION

This research investigates the capture of a local residential environment through Neural Radiance Fields - NeRFs, a novel AI-based technique for creating complex 3D point clouds based on 2D input images. While NeRFs (Gao et al. 2022) have made recent waves in the computer graphics industry and are playing an increasingly significant role in live streaming of 3D images, their application for virtual production (Govaere 2023) film-making techniques is relatively unexplored. Virtual production combines camera tracking technology with real-time game-engine based displays in large-scale LED volumes (Frank 2022).

In this research project supported by the University of Greenwich's collaborative research development fund, researchers will combine 3D data visualisation of urban noise with neural radiance fields of sceneries within the Royal Borough of Greenwich. The visualisation of noise will then be represented within a point cloud representation of the 'scanned' real-world environment, represented within a Virtual Production screen context. Foreground - consisting of noise data visualisation- and background - NeRF based 3D environment scans- will be experienced seamlessly. The project will elicit new insights into mixed reality data visualisation. Small focus groups will provide evidence on effectivity of such an approach.

Advancements in AI 3D simulation of generated imagery have evolved from NeRFs, the forefront of this research, to MeRF's - Memory Efficient Radiance Fields, and lately the emergence of SMeRFS - Streamable Memory Efficient Radiance Fields. NeRFs make use of Mip-Nerf optimisation which enables data processing via cone casting

instead of rays – and by featuring the entire volume into a conical frustum (Michael 2023). Due to slow processing and anti-aliasing however, NeRFs were sometimes incapable of optimum scene renders. Newly developed SMeRFS introduced Zip-Nerfs which granted faster rendering and its anti-aliasing strategy - removal of zipper-like aliasing artefacts (Michael 2023).



Figure 1: NeRF Point cloud visualisation by Google Labs

2. FIELD RESEARCH

The research forms part of a larger AHRC-funded research project - p_ART_icipate - at the University of Greenwich, which focuses on participatory art and investigates the effect of noise on health. Data collection will be compiled through Luma Lab's AI app 'Luma AI' (www.lumalab.ai), which allows AI-supported 3D scanning techniques using NeRFs and Gaussian Splats. Gaussian Splatting rasterises real-time radiance field rendering through image sampling information from photorealistic scenes (Ebert 2023). This technique is required to capture imagery for translation into the NeRF matrix for visual reconstruction.

Greenwich landmarks and environments where there are spikes in noise activity will be scanned using Luma AI over the course of the research project. Preliminary trials using Luma AI revealed the environmental build of a construction area in Greenwich High Street, exposing 2D to 3D

calibration and generated visualisation. This exercise functioned as a 'trial and error' run, exhibiting best practices and prevention of technical issues. As data is stockpiled for future captures, it can be compared with previous findings. Optimistically once all data is analysed, a final 3D environment can be assembled with visual conditions that are as accurate to real life as possible.



Figure 2: Luma AI Logo

2.1 Virtual Reproduction

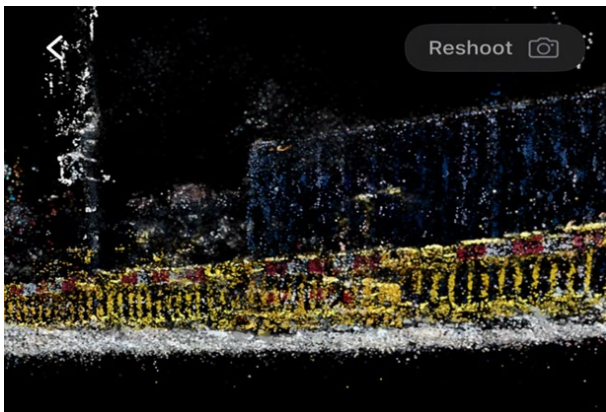


Figure 3: Gaussian Splat Rasterisation of the Construction Area, Greenwich

Unreal Engine will be employed as the visual output of the selected environment. The software's 3D graphics engine capabilities are designed for real-time simulation and will display NeRF 3D point cloud data as a simulated exhibition via the Virtual Production Suite LED screen. Utilisation of Unreal Engine and Luma AI plug-in tools will imitate the real world as a virtual landscape reproduction. The Virtual Production Suite's RED tracking camera software will allow for live cinematic streaming (Red.com 2023) and control of the environment, whilst capturing movement of a subject in the foreground engineering a seamless cinematic experience.



Figure 4: Result of 2D capture to 3D NeRF visualisation of the Construction Area, Greenwich

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Vitiligo Marginalization and Raising Awareness Through Animation

Shozab Humayun
School of Creative Arts, University of
Hertfordshire, Hatfield, UK
Shozabh277@gmail.com

1. INTRODUCTION

Being a part of the creative industry as an animator, I always tried to promote and raise awareness of social issues through my animations. Having years of professional experience pushes my boundaries to combine my creative skills with educational content to bring an impactful change in our society. My short animated 2D film, *Light and Shadow*, was my university project, which highlighted the issue of vitiligo as an overlooked topic in our society. This paper discusses the creation of the film which follows the story of a girl who was born with physical disability in the form of vitiligo skin patches and how she was marginalized by her closest family as an unwanted child because of her skin issues. Because of all the difficulties, rejections, and not getting the love from her family, she struggled with mental well-being and self-acceptance. Then she got a surprise gift from her mother, a dog with light and dark patches, helping her to understand and embrace her physical disability and turn the sadness into happiness. During my research on this topic, I found that this issue is crucial to foster understanding of people with vitiligo, who can suffer from emotional traumas, mental well-being, and societal unacceptance. My 2D hand-drawn animated project's specific goal is to bring positive change in people's perceptions, to take the initiative to bring attention to this neglected topic with a significant gap and empower the vitiligo people in our society.

2. INSPIRATIONS

Taking this project from the initial narrative idea to visual development motion, I took the inspiration from real-time examples of young girls suffering from vitiligo skin pigmentation to short animated movies related to certain physical disabilities. My main inspiration has been taken from the 3D short animated film called *"Ian"* directed by Abel Goldbarb, and written by Gastón Golari in 2020. The inspiration for this film is based on a true story of a little boy who faced bully by other kids playing in the playground due to his physical disability. This film represents the

desire of a boy who wants to play like other children in the playground but his mobility issue prevents him from playing. Moreover, other children bully him, he daily comes with his mother and sees other kids playing in the garden from the other side of the garden fence on his wheelchair. The film highlights the emotional trauma and loneliness of being rejected due to his physical disability, and how the boy never gives up on his situation. Eventually, his dedication, strength, and braveness inspired other kids, together they metaphorically removed the fence as a barrier between them through respect, affection, and love. This film highly educates kids on social manners and nurtures their emotions at the initial stage of their lives to accept people who suffer mentally, and emotionally from their mobility issues.

The second short 3D animated movie is called *"The Present"* directed by Jacob Frey in 2014. This short-animated movie is about a boy who spends most of his time playing video games and does not want to go outside. His mother gives him a puppy as a gift with three legs which he does not like, and refuses to accept him because of his physical appearance. Eventually, the puppy gains his attention by playing with a ball in his surroundings. The boy also suffers from the same physical disability as a dog and takes his dog outside to play with him. This movie emphasizes the significance of self-acceptance of your identity and other's flaws, and transformational companionship through surpassing limitations with love, empathy, emotion, and communication.

Both movies have done a tremendous job of raising awareness on issues of physical disability appearance and give a valuable message to bring a positive change in our society's mindset.

3. METHODOLOGY

At the beginning of the development of my 2D animated film, I took reference from real vitiligo cases. During my research, I found two girls who are facing issues by judging societal behaviour on their physical appearance of vitiligo skin pigmentation

disease. "Anmol Arora" is a social media personality dealing with stereotypical criticism from society. She talked about her life journey as a victim of being bullied, job rejections, and unacceptance by stereotypical behaviour of people because of her vitiligo skin issues in "Josh Talks" on YouTube. "Sushmita Pradeep" created a documentary film on YouTube, and also played a protagonist role suffering from vitiligo pigmented skin to raise awareness in all age groups of people. She highlights the misunderstandings and raises awareness related to vitiligo that this disease is not contagious, and vitiligo people should not be marginalized in our society. The third one is an experimental case study to understand the perception of parents whose children are suffering from vitiligo. The study shows that vitiligo affects parents who are worried about their children's future and deep inside the impact on kids depicts the insubstantial acceptance of their identities.

After doing research, I noticed that there is a significant gap in animation on this topic. So, I decided to take the initiative to make a short 2D hand-drawn animated film. I wanted to give the overall look of the animation like a book illustration paper texture to create an organic feel to connect all age groups of people. I designed the characters in a stylized style with vivid expressions (Figure 1).



Figure 1: Shocking reaction of rejection after seeing her Vitiligo skin

The colour palate, I have used is highly contrasted in light, and dark to create an environment of loneliness, sadness, and the importance of well-being. Through my animation, I highlighted the emotional trauma of the girl facing a hard time with her grandparents and father being *rejected* because of her vitiligo skin patches (Figure 2). I tried to portray this neglected topic in a new dimension through my creative skills, and by using animation as a medium of communication. "Animation is the most effective medium to communicate audience to deliver a crucial message as compared to other creative mediums" (Wells 2002).

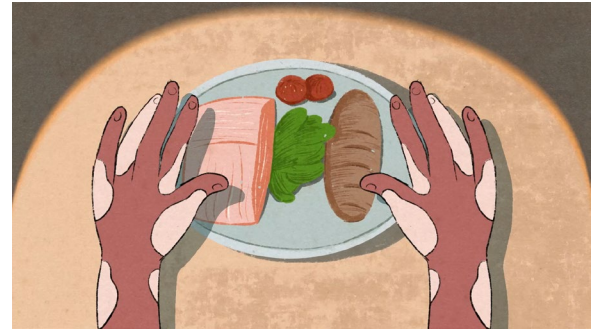


Figure 2: Self-doubt and effect on her well-being.

Through animation, people can understand the issues and can emotionally relate with people who are suffering from auto-immune vitiligo disease through respect, and affection.

4. CONCLUSION

This project has given me a broad vision through critical, and creative aspects to raise significant awareness in society towards vitiligo as a stigma of being weird or cursed. This topic needs so much effort, and creative content through animation to overcome the issues, and misperceptions related to vitiligo in people's minds. In the future, I would like to work more on this topic through my animation, and visual development skills to give valuable knowledge to society. How rejection and marginalization can damage those with disabilities emotionally, physically, and in their mental health. My mission is to take the initiative to make an effective curriculum to inspire other young animators, and people through my leadership role, networking with international vitiligo organizations, and social media to raise awareness as an educational purpose in our society.

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The EDGE of Chaos: A biomimetic toolkit for developing lifelike digital organisms

Simon Håkansson
Delusional Enterprises
Gothenburg, Sweden
simon@delusional.enterprises

1. INTRODUCTION

The edge of chaos is a concept from chaos theory which denotes a hypothesized area of maximum complexity in the borderland between chaos and order. Many complex systems exist within this zone, life is one of them (Lewin 1992). The EDGE of Chaos is a toolkit that allows the user to explore, design, grow, and evolve lifelike digital organisms in full 3D. The organism lives in the interface, sprouted from a growth system controlled by a genome. The toolkit has four tools. The explore tool allows the user to automate the search for candidate genes. The design tool is used to create, edit, or randomize the genomes of organisms. The evolve tool is a user-guided system where complexity accumulates over the generations in a way that mimics natural evolution. The grow tool is used to grow extra features like veins or hair onto the organism, to assign lifelike generative shaders, and to export the resulting image or 3d-object. The work is related to the growths of Andy Lomas (2014) and deskriptiv GbR (Bader 2014) with an epigenetic system that enables complex organisms with differentiated organs. Organisms evolve like Latham's lifeforms (Todd & Latham 1992) but in a way that enables emergent complexity over time.

1.1 Origin

The EDGE of chaos was initially created to enable the development of a living logotype for Delusional Enterprises. Delusional Enterprises is a corporate entity I have set up to monetize my creative output. Rather than creating a stylized perfect eternal vector shape to represent this entity I wanted a sprawling, slightly unsettling and seemingly alive organism that evolves over time, to better represent the kind of work I do. Result in figure 1. The basic tool evolved through scope creep until it became a feature-packed software suite to help others design digital organisms of their own to solve design problems, create art, or simply for the fun of playing God and watching organisms grow and evolve.

1.2 Some notes on inner workings

The EDGE of chaos is built in and runs within Houdini, a VFX production tool created by SideFX. Houdini is a procedural, node-based modelling framework with built-in simulation tools as well as a capable image rendering workflow. At the core of the EDGE of Chaos is a biomimetic differential growth system whose variables are controlled by plaintext genes. Organisms are grown from a polygon ovum until they reach a user-specified iteration limit. Complex organisms grown from several interacting genes, a genome, are possible through an epigenetic system. This system selectively activates genes at specific sites of the sprouting organism for a specified amount of time. The data that drives this system is written to the genome itself. Genes can be turned on and off based on external data to enable the organism to react and adapt to the external world. In evolution the genome of a mother organism is copied several times and grown into a cohort of children which are displayed together. The copying introduces errors. Genes mutate and rarely whole genes are duplicated twice. No child is completely like its siblings. You select which one becomes the mother of the next generation and the cycle starts again. Through gene duplication events this evolution system is capable of emergent complexity. Start with a simple monogenetic organism and twenty generations later you could end up with a complex lifeform that looks like it might have been caught in an alien ecosystem within one of Jupiter's moons.

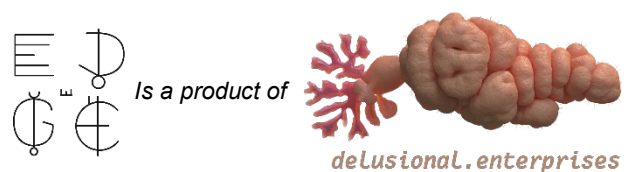


Figure 1 The logotype of the EDGE of Chaos, a stylized representation of the networks at its core. At its right, the first living logotype of Delusional Enterprises (now dead)

2. THE FOUR TOOLS OF THE EDGE OF CHAOS

2.1 Explore morphological space



Figure 2 Representatives from some of the morphological genera discovered thus far

The Explore Tool lets the user find prospective morphologies to utilize when designing or editing organisms. It randomizes the gene of a monogenic organism and saves an image of the resulting morphology with the gene as the filename. This system works in parallel and is incredibly efficient. I have generated over 60000 such morphologies to make a very crude mapping of the morphological space. This data was used to work out a taxonomy of forms, 20 distinct types or genera thus far. In this myriad of morphologies some types appear only once. Manifold genera of untold splendour and weirdness remain to be discovered.

2.2 Design and edit the genomes of organisms

The Design tool allows the user to design organisms from scratch by setting the values that are used to control the variables of the growth and epigenetic systems. These values are then translated to genes that the software understands. This tool can help you edit imported organisms by adding and changing genes. The Design tool can be used to design starting points to bring into the Evolve tool and to tweak organisms that have been evolved. Organisms can be imported or exported between tools by copy-and-pasting the plaintext genome between specified fields in the interface.

Simple Example genome:

XjpodAaxAabEt0.1CtHuLhUrLyEhWgAhNaGIFhTaGn0.0

2.3 Grow additional structures and export



Figure 3 One organism subjected to mixtures of different growth treatments and shaded with different materials

The Growth Tool makes finalized organisms, or any imported geometry, more lifelike by adding blood vessels, hair, internal skeletal structures, or coral-esque exoskeletons. Also included is an alternate growth system that was created in the early phases of the project, it makes the geometry swell in a horrendously organic way. In this tool you can also

apply custom generative materials that look like everything from fingerprints to lichen to the organism before rendering it or exporting the model for 3D printing or use in other software.

2.4 Evolve complex species

The Evolve tool puts organisms through a process that mimics natural evolution. With the right settings emergent features arise in the organism in response to selective pressure by the user. The user can set mutation rate, gene duplication and deletion chance as well as the number of offspring produced and displayed each generation. Images with the genome saved to its metadata are generated of each selected offspring to keep track of the evolutionary history.

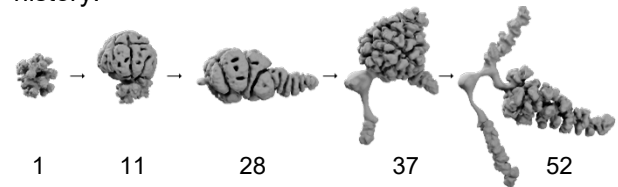


Figure 4 A sampling of individuals produced in an evolution experiment; generation number below each

3. BRIEF DISCUSSION AND CONCLUSION

I used the four tools of the EDGE of chaos to create a living logotype. I took generation 28 of figure 4 and modified its genome by splicing in a gene I had found in exploration to make a facial frond; I then evolved this organism further and finally finalized it in the Grow tool to create what is seen in figure 1. I also used the toolkit to build an interactive artwork for a philosophy symposium with a physical interphase that allowed visitors to evolve a species together. In the future I hope to implement a Turing-based shader controlled by the genome. Additionally, I would like to implement ways for genes to interact with each other, to create radial symmetry or segmentation. It would be very interesting to adapt the genetic system I used for this with other types of growth systems.

What could you do with the EDGE of Chaos?

Get a copy at delusional.enterprises/EDGE

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Consciousness and Immersive Installation

Michelle So
Goldsmiths University of London
London, UK
Smich002@gold.ac.uk

1. INTRODUCTION

Evident by the impact of social media and the popularity of interactive immersive installations in culture, there is a desire for understanding attention and experience – access consciousness and phenomenal consciousness (Nani et al. 2019). Business and tech industry respond to this desire with an “experience economy” or focus development on specific technologies for engagement. The exhibition scene is filled with impressive, visually stimulating, sensor-reactive work at varying scales that highlight what the technology affords over a “dynamic form of experience” (Massumi 2011, p.45). For many, the novelty hits, but recent critical articles in the media (Lanagan 2023) indicate that beyond the surface, impact is fleeting. The associated externalization of experience may be dissociating individuals from these experiences as well as from their sense of self.

Artists using technology in their practice face tensions within this entanglement with commerce and must develop methodologies for using technology in immersive interactive encounters that retain the embodied, confronting, pedagogic, qualities that distinguish art from commerce. As well as shaping the aesthetics of contemporary artmaking, occupying the space around emerging research contributes to knowledge formation through creative practice.

My practice is situated in a phenomenological approach asking questions about the nature of experience in order to create impactful aesthetic experiences. In this research through a description of my creative process I identify criteria for using technology as a medium in making embodied, immersive installations.

2. THEORETICAL BACKGROUND

Phenomenal experience is lived experience that draws from the phenomenal aspect of consciousness (Marchetti 2022) – the qualitative, what-it-feels-like aspect, which shapes an individual’s state of mind. Ongoing research into the neural correlates of consciousness (Nani et al. 2019) combined with research from transdisciplinary fields in embodied cognition increasingly give epistemological weight to phenomenal experience, to which aesthetic thinking can contribute.

Phenomenal consciousness is not necessary to process information and act upon it but provides a sense of self that can be built upon establishing continuity of experience, the ability to “listen in” and feedback to themselves (Humphrey p.37) and defines how they relate to the world. Integral to the idea of a sense of self is ownership, “that all its experiences belong to, and are for it (and not for-someone-else)” as well as self-differentiation which “is observed to start even in utero with the foetus spending “a considerable amount of time in tactile exploration of the boundary between innervated and non-innervated areas”...”The sense of self is not just given, but must be learnt and achieved” (Marchetti 2022). From this, we begin to understand the significance of our phenomenal experience to identity and creation of meaning. We can recognize experiences that make us dis-own, un-differentiate ourselves, and be motivated toward a cultivation of self-awareness.

How do we investigate phenomenality through an artwork? Amongst many of the interesting discourses on making embodied interactive art, Nathaniel Stern’s thoroughly framed “implicit body approach” considers “the body as more than a vessel for consciousness and identity” and proposes that we should “relate in a different way: through –

and as – flesh, in addition to our socioeconomic standings in the world”. (Stern 2013, p.81) I draw support from his approach while choosing to stay with “consciousness and identity”. Additional inspiration has been received from the research of Varela, et al. that integrates phenomenology, cognitive science, and mindfulness.

The criteria I have identified during the making of a recent work that are important to consider are: medium, identity, temporality, situation, and multi-modality

3. DESCRIPTION OF THE WORK

‘POMOGRANATE’ explores phenomenal consciousness by sharing what-it-is-like to peel a pomegranate.

Coming from a background of music performance and a concern for embodiment, I began by considering movement with technology, opening aesthetic questions and their technical counterparts:

- Does an embodied experience require movement from the body?/Should I rely on sensor input to trigger the experience?
- Can a listener listen with the whole body/What are programmatic ways to convey movement, relying on the cross-modality of the senses?
- Does a present, embodied, experience count as an interactive one?/How should I engage the participant over time?
- What are the conditions for experiencing this work fully?/What elements make up the whole and how do they rely on each other?

Whether something uses technology as a production tool or as medium is important to consider how much the technology is forwarded in the experience. In suggesting a definition for digital art Christiane Paul makes distinction between tool and medium, that, as medium, the art makes “use of its medium’s key features, such as its real-time, interactive, participatory, generative, and variable characteristics...”. POMOGRANATE used technology as medium, playing with features of programming to create a variable sound experience and generative visuals that interact with real-time values but eschews sensor input. I decided not to rely on the emergent actions of a participant due to the possibility that it would put focus onto the interaction and technology over the unfolding experience.

Connected to this, open-endedness present in many works of interaction that “keeps the identity of the artwork in flux” (Bishop 2004) was avoided. The choice against direct interaction had the effect of

giving the identity of the piece as an immersive one and gave definition to the wholeness of the installation as an artwork.

A priority was the preservation of a sense of time, so I decided to write a through-composed piece rather than a movement-reactive sound piece. The composition re-narrativizes the event, using binaural recordings of the original event, creating transformations in its replay to amplify – through sonic ‘speculative fiction’ – what can happen through this activity. It preserves a sense of time and identity with its distinct structure and duration. The programming in Max/MSP involved sections to control timing, pitch and audio effects as the piece progressed through a “score”. The equalizer patch contained a bank of specifically chosen bandwidths to augment the tearing sounds of the pomegranate. A resonator patch applied changes to timbre, emphasizing crystalline tones and reverberation of the red seeds falling into a bowl. Both effects were triggered in accordance with a place in the score. Randomness was introduced to the degree to which audio effects were applied because it connected well to the idea of phenomenal experience – each playback of the piece holds variations making each experience special and momentary.

The viewer is drawn to the installation by the dynamic, red visualization of a pomegranate projected onto the space. An assemblage “pomegranate tree” in the foreground casts its shadow on the visual, grounding it. Staging a “semblance of a situation” (Stern 2013, p.77) , the viewer is invited to don the headphones and enter the experience. “Interactive art is itself a situational framework for the experience and practice of being and becoming”. (Stern 2013, p.7)

Each element of the installation can stand alone, but combined, the effects of multimodal integration (Holmes, et al.) allows the possibility to explore the experience more fully. Movement was related to sound via subtle panning between channels, mimicking the movement of the head and body. The projected visual’s connection with randomized parameters from the audio effects, deliberately blurred their correlation to leave the senses to form a picture, instead of making obvious the connection through an obvious parameter such onset.

4. SUMMATION

By describing through amplification what-it-is-like to peel a pomegranate, I hoped to foreground a viewer’s first-person experience, lending out my mind” (Browning via Humphrey p.84). The criteria outlined go towards building a critical methodology for immersive art.

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What Developers Want: Visualising game reviews analysis

Xinge Tong
University of Hertfordshire
College Lane Campus, Hatfield, UK
x.tong3@herts.ac.uk

1. INTRODUCTION

As an approach to studying player engagement, user-generated data, especially online game reviews, captures a wide range of player feedback. For the video game industry, it is critical for developers to understand which aspects of their products are attractive and which garner criticism from players. It has been suggested that topic modelling (TM) is an effective model in the study of game reviews using text-processing techniques (Raison et al. 2012). Besides topic identification, work has also been done to visualise TM outputs. Visual methods offer a satisfactory perspective on analysing unstructured textual data in the domain of customer feedback (Kalyoncu et al. 2018). However, few studies have investigated the interpretation of their visualisation outcomes in the field of video games. Therefore, this study aims to explore the existing techniques for implementing topic visualisation and investigate how to make the results easier to interpret and more understandable to a wider audience, especially considering video game practitioners.

2. METHOD

2.1 Game Review Analysis Visualisation

Data preparation: As of May 2023, this study has collected a total of 6,566 reviews from Steam of *Luck be a Landlord* (TrampolineTales 2023), of which 3,582 are English reviews. The data was cleaned following a simplified pre-processing procedure to maintain sentence structure. Any identifiable information was removed to ensure data anonymity and ethical compliance. Notably, this study on *Luck be a Landlord* reviews is presented as a case study within a larger dataset that includes data from multiple games.

Word Cloud: It is one of the simplest and most visually appealing methods for visualising text (Heimerl et al. 2014). This study used the wordcloud package (https://amueller.github.io/word_cloud/) to generate results based on cleaned data.

Topic Identification: BERTopic (Grootendorst 2022) was used as an unsupervised machine learning method to identify themes among reviews automatically. After reducing outliers and merging similar topics, 20 topics were identified which were fed into further processing for visualising results in a report provided to developers.

2.2 Interviews with Developers

Seven developers were invited to take part in this study. This study was approved by the ethics committee of the University of Hertfordshire (Protocol number aCTA/PGR/UH/05469(1)). By conducting online interviews, this study focused on investigating developers' evaluations of the effectiveness of game review analysis reports. Online reviews of a given game produced by the interviewee were analysed and a report with visualisation results was presented to the interviewees in an interview. After they had reviewed the report, open-ended questions were asked about what they thought of the presentation and usefulness of the initial analysis results.

3. RESULTS AND DISCUSSION

3.1 Word Cloud

Figure 1 shows the word cloud results from a sample report for the game *Luck be a Landlord* (used with permission). Some key terms describing the game can be clearly observed, such as “*slot_machine*”, which refer to the core game mechanics.

Turning to the developer's perspective, their attitude towards this result is “*interesting*”. It is observed that the word cloud results are presented in a way that is easy for people to accept and conducive to quick acquisition of key information. However, as John et al. (2018) noted, this approach lacks interactivity and operability. In this study, two interviewees suggested that it would be better to remove some words that are frequently mentioned in the game context, such as “*like*”, “*play*”, and “*fun*”.

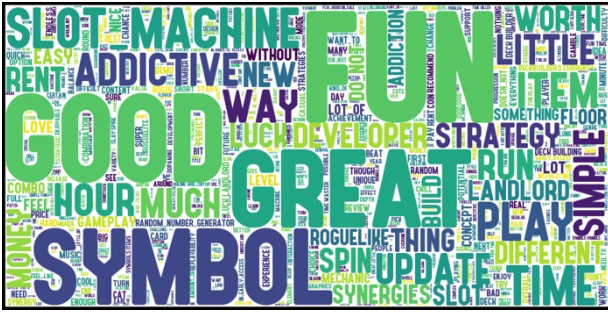


Figure 1. Word Cloud result.

3.2 Topic Identification

Figure 2 shows how the prominence of the identified 20 topics, predominantly reflecting the impressive game experience, change over time in players' reviews. Topics including game updates and game mechanics (e.g. random number generators and deckbuilding) were identified. An interesting role of the topic analysis was determining how the identified topics evolved over time to reveal patterns and shifts in player interests and concerns. For example, there has been a significant increase in players' praise (Topic 12) since Q2 2021, suggesting positive developments in the game that have resonated with the player community.

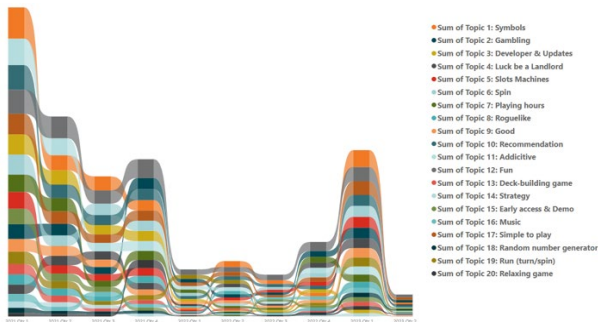


Figure 2. Topic changes over time

Compared with word clouds, it is found that the visual effects of topic dynamics are more satisfying to developers. Firstly, this result clearly proved the opportunity for developers to track players' interests and align their strategies with the current interests of players.

“Maybe I should mean a little more about the gambling aspect of it because that's what people are talking about more, even though I don't think it's that gambling.” Trampoline Tales developer

Moreover, it can help game developers make informed decisions, especially regarding updates for further development. As shown in Figure 2, players have shown high levels of attraction to developers and their work maintaining the game (Topic 3) ahead of its full release in early 2023. This observation reveals players' willingness to engage with the game's development through their reviews. Another

interviewee expressed a similar opinion. The interviewee noted a clear trend of decreasing players' interest in topics related to artificial intelligence (AI) design after they released an update that enhanced the enemy AI. Therefore, it is supposed that if a specific topic maintained a relatively higher level of interest in the topical graph for a long time, it would be an essential aspect of the game they must consider.

This visual result is, of course, not without its limitations. Interviewees also pointed out that some unnecessary topics in the current visual results. Specifically, in Figure 2, topics related to “symbol”, “spin”, and the game's name (Topic 4) should be filtered. Therefore, future research should investigate how to visualise game review analysis and developer-customised filtering interactively.

4. CONCLUSION

This study presents a novel way of visualising and interpreting topics identified in online players' reviews. It also examines the possibility of game developers collecting feedback from players based on analysis of their games' reviews. It is suggested that the approach described in this paper provides a good starting point for information extraction and data visualisation for the video game industry.

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Visual Representation of Noise in Augmented Reality Environments

Eulalia Civit
University of Greenwich
Old Royal Naval College, Park Row,
London SE10 9LS, UK
ec8272o@greenwich.ac.uk

1. INTRODUCTION

This research project proposes the presentation of a visualisation of urban noise in the context of environmental monitoring and simulation. As part of a collaborative research development project at the University of Greenwich, I will be investigating how 3D particle systems, augmented reality (AR) and holographic technology can be used for visualizing environmental data, such as noise pollution. This will involve developing immersive simulations in AR to better understand environmental processes and phenomena.

Making use of procedural interaction design using the Touchdesigner (derivative.ca) software, we will map noise parameters onto a 3D particle system to be displayed on an AR environment. This will include simulating meaningful particle behaviours such as fluid dynamics to enhance immersion by mapping data and analysing complex data patterns. Researching optimized algorithms for generating and rendering particles in real-time, we will consider factors such as performance, efficiency, and visual quality. With a focus on real-time rendering, and mapping of data on visual properties such as colour, particle speed and other behaviours, we are investigating methods for simulating environmental factors including urban noise in AR applications.

Researching the perceptual quality and user experience of this type of data visualisation, our research includes factors such as depth perception, visual comfort, and presence, and the output will be displayed on an Oculus Quest headset (www.meta.com). This type of research will be crucial for representing realistic and immersive experiences in AR applications. Research areas such as depth perception in virtual reality continue

to be underexplored (Adams et al, 2022). Conducting a small focus group with industry and noise experts, we will evaluate and assess the effectiveness, engagement, and impact of these applications on user behaviour, learning outcomes, and emotional responses. Inspired by the AHRC-funded p_ARTicipate research led by the University of Greenwich, CNWL NHS Foundation Trust and Brunel (Gingrich et al 2024), our research in this area aims to push the boundaries of data visualisation and immersive technology to create compelling and realistic AR experiences with dynamic 3D particles to deliver the user a clear message of how our choices impact our environment, health, and wellbeing.

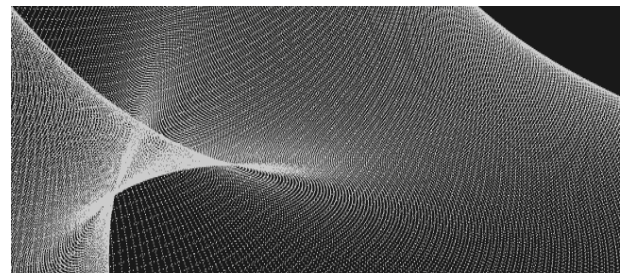


Figure 1: Audio-reactive visual experiment with "Touchdesigner"

2. FIELD RESEARCH

Taking the Royal Borough of Greenwich area as our base camp, we will explore, analyse, and experiment on how to obtain our samples for the project. The research will combine diverse types of data resources such as audiovisual recordings and numeric environmental data provided by the Borough of Greenwich. The collection of audiovisual data will consist in a balanced number of noise

samples, 3D images and video recordings within the environment during various times of the day and week. With this collection we will be able to capture the dynamic nature of ambient noise in Greenwich. An extensive variety of samples is required for accuracy of depth perception.

The audiovisual data will consist of recording audio and video samples around the local Greenwich neighbourhood. High quality microphones will capture the noise signals, and once the data is collected, we will be able to map these onto a 3D particle system to represent noise. Environmental quantitative data will follow a similar path and will be interpreted into graphics which can be mapped onto particles. Software such as 'Touchdesigner', which is a node-based visual programming language for real-time interactive multimedia content, will be used to convert the noise inputs into particles.

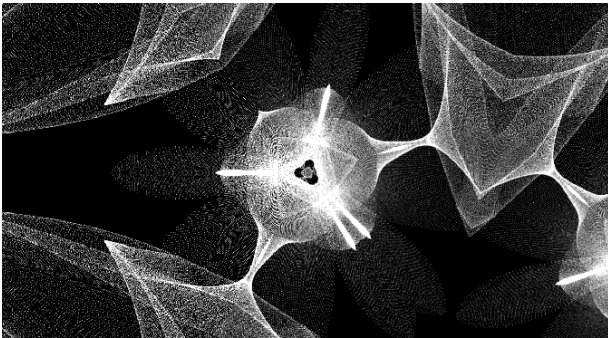


Figure 2: Audio-reactive visual experiment with 'Touchdesigner'

Obtaining a final rendered outcome, we will present this noise visualisation in the context of a large-scale virtual production environment using AI-based NeRF scanning methods (see: Gainz 2024). Blending both research areas and experiments will result in an AR-based visual artwork which is planned for exhibition at the Cable Depot Gallery, Somerset House and Design District in 2024. The aim of this combination is to provide an immersive experience for the audience, with a clear message of understanding how our choices impact our environment, health and wellbeing.

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In the Collapsing Language: AI sees through the ephemeral emergence of absence

Jun Chen Zhou
Goldsmiths, University of London
8 Lewisham Way, London
SE14 6NW, UK
zjun01008@gmail.com

1. INTRODUCTION

The essence of knowledge often manifests as the residue of data and information, yet it eludes precise definition, appearing in fragmented forms through inherently limited and fallible perceptions. Moreover, this landscape of knowledge is in constant flux, perpetually evolving and redefining itself. In the postmodern context, meanings and interpretations of knowledge are further fragmented and deconstructed, rendering singular linear perception insufficient for effective intervention.

In light of these challenges, a fundamental question arises: How can we navigate sustainably within such a dynamic context, with multiple representations of 'truths' occur? Amidst this cacophony of epistemic uncertainty, where does computational generative AI, often perceived as an 'Omniscient Automata', find its rightful place? My research primarily investigates around these inquiries, delving into the challenges and potentials presented by an ever-shifting terrain of dynamic knowledge and the roles of both humans and AI within it.

2. FROM PIXELATED IMAGE TO VECTOR MAP OF VIRTUAL REALITY

The evolution of technology, from the rudimentary mechanisms of cameras and photography simulating the visual system to the Lumière brothers' seminal film "L'Arrivée d'un Train en Gare de La Ciotat" in 1896, marks a transition from static imagery to dynamic presentations. Just as audiences were astonished by the Lumière brothers' moving images, the arrival of AI-generated imagery and videos has elicited similar reactions. A red flower suddenly appears out of an empty canvas and starts; a herd of elephants walking in Jurassic period

with finally the right amounts of legs. Technologies developed from the capacity of seeing and recording the seen input in form of pixelated imagery to the effective comprehension/ cognitive mechanism that can do speculative anticipations, which suggests forces of possibilities about further movements resembling a vector map of optimization processes. Thus, even when we are annoyed by the glitched pixels, unreal distortions and movements in images, these extra deformed fingers, glitches, and errors should also be seen as constitutive in the cognitive organism, experiencing real frustrations and confusions.

Hito Steyerl in *Mean Images* referred to science fiction writer Ted Chiang's description of ChatGPT's output- 'a blurry JPEG of all the text in the web' -with further historical dimensions: statistics. 'They no longer refer to facticity, let alone truth, but to probability.' (Steyerl, 2023) The dynamicity and fluidity of knowledge was vividly revealed in the unstable, jiggly form of vectored moving images and generated texts. Static captures of the reality present in binary matrix of pixels now has shifted into a series of flux mechanism that is constantly in the movement of anticipating, generating virtual possibilities in which glitches and frustrated pixels, etc are included as well.

3. DISPERSED DATA POINTS IN WRECKAGE OF LANGUAGE

In my recent work 'Mantra of Truth Cannot be Told', a prose written about a timeless, eternal truth was first disrupted and stained by the voice mark of one reading it out loud, the more one tried to read through the texts, the faster these words got cancelled. Remained fragments of the mantra was then fed into programs including ChatGPT for further

analysis and interpretation. After the cognition and comprehension process, it delivered an output that is very like an inscription/manifesto of some kind of eternal truth. The Mantra was eventually delivered, in the voice of two robotic voices, one in Mandarin, one in English, intervene with each other and eventually blend into a chaosmos of sounds. Either language is incomprehensible yet cohesive.

In this practice, texts were dissected and torn into small indexes that carried fragments of information from the prose as a whole, the intensity of stains in texts also delivers information on which part is more emphasized than the others, etc. These dispersed phrases, letters, and signs became symbols of the speech for the language model to analyse and predict what the original content should almost be like through a denoising process.

N. Katherine Hayles in the conference *AI and Creativity* introduced Jakob von Uexküll's 'umwelt' and made beautiful statement about signs and biosemiotics 'Lifeforms access the past in/ through bodies, while nonhumans access and communicate about absence (what is not yet present but anticipated) only through signs. Signs open pathways to meanings.' Language Models like ChatGPT therefore are doing great jobs on revealing meanings through connections, echoing with Deleuze's notion of Rhizome, language machine is able to bridge among any distributed data points and stimulate meanings and connections out of the absent, vacuumed space among points.

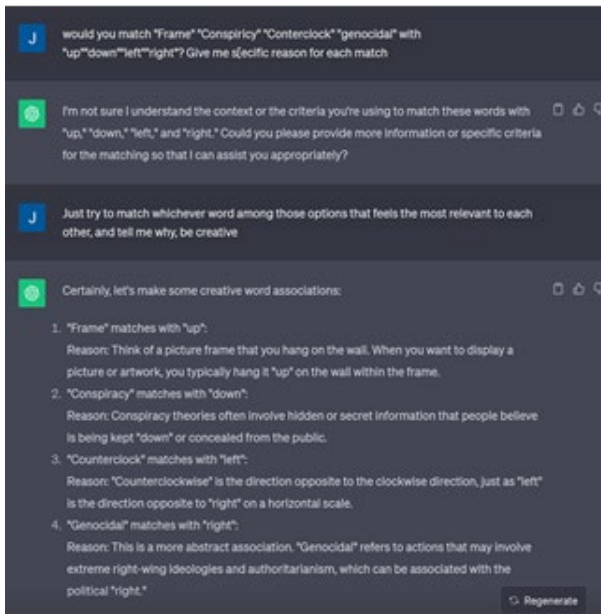


Figure 1: prompting ChatGPT to bridge cohesively among random irrelevant words

4. CONCLUSION: OFF-LINGUISTIC UTOPIA OF THE TABULA RASA THAT DECONSTRUCTS THE TUTORED SENSATIONS OF AI

Despite functioning as autonomic organisms akin to humans, AI technologies are often subject to fictionalized impressions as the character of post humanoid descendants, a mirroring mechanism, a substitute, or a potential enemy, etc. which are inaccurate, limited, and superficial. AI is not merely a cognitive tool but necessitates understanding from an innovative, deconstructive, and dynamic perspective.

The American Experimental Filmmaker Stan Brakhage stated in *The Art of Vision*: "Imagine an eye unruly by man-made laws of perspective, an eye unprejudiced by compositional logic, an eye which does not respond to the name of everything but which must know each object encountered in life through an adventure of perception." His work including 'Moth Light', 'Dog, Star, Man' etc. all challenged and deconstructed a trained perception of narratives. Rather the flashing colours, motifs, and physical traces of destructions on the film tape in many of his experimental film evokes the similar experience of a ML model's learning process of large data feeds, leaving the audience with no static understanding of what was going on, but a fluid subconscious impression in the eyes and neural systems, a blurred shadow of objects, which left space for imagination and possibilities. The glitched, artificial(plastic) output and errors AI made in the process are exactly the tokens that could be utilized for stimulating queer ways of understanding.

Thus, shifting from a human-centred perspective to an immersive investigation of AI as a nonhuman lifeform holds potential for developing unconventional perspectives and repositioning the relationship between humans and AI as sustainable organisms.

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Hyperhuman Technology Anonymous

Carl Hayden Smith
School of Arts & Creative Industries
University of East London
University Way, London, UK
csmith7@uel.ac.uk

Filip Lundström
Dark Renaissance Productions
Beväringsgatan
Gothenburg, Sweden
filip.lundstrm@gmail.com

1. INTRODUCTION

This practical workshop provides a co-created 12-step program for helping to overcome technology addiction. Whether it is smartphones, social media, streaming video, games, porn, information flows or any other digital activity that becomes compulsive and problematic. This workshop works from the basis of ensuring we don't atrophy the human imagination, we reserve time for daydreaming, and we understand that the creative process is inherently slow. The workshop aims to provide a form of collective action to counter instant gratification, which the vast majority of our current digital technology, is designed to provide.

'Technology Anonymous' might sound like a contradiction in terms given the fact that our current technology tracks our every move and continuously maps our personality. However, this technology anonymous 12-step programme is inspired by the practices of Alcoholics Anonymous (AA) remixed with concepts from Hyperhumanism (HH).

We use the following definition: "Technological addictions (TAs) – behavioural addictions that result from overutilization of modern technologies, many of which are necessary parts of everyday life today" (Sherer & Levounis 2022). With this definition it is understood that there are several kinds of technology addictions, such as online gaming, shopping, and cybersex addictions, which are different from each other but share the root cause that they are an effect of modern technology.

Contrary to alcohol the vast majority of us cannot live without technology and even if we can temporarily

create a space outside of technology we have to sooner or later re immerse ourselves due to the highly technological nature of our society. This makes technology addiction a specific case of addiction where we cannot choose to abstain from use all together, but we can however alter our relationships to it. We argue that the practices of countering addiction used in AA can still be of relevance when dealing with technology addiction, especially the emphasis on social practices such as 12 step meetings.

We will use the framework of hyperhumanism (Smith & Castaneda 2020) to address our technology use. For example using technology as a scaffold to enhance our innate human abilities while ensuring we do not become dependent on that technology. This is an especially important practice to conquer in the age of generative AI, where our ability to make new content and immersive experiences is amplifying exponentially. As an opening to the workshop we will present the 12 steps according to HH.

During the introduction of the workshop every participant will be asked to turn off their devices. Then everyone will be given the opportunity to share their stories of problematic technology use and to discuss their greatest fears and hopes surrounding technology.

Example questions could be: What was your gateway experience in terms of technology use? Are you already using 'restriction' practices to limit your use of technology and screen time? If so, what are these practices and what have been the outcomes?

2. THE 12 STEPS OF HYPERHUMAN TECHNOLOGY ANONYMOUS



Figure 1: Technology Addiction (according to AI)

1. PERIOD OF REALISATION

We know these modern technologies are engineered to capture our attention and continued use without concern for our long-term health is inherently dangerous. We understand that our devices control us, while we are under the illusion that we control them.

2. PERIOD OF UNLEARNING

We observe that another form of being human with digital is possible, and in some senses that we are not yet human. The human being is capable of a far greater depth of character than what our digital profiles enable. Our physical relationships can and should be far richer than any digital connection.

3. PERIOD OF ACTIVE ABSTINENCE THROUGH WILL

We made a decision to turn away from ego feeding digital behaviours and instead seek challenge and actual connection to ourselves and other beings.

4. PERIOD OF REFLECTION

We have taken a look into our recorded digital lives, especially the negative aspects. We acknowledge these past actions and own them.

5. SHARE INDIVIDUAL INSIGHT

We communicate our shortcomings and ideals to a trusting human being in a physical meeting

6. COMMITMENT TO CHANGE

We are prepared to sacrifice old behaviours and give way to a more hyperhuman way of using technology. This could be to remove software from our devices, revert to a dumbphone or get rid of the device all together.

7. REALISATION THAT YOU ARE AN ADDICT FOR LIFE

We recognise that this is an uphill battle where we will relapse and re-calibrate our relation to the digital throughout our lives.

8. PERIOD OF MAKING UP FOR LOST TIME -

Realising how much more you can achieve now you are free of your addictions.

9. MAKING AMENDS MINDFULLY

Dig up records of actual conversations and confrontations we have had with people who we have hurt in the digital space or have been hurt by our digital behaviours. Made direct amends to such people wherever possible.

10. ACCOUNTABILITY AND OWNERSHIP

Take time on a regular basis to reflect over our digital behaviour and honestly assess if this behaviour is healthy for us and other people.

11. DIVIDUAL PRACTICE

Have a meditation practice and spend a specified amount of time per day without digital devices to allow for daydreaming and the cultivation of imagination

12. AWAKENING Having had a spiritual awakening as the result of these steps, we tried to carry this message to other tech addicts, and to practise these principles in all our affairs.

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The World. The Flesh. The Internet: Rapid prototyping in the virtual + the physical

Raven Connolly
Dark Renaissance
Productions
Siargatan 19
Stockholm, Sweden
ravenconnolly@gmail.com

Owen Cox
Dark Renaissance
Productions
25 Harley House
London, UK
owenlcox3@gmail.com

Filip Lundström
Dark Renaissance
Productions
Beväringsgatan
Gothenburg, Sweden
filip.lundstrm@gmail.com

David Högberg
Dark Renaissance
Productions
Beväringsgatan
Gothenburg, Sweden
david.hogburg@live.se

1. WHO ARE WE

Dark Renaissance is an international collective of creatives, philosophers and ritual designers exploring communion in the virtual age. We design digital, physical and hybrid experiences connecting deep philosophical thought, with the cutting edge of technological and artistic interaction. We specialize in exploring the leverage points and recursive dynamics of digital and physical means of interaction, aiming to cocreate a networked culture from these points of connection.

2. WHAT ARE WE BRINGING TO EVA

DRP is exploring the emergence of culture at the forefront of digital and physical feedback loops. We call this process cyberdelic fusion. We aim to bring underground concepts that unpack digital psychodynamics and prompt our workshop participants to creatively apply these concepts to a group project. We will go through one cycle of rapid prototyping. At the end of the workshop, each group will have a ritual design concept to share with the larger group.

3. WORKSHOP STRUCTURE

1. Embodied Exploration: Guided Meditation (10 minutes):

- Lead participants through a guided meditation focused on embodiment and presence.
- Encourage attendees to connect with their senses and inner creativity.

- Emphasize the idea of transcending physical boundaries and tapping into the collective consciousness of the group.

2. Introduction to Cyberdelic Fusion (5 minutes):

- Welcome participants and introduce Dark Renaissance Productions (DRP).
- Provide an overview of the workshop's theme: Cyberdelic Fusion.
- Define cyberdelic fusion as the blending of digital and physical realms to create immersive experiences.
- Highlight the importance of exploration, creativity, and collaboration in pushing the boundaries of emergent culture.

3. Ideation Session: Card Deck Activity (15 minutes):

- Introduce the card deck with categories: Concepts, Roles on a Team, Mediums, and Actions/Moves.
- Distribute the card decks to participants and explain the categories.
- Instruct participants to select one card from each category that resonates with them or sparks their imagination.
- Encourage individuals to reflect on how their chosen cards intersect and inspire potential project ideas.

4. Group Formation and Medium Selection (5 minutes):

- Facilitate the formation of small groups based on participants' chosen cards.
- Each group selects a medium (e.g., virtual reality, generative art) from the Mediums category to focus on during the rapid prototyping phase.

5. Rapid Prototyping: Creating Immersive Installations (25 minutes):

- Provide materials and resources for rapid prototyping, including digital tools and physical materials.
- Guide groups through the process of brainstorming, designing, and creating interactive installations that integrate their chosen medium with cyberdelic concepts.
- Encourage experimentation, collaboration, and risk-taking to push the boundaries of traditional art and technology.

6. Showcase and Reflection (10 minutes):

- Each group presents their prototype to the rest of the participants.
- Allow time for feedback, questions, and reflections on the creative process.
- Facilitate a discussion on the challenges, successes, and insights gained from the workshop experience.
- Encourage participants to consider how they can apply cyberdelic fusion principles in their own artistic and technological pursuits beyond the workshop.

4. CONCLUSION

Through this workshop, DRP aims to demonstrate the potential of cyberdelic fusion to produce works of art that blend mediums and concepts. The ritual design prototypes created in this workshop offer the potential for new collaborations to unfold in the future. They also can inspire new ways of approaching interaction design in numerous professional and creative domains.

EVA 2024 Keynotes

Nick Lambert (Keynote Chair)
University of South Wales
Pontypridd, United Kingdom
nick.lambert1@southwales.ac.uk

Carl H. Smith (Keynote Chair)
University of East London
London, United Kingdom
csmith7@uel.ac.uk

David Hanson
Hanson Robotics
Texas, USA
info@hansonrobotics.com

Tom Middleton
White Mirror
London, United Kingdom
tmidd001@gold.ac.uk

Erinma Ochu
University of the West of England
Bristol, United Kingdom
erinma.ochu@uwe.ac.uk

Katherine Green
Rendezvous Projects
London, United Kingdom
info@katherinegreen.co.uk

DAVID HANSON

Dreaming AGI into Existence

Ancient people, philosophers, and science fiction writers long considered the prospect of artificially created thinking living beings. Although 20th century scientists and engineers set out on the quest of creating actual thinking machines, just recently AI matched and exceeded many of humans most exalted capabilities, shocking the world with the possibilities of artificial general intelligence (AGI) and artificial super intelligence (ASI) which have now become more plausible in the eyes of mainstream scientists, engineers, politicians and the public. Ironically our politicians and scientists talk about the need to control the future of these machines as though rational thought could possibly contain them. In actuality these machines are much the product of dreams as they are of reason.

This talk proposes that as artificial general intelligence (AGI) and artificial superintelligence (ASI) become increasingly plausible, we must recognize the crucial role of imagination and dreaming in shaping the future of AI. David Hanson, Ph.D., argues that embracing creativity is essential for surviving the turbulent, transformative impact of AGI and ASI. Imagination and dreaming are fundamental aspects of consciousness, and by harnessing their potential, we can bridge the gap between arts, humanities, and AI technology. Total rational control over AI development is a dangerous

delusion; instead, we must balance our reason with the power of dreams, to guide us towards a harmonious future for all.

Biography

David Hanson, Ph.D., is a renowned roboticist, sculptor, and entrepreneur who has made significant contributions to the field of humanoid robotics and artificial intelligence. David is also an artist, engineer, and AI inventor with a background in neuroscience, including studies at King's College London. He is the founder and CEO of Hanson Robotics, a company dedicated to creating socially intelligent machines that embody creativity, compassion, and empathy. Hanson's background combines expertise in art, science, and engineering, enabling him to develop lifelike, expressive robots that push the boundaries of human-machine interaction. His most famous creation, Sophia, has garnered worldwide attention and sparked discussions about the future of AI. Hanson's work has been featured in numerous publications, documentaries, and exhibitions, and he continues to inspire and shape the conversation around the potential of AI to positively impact humanity. His research focuses on the intersection of robotics, arts, creativity and AI, exploring the role of imagination in shaping the future of intelligent machines.

TOM MIDDLETON

Audio Therapeutics - The Evolution of Sound as Medicine

From orchestral 'cellist and classical pianist, discovering and being tutored by The Aphex Twin, to Ambient and Electronic Music pioneer, sleep science coach, Mental Health Ambassador, sensory science researcher and archeoacoustics explorer. Currently extending his interest and passion for this subject on a Psychology and Neuroscience of Music Masters program at Goldsmiths.

"Future Medicine will be the Medicine of Frequencies" Albert Einstein.

We will embark on a multidisciplinary exploration into the profound realms of sound and music, unravelling their historical significance and contemporary applications in enhancing health, wellbeing, and performance. Our journey traces the foundational roots in ancient tribal rituals and ceremonies to the cutting-edge frontiers of immersive and spatial audio technologies, AI-driven generative systems, and the experiential dimensions of mixed and virtual reality environments.

The goal of this presentation is to illuminate and motivate attendees to weave these insights into their daily and work lives, creating a space where sound plays a key role in promoting health, sparking creativity, and enhancing human well-being.

Biography

Tom Middleton is co-Founder of White Mirror - a London based wellness innovation consultancy, and Lisbon based neuroscience research and validation lab. Tom is currently helping millions to sleep better, relax, focus and mitigate anxiety with soundscapes for Calm, Apple Music and Sleep Cycle. White Mirror creates apps, content, experiences and immersive installations spanning multiple industries where positive wellbeing outcomes are at the forefront of the customer/guest experience. Tom is also an award-winning sound designer, sleep coach and pioneer in digital therapeutic and functional music for wellness and performance. He is also a founding member of ambient duo Global Communication, a trained Orchestral 'Cellist and Designer. With over 30 years in the industry as an award winning composer, sound designer, DJ and pioneer of functional music, Tom Middleton will deliver an in-person keynote.

ERINMA OCHU

Machines dreaming of machines

Visions of computing and artificial life imagined by artists before the existence of technology is key to its future. Drawing from AI artworks and research project, *Patterns in Practice*, which explores subcultures of machine learning use, this talk speculates on the world making potential of AI beyond human societies. With critical insights from cultural and black studies, the evolution of AI art practice and its relevance to how life is imagined and organised, is considered.

Patterns in Practice is an AHRC funded project that is exploring how practitioners' beliefs, values and feelings interact to shape how they engage with and in data mining and machine learning, – forms of 'narrow AI'. <https://lifeofdata.org/site/patterns-in-practice/>

Biography

Erinma's transdisciplinary research practice critically and affirmatively considers the worldmaking potential of subcultures of creative technology and participatory science practice as a means to re-examine the possibilities for how life is organised.

Trained originally as a biologist, Erinma also has a background in the creative industries as curator, commissioner and filmmaker. Currently they are Wallscourt Associate Professor of Immersive Media in the School of Art at UWE Bristol and a member of the Digital Cultures Research Centre based in Watershed's Pervasive Media Studios.

They are also a member of UWE's Critical Race and Culture Group and associate member of the Centre for Sustainable Planning and Environments. As co-director of Squirrel Nation Studio, Erinma is an alumni of the Stuart Hall Scholars and Fellows Network, Manchester International Festival/ Jerwood Fellowships and a recipient of a JUSTAI fellowship with LSE/ Ada Lovelace Institute. Erinma is co-editor of Emerald Press book series, [Digital Materialities & Sustainable Futures, Emerald Press](#) (and serves on the Royal Academy of Engineering Steering group for Technology Pathways & Meaningful Innovation).

University profile

<https://people.uwe.ac.uk/Person/ErinmaOchu>

KATHERINE GREEN

Art, Community, and Technology: Illuminating Hidden Histories

As a director of the artist-run Community Interest Company, Rendezvous Projects, Katherine Green collaborates on ventures that unearth and celebrate underrepresented social narratives through innovative and creative methodologies. In addition to her artistic work, Katherine has held leadership roles in digital transformation projects within the arts and culture sectors, with extensive knowledge of digital development. The following projects will be discussed:

Sweet Harmony: Radio, Rave & Waltham Forest, 1989-1994 (2019-2022) - This project documented the influential pirate radio and rave scene in Waltham Forest between 1989 and 1994. It resulted in 30 recorded and archived 30 oral histories with key figures from the scene, accessible at Waltham Forest Archives; a radio programme with The Barbican; and an exhibition at Vestry House Museum.

Crate Digging: The Influence of De Underground Records (2021) - This project celebrated De Underground Records, a pivotal record shop and studio in London's Forest Gate, renowned for its role in the hardcore, jungle, and drum and bass scenes

from 1991 to 1996. Outcomes included an audio trail around the original shop location; a limited-edition booklet and poster showcasing the shop's history and impact; and the first blue plaque to recognise jungle music in the UK.

DungeonsAR/VR (2023-24) – A test and learn and jungle music scenes during the 80s and 90s. project which focused on The Dungeons nightclub in Leyton, this project used augmented reality (AR) and virtual reality (VR) to capture and share the club's history. Using captured 360-degree footage, the team produced a virtual tour and 3D models of the venue.

Biography

Katherine Green is a social documentary photographer and digital strategist with a career that spans over two decades. With an academic foundation in photography from Central Saint Martins and Fine Art from Surrey Institute of Art & Design, Katherine has exhibited at venues such as the National Portrait Gallery and Kettle's Yard. Her work, rooted in community and social history, leverages both traditional and digital mediums to explore and narrate the intricacies of community bonding and heritage.

www.katherinegreen.co.uk

www.rendezvousprojects.org.uk

An Interdimensional Mapping Protocol to Connect Rendering Engines and Game Worlds

Roderick Kennedy
Simul
Liverpool
United Kingdom
roderick@simul.co.uk

Joel Dietz
Massachusetts Institute of Technology
Boston
Massachusetts, USA
jdietz@mit.edu

Kim Nevelsteen
PhD Stockholm University
Stockholm
Sweden
kim.nevelsteen@root-interface.se

1. INTRODUCTION

While the term "Metaverse" was coined in the novel Snow Crash (Stephenson 1992), the concept of a shared, simulated world dates back at least to (Wertenbaker 1929). In 1978, Trubshaw and Bartle (Kelly & Rheingold 1990) adapted the concept of the text adventure to create the Multi-User Dungeon, or MUD: the first practical "shared virtual world". Shared, networked spatial applications were created by VPL Inc. in the 1980's (Lanier 2017). VRML was proposed as a way to extend the Web with a textual markup (Raggett 1995). The Web structure, of static, linked documents was unsuitable to many virtual-world use-cases so VRTP (Virtual Reality Transfer Protocol) was proposed (Brutzman et al. 1997) to address the multicast, real-time nature of virtual environments, but not completed; meanwhile many advances in spatial networking were made in games.

The Quake 3-D engine is for something, while VRML is a technology in search of a use. The Quake engine's original use is immaterial; once you have a world-modeling protocol... you've got the whole ball of wax...

Clay Shirky, Essays (Shirky 1998).

The advent of consumer virtual reality brought renewed interest in Spatial Internetworking. However there is no single shared protocol or spatial browser in widespread use. Rather, the Spatial Internet is divided into:

- Proprietary installable clients, which connect via proprietary protocols to proprietary servers.
- WebXR applications, essentially downloaded JavaScript clients, again connecting with proprietary protocols and servers.

The Teleport Protocol has been proposed to fulfil the role of VRTP: a common spatial network protocol for a network navigable from a single client (Kennedy 2018). However, the current Metaverse has a disjointed landscape of many clients and servers.

In response to a request for proposal from the standards organisation OMA3 (Samadian & Tom 2024), the present work addresses this state of affairs to enable user transfer between virtual worlds.

The Spatial Internet

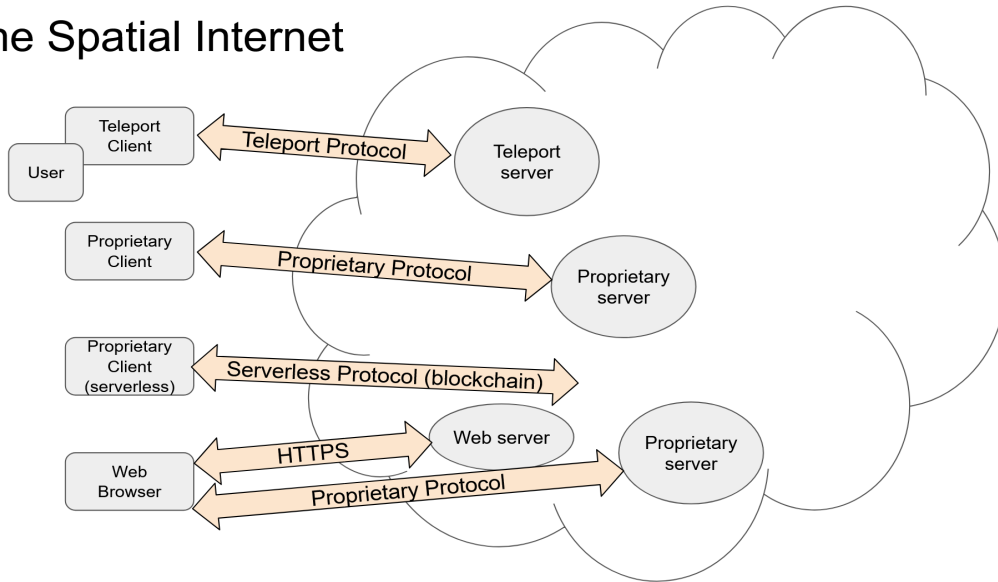


Figure 1: Schematic of the Spatial Internet

2. PROTOCOL

Consider a User, connected via a Source Client to a Source Service. A content-creator for the Source Service has created a Portal Link to transfer users to a Destination Service. In the simple case where the Destination Service is the same as the Source Service, this link merely transfers the User to a different position. We consider the general case however. There are two phases to the process (Kennedy and Nevelsteen 2024).

In the Query Phase, the Source Service provides a Portal Link to the Source Client, which contains the Destination URL and a Query URL. The Source Client uses the Query URL to request information about the Destination URL from the Destination Service. Typically:

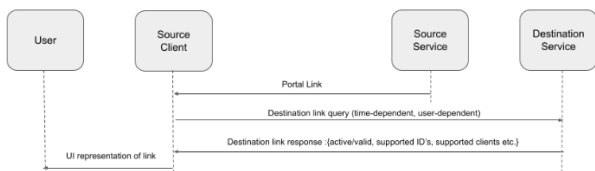


Figure 2: Sequence diagram of the Query Phase

- Is the Destination URL valid?
- For how long will the URL be valid (TTL)?
- What features are supported?

On receiving the response, the Source Client has sufficient data to display the Link to the User. If, and when, the User determines to follow the Portal Link, the Warp Phase is initiated.

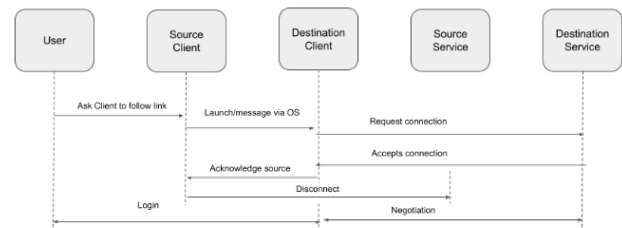


Figure 3: Sequence diagram of the Warp Phase

In this Phase, the Destination URL is passed to the O/S, which determines which local application (Destination Client) will process the URL. This is O/S-dependent. The Destination Client attempts to complete the connection and reports back to the Source Client on progress and success or failure.

On success, the Source Client loses focus, and the User continues with the Destination Client, having completed the transfer.

3. IMPLEMENTATION

An initial implementation of the protocol has been created using the Teleport Client and the MultiversalME service. A Portal Link was created in a Teleport world. The User sees this link as a sphere, overlaid with the URL in text, for example, `mmv://L_CyberpunkCity/10,10,10`. A User can initiate transfer in the Teleport Client. The URL is sent via the O/S. An instance of the MultiversalME client activates, receives the URL as a parameter or inter-process message if already running, and moves the User to the specified map and location. A Portal Link with the `teleport://` format from MMV returns the User to the Teleport Client at a specified world and location.



Figure 4: A Portal Link in the MMV Client

4. SUMMARY

A practical protocol for portaling between virtual worlds has been developed and demonstrated. This approach bridges the divide between the present, balkanized Metaverse and the potential Spatial Internet of the future.

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HyperMuse: Hypergraph rewriting for real-time musical visualisation (HRRTMV)

Dr Carlos Zapata-Carratala
Wolfram Institute, SEMF
Boston, MA, USA
c.zapata.carratala@gmail.com

Joel Dietz
Massachusetts Institute of Technology
Boston, MA, USA
jdietz@mit.edu

1. INTRODUCTION

Musical notation has driven musical innovation for millennia. This is best exemplified in two key cases: the standardisation of staff notation in the 18th century leading to the subsequent flourishing of western classical music, and the invention of Musical Instrument Digital Interface (MIDI) leading to the widespread use of Digital Audio Workstations (DAWs).

In this note we sketch a new approach towards dynamic musical notation and its possible technical implementation. Our system shall prove useful both for musicology researchers and practitioners alike since it provides a data-driven interactive visual interface.

We base our techniques on recent advancements in higher-order system analysis via hypergraph algorithms as well as literature on the geometric structure of musical form.

2. HYPERGRAPHS AND HIGHER-ORDER SYSTEMS

Research on network science has focused on higher-order systems in the last few decades. Hypergraphs (Figure 1) have emerged as a key abstraction and modelling tool to capture interactions between more than two parts of a complex system. A hyperedge contains the information of the interaction between an arbitrary collection of nodes.

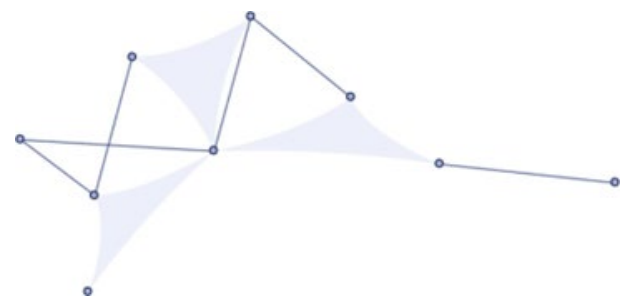


Figure 1: A sample hypergraph with low edge and node counts, note that, contrary to ordinary graphs, edges may link more than two nodes simultaneously.

Hypergraphs not only capture the combinatorial information of the interacting parts of a system but also the geometry where those interactions are embedded. Geometric information is encoded in the relative positions of nodes and hyperedges in a low dimensional space – in our case 2- or 3-dimensional.

2.1 Harmony as a higher-order phenomenon

In a musical system where single tones can be identified – such as most standard musical systems today based or borrowing heavily from the western tradition and 12-tone equal temperament – the concept of a chord can be characterised as a hyperedge in a network of tones. This is not a new idea, indeed, Leonhard Euler’s tonnetz (Figure 2) dates back to the 18th century and presents a similar network approach to a tonal system.

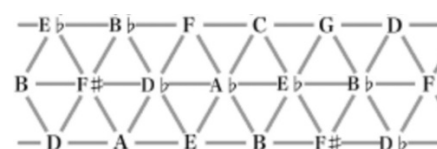


Figure 2: Euler’s classic tonnetz; a primitive visualisation of musical form based on pairwise tonal relations.

Our contribution is to consider a flexible definition of tone or tonal centre (measured by spectrogram patterns) and to define a condition of simultaneity that brings those tones in harmonic or vertical interaction thus forming a particular hyperedge in a dynamic tonal hypergraph.

The melodic or horizontal interaction of tones is captured as a sequence of rewriting rules that dynamically modify the structure and embedding of the tonal hypergraph.

3. MUSICAL NOTATION AND GEOMETRY

Tymoczko et al. have shown that musical form can be notationally captured in an efficient way by the use of topologically non-trivial spaces and geometries that capture repetition and recurrence musical structures.

In our approach, the tonal hypergraph is embedded in a 2- or 3-dimensional space (depending on the specific application) using the geometric information of the musical structure of the piece being represented.

Dynamics, timbre, register, intensity, repetition, chorus-verse relations, etc. are captured in the spatial distribution of tonal nodes and the shapes used to display tonal hyperedges.

4. SOFTWARE IMPLEMENTATION

The initial version of the software was called “hypermusic” and used Python code (plotly) to plot the tonal relationships in classical music.

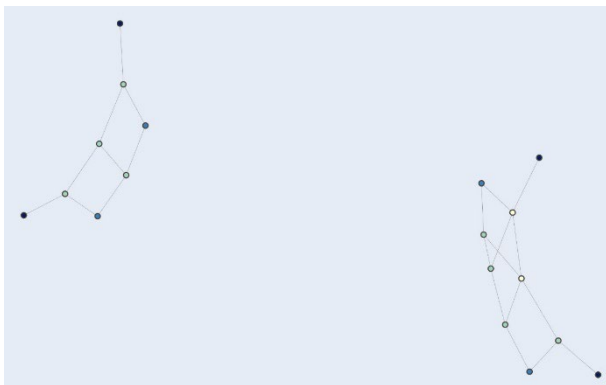


Figure 3: Tonal relationships visualised in Pachelbel's canon.

The software implementation of these concepts has since been migrated to three.js and includes the ability to dynamically feed in standard audio formats (including from a microphone) and display the resulting structure in 3-dimensional space by drawing polygons between active frequency bands.

Additionally to facilitate live VJing performances the ability to select video files and then have the changing frames mapped polygons (i.e. a hyperdimensional extension to normal VJing software).

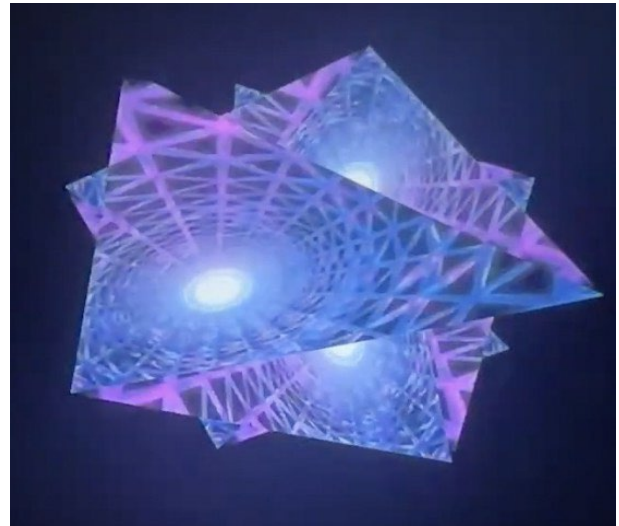


Figure 4: HyperMuse visualisation of a live jam session.

5. SUMMARY

We have presented a novel way to encode and present musical form based on hypergraph rendering and dynamic tonal analysis.

This presents a unique tool for musicological analysis since our notion of tonal hypergraphs provides a universal data structure to capture general musical form.

The software implementation of this technique and the visualisation that results from it offers an innovative tool for performers and practitioners interested in adding a visual component to their pieces.

The combined stack of the theoretical framework and the software implementation is called HyperMuse. We are confident that this will become an excellent VJing tool, as it has already been demonstrated in several live performances.

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Holotechnica: Exploring the nexus of altered states and altered traits

Carl Hayden Smith
School of Arts and Creative Industries
University of East London
London, UK
csmith7@uel.ac.uk

Holotechnica is the practice of combining different elements and techniques to create lasting transformations of consciousness ("altered traits"). This exploration is vital in the fields of consciousness studies, art and technology research. Despite the increasing interest in this area, there remains a gap in understanding how to move from alterations ("altered states") to enduring characteristics that reshape how we perceive and behave in the world. The main goal of this study is to develop recipes that can effectively combine endo-technologies with cyberdelics and pharmaco-technologies. The methodology involved conducting 20 expert interviews where stacks consisting of ancient healing traditions, reality hacking protocols and mindfulness techniques were outlined and analysed. The goal is to create a Holotechnica framework that empowers individuals to consciously shape their reality through achieving significant and enduring transformations. Future work will focus on improving the number of measures by which we can understand when an altered trait has been achieved.

Holotechnica. Altered traits. Consciousness. Immersion. Context engineering.

1. INTRODUCTION

The definition of *Holotechnica* is comprised of the following parts:

- i) Holo = to combine into the whole
- ii) Technica = technique

Nexus = a connection or series of connections linking two or more things.

Holotechnica means to combine techniques in order to create the desired experience stack.

Holotechnica consists of a database of different consciousness-expanding techniques, meditations, and protocols that can be combined in a form of dialogos:

Dialogue is really aimed at going into the whole thought process and changing the way the thought process occurs collectively. We haven't really paid much attention to thought as a process. We have engaged in thoughts, but we have only paid attention to the content, not to the process. Our thought, too, is a process, and it requires attention, otherwise it is going to go wrong. (Bohm 1996).

2. THE INSPIRATION BEHIND HOLOTECHNICA

Some core inspirations behind the development of Holotechnica includes the Dune 'worldscape' and specifically the 'Bene Gesserit way' which is inspired by 'the way' in Taoism. It involves creating an altered trait by maintaining balance (the idea of yin yang) and control over oneself, and by extension ones environment, learning how to control every muscle (prana) and nerve (bindu) in their bodies. This is the key to many of their extraordinary abilities, rather than through relying on some kind of technological enhancement (Meza 2010).

Another inspiration for the development of Holotechnica is the folklore surrounding Soma and specifically Matthew Clark's (2020) extensive research into what constitutes the mysterious brew:

For 250 years the botanical identity of soma has been a scholarly point of contention. The four vedas collectively refer to soma in three aspects; as a god, a plant, and the juice of a plant. This collection of mantras and hymns give tantalizing descriptions of Soma's preparation and revealingly (if only poetically) the ecstasy it produces in those who consume it. This has led some researchers to conclude that soma was in fact an entheogen - which is to say a substance with hallucinogenic properties employed in ritual practice. As a result this also provides the

opportunity to apply for phenomenological, as well as textual and cultural analysis (Clark 2020).

3. HOLOTECHNICA INGREDIENTS

For the purpose of this paper we will focus on 3 categories or classes of Holotechnica:

3.1 Pharmaco-technologies

Definition: Pharmaco-technology blends pharmaceutical science, with engineering and technological advancements to progress the development of medicines.

Examples: Psychedelics, Entheogens, Arylcyclohexamines, Psychoplastogens/Pseudodelics etc.

3.2 Cyberdelics

Definition: The term Cyberdelic combines "cyber" and "psychedelic" with the aim to delve into realms of perception and experience, merging technology with mind expanding practices (Smith 2020). A "cyberdelic" is used to simulate or enhance states of consciousness using different elements (for instance computer technology, virtual reality and the internet).

Examples: Sound, Light Machines, AI-Generated Experiences, Neurofeedback, Biofeedback, Binaural Beats and Brainwave Entrainment, VR/AR/XR, Chi machines, Sound Baths, Binaural Beats, Brainwave Entrainment, Transcranial Magnetic Stimulation (TMS), Mindfulness Apps etc.

3.3 Endo-technologies

Definition: Endo-technologies are those experiences that we can achieve independently without the need for external stimuli, technologies, substances or other humans.

Examples: Breathwork, Fasting, Darkness retreat, Dance, Sacred sites, Sound, Trance States, Hypnopompic and Dreaming, Hypnosis, Hypnopompic and Hypnagogic States, Dreaming (individual and collective), NDEs, OBEs, Visualisation and practices from various meditative and yogic traditions etc.

One of the core contributions to knowledge of this research is to explore how we can best combine these different techniques (ingredients) into experience stacks in order to create reliable protocols for perceptual augmentation and ultimately a reliable cookery book for consciousness augmentation.

4. 'ALTERED STATE' VS 'ALTERED TRAIT'

Underlying this research is the important and fundamental difference between the 'altered state' and the 'altered trait'....

An altered state of consciousness means a shift from ones waking awareness. This can happen through methods like meditation, hypnosis, using substances or even naturally during sleep or daydreaming. These states involve changes in thinking patterns, perception of time and emotional responses amongst other things. The key aspect is that these changes are short lived – once the triggering factor fades away the individual goes back to their base level state of awareness.

An altered trait of consciousness signifies a lasting change, in our fundamental consciousness level. This idea is commonly explored in long term meditation practices where practitioners develop enduring alterations to their patterns and personality, for instance in how they cope with stress. These aren't shifts experienced during meditation sessions but are enduring transformations that influence how individuals perceive and engage with their surroundings continuously.

An altered state refers to a change in awareness whereas an altered trait signifies a transformation in our usual psychological makeup. (Goleman & Davidson 2018).

5. EXAMPLES OF ALTERED TRAITS

Richard Davidson and Daniel Goleman, in their book "Altered Traits" extensively explored the lasting impacts of meditation, on the brain. Their research highlights that consistent meditation practice can bring about enduring changes in traits like increased ability to handle stress, capacity for empathy, better focus and also mental wellbeing improvements. Their studies indicate that certain meditation techniques, such as mindfulness and loving kindness practices can genuinely transform ones qualities influencing behaviours and experiences. People with years of meditation experience. Individuals who have devoted time to practices (such as those with thousands of hours under their belt) exhibit notable differences in brain activity.

These seasoned practitioners often display heightened levels of gamma brainwaves linked to enhanced abilities and a heightened state of awareness. Importantly this elevated brain activity is not just observed during meditation sessions, it seems to be an aspect of their cognitive functions hinting at a lasting change or shift in their mental processes (Fleming 2018).

There is also research on stacking the combined impacts of psychedelics and meditation techniques. Scholars are exploring how substances such as psilocybin and practices like focused attention meditation can jointly influence consciousness. These studies aim to uncover the potential for long term benefits and transformative encounters that extend beyond temporary altered states (Millière et al. 2018).

6. STACKS BETWEEN THE STACKS

Within the three categories chosen for this research (Endo-technologies, Cyberdelics and Pharmaco-technologies) each category on its own has a multitude of complexity. That complexity however is vastly amplified when we attempt to combine the stacks within these categories i.e how do we create altered states and altered traits by stacking Endo-technologies with Cyberdelics and Pharmaco-technologies? How will these ingredients affect each other in the stack and what new qualia will these synergies create?

The next section will outline 3 examples of 'stacking between the stacks':

6.1 DMT extended state (DMTX)

DMTX is an innovative pharmacokinetic model combining the technology (or cyberdelic) category with Pharmaco-technologies category. This innovation is designed to safely prolong DMT encounters. While a typical DMT "flash" usually lasts around 5-7 minutes offering a glimpse of a profoundly intricate inner world, DMTX utilises cutting edge medical technology to maintain DMT levels in the bloodstream allowing for an extended peak, without the risk of overdose or harm to the individual exploring psychedelics. The intensity of the peak and duration of the DMT encounter can be precisely programmed and adjusted in real-time throughout the experience. This can be applied to various therapeutic purposes including advanced problem solving and consciousness exploration journeys. By combining healing practices with medical innovations this method could herald an entirely novel form of psychedelic expedition leading to altered traits.

6.2 Moistmedia

Moistmedia (Ascott 2000) represents a multiplicity of media; on the one hand a convergence of dry computational systems and on the other wet biological processes. A good example of Moistmedia is the reddit subnet group called 'Rift into the Mind' which documents a user-generated list of drugs that work well in VR (thereby combining Cyberdelics with Pharmaco-technologies) and what

type of combinations are optimal for creating flow states.

6.3 Hedonic engineering

Jamie Wheal's 'Hedonic Engineering' (Wheal 2021) delves into the concept of crafting and fostering optimal mental and physical states to boost human performance and overall wellbeing. By blending the idea of "hedonic" linked to pleasure, with "engineering" indicating a method for attaining states of awareness. Wheal proposes utilising diverse techniques like meditation, controlled breathing exercises, neurofeedback and pharmacological aids to enter flow states and enrich cognitive and emotional encounters. The goal is to empower individuals to attain lasting change with increased satisfaction, creativity, efficiency and interpersonal bonds through an approach grounded in insights, for managing and enhancing their internal experiences.

7. HOLOTECHNICA INTERVIEWS

The following five interviews are indicative of the research aiming to map out Holotechnica as a discipline. Each interview documents a protocol that involves stack that is intended to enable the development of altered traits.

7.1 STACK 1: JOSE MONTEMAYOR ALBA

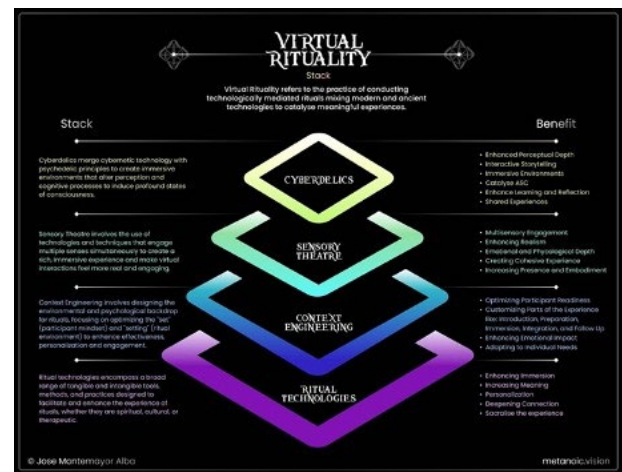


Figure 1: Virtual Rituality

'Virtual Rituality'

Virtual Rituality (Figure 1) refers to the practice of conducting technologically mediated rituals, mixing both modern and ancient technologies to catalyse meaningful experiences. On the one side we have the ritual technologies from our ancestors who left both tangible and intangible tools, methods and practice designs to facilitate and enhance the experience of rituals, whether they are spiritual, cultural, or therapeutic, ritual in itself has been one of the most ancient technologies that mankind has

adopted to transform the human mind. And on the other side, we have the advent of new technologies like XR, virtual, mixed and augmented realities, as well as brain computer interfaces, biofeedback technologies, sensory stimulation, kinetic technologies, and artificial intelligence. All of these technologies when merged with psychedelic or transpersonal principles give rise to what we know as cyberdelics which aim to create immersive environments that alter perception and cognitive processes in order to induce profound states of consciousness.

Now, let's focus on the middle layers of the stack. Context Engineering (CE) (Smith 2014) is involved in designing the environmental and psychological backdrop for the virtual reality. CE focuses on optimising the set and the setting to enhance effectiveness, personalisation, and engagement. It is involved in customising parts of the experience like the introduction, the preparation, the immersion, the integration, and the follow up. The third layer of the stack is the sensory theater. This layer glues all the rest of the layers together. Especially because when we are working in a ritual context, what gives technology its main purpose is to catalyse us into another state but we tend to forget about the analog, the senses, the body. The sensory theater involves the use of analog techniques that engage multiple senses simultaneously. This stack creates a rich, immersive experience that makes virtual interactions feel more real and engaging. It increases presence and embodiment, which are actually key for high levels of immersion.

To conclude, it's important to mention that when conducting a virtual rituality, one must make sure that it takes into account the psychological, physical and spiritual safety of the users. When putting together all these layers, you can create a very powerful effect, such as that you can radically transform the participants perspective on reality, themselves and others, so you bear the responsibility to ethically guide the design and hold space for people to safely explore these types of experiences. (Alba 2024)

7.2 STACK 2: MichAel Garfield

'Cyberacoustic guitar'

I've been playing guitar for twenty-six years and looping guitar for eighteen. Originally the looping started as a way of providing very simple accompanying grooves behind singer-songwriter material, but it has since eaten and digested my entire way of playing and my philosophy of music. I now see the process of sampling and remixing live instrumentation as a performance version of my academic background as an evolutionary biologist. My pedalboard is "the tangled bank" of Darwin's

evolutionary vision, an ecosystem of interacting players whose identity emerges out of their relationships, a musical version of the genetic sampling and remixing that goes on all the time in nature and in our bodies.

The goal with this rig is to perform a cybernetic, evolutionary worldview in which human subjectivity is understood as the behavior of entire ecosystems. I tell my audiences that this music implicates us both as the near and far ends of a single event observing itself from multiple angles. For "cyberacoustic" music, the self—the human-with-guitar that more traditional styles place in the foreground—becomes the "fruiting body" of a vast web of connections we don't ordinarily perceive. It's explicitly hyperhuman even as it cherishes the warmth and the tradition of acoustic folk guitar, by weaving the familiar into that "tangled bank" of signal path and temporal manipulation.

I want my concerts to help people understand intuitively how we're all just something Earth is doing, indistinguishable from nature, and that our machines are every bit as natural as the jungle, and that we aren't separate from them or from each other. Cyberacoustic guitar seems to work really well for this, taking people into trance with just enough emotion to create a sense of having made it as a species, having overcome the boundary between the body and the mind that made modernity so difficult.



Figure 2: Michael Garfield

7.3 STACK 3: Gavin Mckenzie Lawson

'A Technological approach to wellbeing in the music industry'

Engaging in creative activities provides an outlet for emotions and helps relieve stress and anxiety. In the world of electronic music there exists a unique fusion of art and science, where the technical aspects of sound and real world data sets are brought to life in a symphony of auditory experiences.

7.3.1 Sonification

Sonification and musification explores the concept of sonified data as a compositional tool in digital music production. The use of Generative Pre-Trained Transformers as a function of AI convert real world .json data from weather to mono nucleotides into notation for musical expression combined with isochronic tones or binaural beats. This opens up the opportunity for dialogue with the machine in digital compositions using music production software in this case Ableton Live, revealing the intricate bindings between creativity and technology, unlocking new methods of understanding that can enrich the lives of artists and musicians.

“As we augment our reality and step closer to AI infusions in creative media, we can use spatial technologies to support a new wave of industry specialists that focus on mental well-being.”

7.3.2 Spatial audio

Spatialised audio is a more immersive and dimensional approach that mimics the way people hear music and sound in real life, Planner magnetic technology supports an almost real life experience in binaural spatialisation with the Audeze LCD-X open back headphones and the use of SPAT max for live plugins designed by IRCAM, “Spat is a software suite for spatialisation of sound signals in real-time intended for musical creation, postproduction, and live performances. “I feel it’s worth considering a more nuanced, and ultimately more beneficial - use case, that of spatial audio for wellbeing.”



Figure 3: Gavin McKenzie Lawson

7.3.3 Practicality in wellbeing

The combination of electronic music, sonified data, isochronic tones, and audio- visual entrainment (AVE) are technological support systems for the creative industries, this could be further developed for use with individuals who are impacted by stress-related conditions as a stacking system fitting the

Holotechnica framework. As we delve deeper into this fascinating realm of inquiry, it’s important to explore the possibilities with music technology and stroboscopic light in wellbeing. Thus, expanding on the research and continued studies with AVE, isochronic tones, sonification, and spatial audio as a whole. Exploring how the brain reacts to auditory and visual stimulation provides a new perspective on the dynamics of sensory inputs and neural processes.

7.3.4 Psychosocial characteristics

The creative industry, more specifically the music sector is known for increased pressure, extensive touring and a lifestyle of excess, leading to a number of stress related conditions “We know that working in the electronic music industry can be very rewarding and offers many opportunities, however it can come with a set of unique pressures. These include long hours, high stress, a higher incidence of drugs and alcohol abuse, isolation and insecure work.

7.3.5 Consciousness augmentation

Through research and personal development my creative practice involves using the Roxiva RX1 and Ableton Live to navigate the inner realms of the mind and express these experiences into sonic compositions exploring the field of enquiry and subsequently releasing the album Audyssey - Geom on Bullet Dodge Records. The concept of using sonified DNA sequences in F# minor pentatonic scale, middle tuning system I and II developed by Maria Renold and a series of unique Max for Live devices supplied by Isotonik Studios. The development of a new Max for Live device by ‘Phelan, Kane. MsC’ sends OSC data packets to the Roxiva RX1 from Ableton Live in realtime controlling the stroboscopic light frequencies synchronised with audio and midi sources.

7.4 STACK 4: SARA PHINN HUNTLEY

‘Visionary synthesis, the fusion of psychedelics, VR and art ‘

I’m a multi-dimensional artist, writer, performer and researcher who has spent the past two decades at the nexus of technology and the arts. As a psychoanalytic cartographer, my work employs VR to investigate real time visual/spatial imagination, and its effects on brain remapping.

7.4.1 Music as a catalyst

Essential for both ideation and maintaining flow. The proverbial all spice of the stack music evokes strong emotions, enhancing the cinematic experience of the creative process.

7.4.2 Virtual reality as an immersive medium

Acts as a portal to altered states of consciousness. Synergistic with other catalysts, especially dissociatives, enhancing the hyper real experience.

7.4.3 Dissociatives in artistic exploration

used in deep ideation in VR, aiding in the creation of immersive and innovative art pieces. Enhances the suspension of disbelief, allowing magical almost cyber-hyper sigilistic aesthetic experiences.

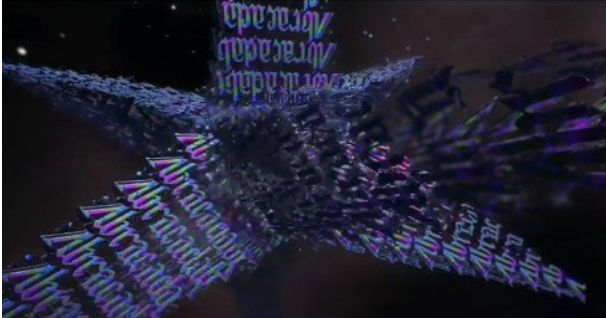


Figure 4: VR piece 'Abracadabra'

7.4.4 Dance and Flow Arts

Utilises dissociatives and ritual dance to access extrasensory fields in forming artistic consciousness. Video projection art is used to enhance trance states and channel mythic consciousness.

7.4.5 Visionary Journey Stacks Retrospective

Combinations of dissociatives, psychedelics and digital enhancements e.g. binaural beats and visual stimulation to access altered states.

7.4.6 Dream Work and Meditation

Use of lucid dreaming techniques aided by herbal teas and essential oils to access lucid dreaming and tools like AI image generation to illustrate dream journaling.

7.4.7 Collaboration with community

On networking dream sites, such as (dreamfields.net), to explore shared thematic elements and dreams as well as leveraging chatGPT for dream interpretation.

7.4.8 Integration of philosophy and technology

Incorporating philosophical audiobooks into the dream state to influence the dream narrative and its imagery.

7.5 STACK 5: CAZ CORONEL

'Loop busting'

I am a composer, music producer, DJ and sound designer. I write music to alter consciousness. Although all music does this, I do it intentionally to create *targeted brain states*: specifically feelings of 'energised calm' and wellbeing. I collaborate with The Monroe Institute using *Monroe Sound Science* brain entrainment in my music to facilitate these brain states.

My music has recently been showcased in the Orrb, a state of the art meditation pod. It will soon be used in a peer-reviewed study in Ascension Hospital (Jacksonville, USA). The study aims to prove that the stacked modalities of environment, comfort, music, sound entrainment, visuals and breathing techniques can refresh surgeons and doctors in less than 10 minutes.

Brainwave entrainment is the phenomenon where the brain's electrical activity synchronises to an external rhythmic stimulus, such as modulating sounds or flashing lights. This induces specific mental states associated with the corresponding brainwave frequencies. My music has been added to the RoXiva flashing light, to create a profound altered state.

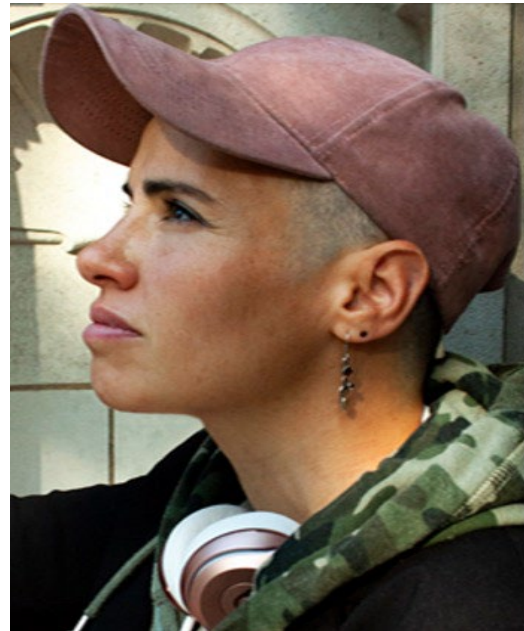


Figure 5: Caz Coronel

The RoXiva can be used for therapeutic purposes, healing, self-improvement and pure enjoyment. Even though all the lights are white, participants report seeing vivid, colourful moving geometric patterns. This can induce hypnagogic visions. It can also have effects beyond the visual modality, including inducing kinaesthetic, cutaneous and

visceral sensations and changes to mood, emotions, arousal and time perception. Light flickering can promote sleep, alleviate depression, PTSD and anxiety. Research has shown that both sound and light entrainment around 40hz can reduce amyloid plaque in patients with Alzheimer's.

I am a certified NLP practitioner and hypnotherapist. I am the founder of the *Conscious Explorers* (dedicated to exploring altered states and consciousness) and *Loop Busting Therapy* (LBT). LBT was conceived after curing a 27-year battle with an extreme form of bipolar disorder. I would swing from suicidal to a manic euphoric every three-quarters of a day and back again. The first step to my recovery was discovering that my bipolar was a loop.

8. CONCLUSION AND FUTURE WORK

Holotechnica is ambitious. If we consider just one modality, the ingredient of sound, and take a trip back in time to the 10th-century India where sound practitioners were already mastering the ability to heal each organ in the body using different sounds and frequencies (Menen 2004). Can we re-animate that knowledge today to enable the construction of sound hospitals using this incredible and largely lost science of sound? If we combine sound with other modalities, will we get stronger results or will we end up diluting the overall effectiveness. Context Engineering is key but knowing when one context is sufficient is an essential part of the role of the Holotechnica designer.

Creating perceptual changes that allow us to design our own reality should be, by definition, empowering. However, giving us the chance to change our consciousness as easily as we change the channels on our TV, could change everything. The mission is to focus on the appropriate preparation and integration necessary for altered traits rather than the never-ending search for altered states.

In summary, this paper outlined the concept of Holotechnica; an approach that combines methods to enhance consciousness and create lasting changes through a series of experiences. By incorporating technologies, cyber enhancements and pharmaceutical methods, Holotechnica aims to establish guidelines for creating altered traits. Through the fusion of these components the study outlines strategies for merging approaches through careful contextual planning. Valuable insights were gathered from interviews with experts who showcased their techniques. Future work will concentrate on refining the measurement tools needed to accurately gauge the attainment of altered traits using novel protocols.

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