IF THESE WALLS COULD TALK

IF THESE WALLS COULD TALK

1889 FLORENCE MAYBRICK

CAVA CENTRE FOR ARCHITECTURE AND THE VISUAL ARTS

RESEARCH PORTFOLIO

Prof Richard Koeck

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Index

Contents

Index

Contents continued

◗ Project Details

Designers:	Prof Richard Koeck (PI); Pete Woodbridge
Title:	If These Walls Could Talk […]
Output type:	Mixed Reality Museum Installation
Function:	Visitor Experience
Location:	St. George's Hall, Liverpool
Client:	Liverpool City Council
Curator:	Alan Smith, Director
Practical completion:	June 2019
Dates:	Commissioned 2017; First public exhibition June 2019; Permanent installation (stage 1) Dec 2019; EU-Presentation at ROCK conference October 2020
Fabrication Budget:	£20,000 (+ circa £30,000 in kind / voluntary contribution)
Funder:	Horizon 2020, EU programme "ROCK	Cultural Heritage Leading Urban Futures
Size:	Over two floors, covering ground floor prison cells and first floor courtroom

Collaborators

University of Liverpool / CAVA
Culture Liverpool
LJMU / Immersive StoryLab
Liverpool Institute of Performing
Arts / LIPA

CineTecture
Draw & Code
Dimension Studios

Additional Outputs/ Dissemination

Two films, keynotes and invited lectures at Kent University (2019 and 2020); National University of Singapore (2019); University of Cambridge (2019); Monash University/Melbourne (2018); King's College London (2018); ETH Zürich (2017); SIT Singapore (2017)

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Research Context

Much discussion surrounds the creative and economic potential of immersive technologies, such as mixed reality (referred to here as XR). Recently published figures predict a £160 billion global market in the field (Kilkelly/ Immerse UK, 2019) offering the potential to significantly transform economies, particularly within those countries investing in its research and development. Sectors such as architecture, design, arts, culture, engineering, education and entertainment see considerable potential in the ability of mixed reality technologies to facilitate the creation of immersive content and modes of experience, resulting in new value propositions and ultimately new value itself.

2017 marked an important UK milestone for discussions within academia and industry around immersive technologies, and in particular concerning their application in the context of 'immersive experiences' across the creative industries. In the *Bazelgette Creative Industries Review* (2017) Sir Peter Bazelgette argues that: 'Immersive experiences require novel narrative mechanisms & new language of production [...]. The best technology will not produce the change needed without equal excellence in content production and understanding of immersion as a narrative form' (2017). While the report was much noted at the time of its publication by funding bodies, researchers and creative practitioners alike, we believe that its deeper implications are only now becoming much clearer.

In contrast to this report, it is interesting to examine more closely what type of publications and media communications are emerging from technology companies advertising their products – and indeed attempting to identify new and significant markets. We observed a significant emphasis on "technological innovation", rather than "creative application", particularly for more recent technological developments in the area of mixed reality, where the digital and the physical worlds coalesce into a unified experience (Constansa 2009, Billinghurst 2015). In fact, a huge amount of investment is going into companies such as Magic Leap, whose expectations are yet to materialise into sales of devices (Robertson, 2019). We believe that such developments are opening up new opportunities for designers, allowing them to use digital tools capable of creating new kinds of hybrid spaces. These exciting new possibilities should be of particular note to architects, planners and local authorities.

Indeed, Liverpool is a particularly suitable location in which to test such a theory. The city's immersive ecosystem includes companies of all sizes, from individual entrepreneurs, consultants and micro-businesses, small and medium-sized agencies and production businesses, to large companies investing in immersive applications and technology (Bennett 2020: 4). Liverpool City Council (LCC) is keen to offer its residents and visitors new and engaging ways to experience the city and its buildings. Liverpool is a UNESCO World Heritage Site (WHS) with protected areas in its city centre and along its historic waterfront; it is proud of its heritage assets (e.g. listed buildings); and has a high density of cultural institutions – yet, it is short on funding. Consequently, as with many other cities in the UK, it is increasingly dependent on its visitor economy. It therefore needs to carefully consider strategies that will enhance the city's heritage and boost investment, tourism and regeneration. Liverpool City Council is keen to 'ensure the effective protection of the WHS for present and future generations' and plans to encourage this by establishing a more valued role and active profile for the WHS in Liverpool, through its promotion, interpretation and celebration (Anderson J, WHS Management Plan 2017- 2014).

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RESEARCH CONTEXT

The Mayor's Office and the team at LCC's Culture Liverpool are increasingly interested in what immersive technology could do for them. From an economic perspective, a digital, immersive, tailored heritage offer could provide a new pathway for new and meaningful citizen engagement and visitor experiences in the city, without the need for a large capital investment. Furthermore, from a preservation perspective, immersive digital technology could transform existing heritage sites into highly adaptable visitor experiences, without impacting on the fabric of the original buildings themselves. From a research perspective, this raised a series of important questions for us around tangible and intangible heritage. What value propositions do such technologies offer in the context of architecture? What implications/limitations do we currently encounter when working with e.g. AR/VR immersive technologies in the context of "location-specific" heritage experiences? What new methods are necessary to realise fluid interactions between users and high-quality holographic content inside a heritage building?

St George's Hall (1840-55)
Harvey Lonsdale Elmes

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▪ **Description**

"If These Walls could Talk" is the world's first volumetrically filmed (hologram), mixed reality (HoloLens) heritage visitor experience, purposed-designed for a Grade 1 listed building and a UNESCO World Heritage Site. The author led a team of industry professionals from Liverpool, London and San Francisco (Microsoft Mixed Reality Lab) in the production of a piece of practice-based digital design research that provides ground-breaking innovation in relation the use of volumetric film (3D-holograms of real people) and other audio-visual techniques (AR/VR/projections). This resulted in the creation of a new form of immersive/mixed-reality (MR) and site-/location-specific, future, non-invasive method (spatial storytelling) for visitor experiences within a sensitive architectural heritage context. Hence the team designed, developed and user-tested the narrative potential of emerging technologies applied to an iconic architectural setting.

▫ **FUNDING**

The project was funded by the EU / Horizon 2020 project *ROCK: Cultural Heritage Leading Urban Futures*. ROCK aims to demonstrate how historic city centres can act as extraordinary laboratories in which cultural heritage holds the potential to act as a unique and powerful engine of regeneration, sustainable development and economic growth. Thirty-three organisations across Europe were invited to translate research into practice and to develop an innovative, collaborative and circular systemic approach to the regeneration and adaptive reuse of historic city centres. Richard Koeck (CAVA) was commissioned by Liverpool City Council to prototype and user test an experimental mixed reality experience. He led the project and consortium of cultural and industrial partners and was principally responsible for the delivery of all research questions and outputs.

▫ **HYPOTHESIS**

The late William J. Mitchell, who in 2003 founded the Smart Cities program within the *MIT Media Lab*, speculated in *City of Bits* about the future of architecture in the information age. He argued that 'Architectural solids and voids become fluidly interchangeable, and the usual relationship of interior to exterior space is twisted into jaw-dropping paradox'. (W.J. Mitchell, 1995, p. 33). Almost 25 years later, we took this quote

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DESCRIPTION

as inspiration to speculate about our own future.

Given recent developments in 'spatial computation' (e.g. AR/MR/sensor tech), it should be possible to create new forms of bespoke visitor experiences for historical, architectural sites — based on our understanding of architecture (e.g. design) and social history (e.g. factual events) — which might create some kind of fluid exchange between architectural solids and ourselves. What if architectural buildings, whose porous walls must have absorbed all kinds of stories and events over a long period of time, could release some of their secrets? What **'if these walls could talk […]'**?

AIMS & OBJECTIVES

There is a growing realisation that particular areas such as cultural heritage could benefit enormously from an evocative implementation of augmented, virtual, and mixed reality technologies, with potentially significant implications for the cultural heritage domain (Bekele et al. 2018). We wanted to pioneer a new approach and method that, in the not-so-distant future, could potentially be adopted by other cities in UK, EU and worldwide and adapted to suit their own approaches towards urban regeneration and the use of urban heritage sites.

Our overall aim was therefore to explore "how" such digital and immersive technologies could be applied, in a perhaps more meaningful discourse around "narrative" and "place" – a concept for which, we would propose the term "digital location-based storytelling". In relation to our own, concrete example, this meant that we had consider ways in which to create a dialogue between the building and visitor, such as through a ground-breaking new method which would transform passive observers into active participants.

CROSS-DISCIPLINARY APPROACH

In order to address the above-mentioned complex and intertwined research problems, we defined and focused on three interlocking research pathways. These relate to individual work packages within our project plan and required specialist expertise. In the final installation, all three pathways were brought together into a unified user experience

1) **Architectural/social history** of a building (new tangible connections between place, historic events and people)
2) **Story-telling techniques** (new narrative approaches, specifically tailored to architectural heritage)
3) **Digital/technical R & D** (digital innovations, specifically designed for a heritage building)

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Research Approach

PRACTICE-BASED DIGITAL DESIGN RESEARCH
One of ROCK's ambitions was to demonstrate how interdisciplinary, collaborative research can be translated into practice in the heritage sector and how such newly generated knowledge could influence practices across Europe. Our practice-based digital design research provides ground-breaking innovation in relation to the use of volumetric film (3D holograms of real people) and other audio-visual techniques (AR/VR/projections) as a new form of immersive/mixed-reality (MR) and site-/location-specific, future, non-invasive method (spatial storytelling) for visitor experiences in a sensitive architectural heritage context (Grade 1 / UNESCO WHS). This meant that we had to develop a novel digital-physical spatial experience that embodies the spirit and history of a historic building, build around spatial setting, characters and storytelling. The following considerations helped define our research problems and design-led approach:

User Experience
Create a new audience experience, effective and end user tested

Technology
Push existing tech boundaries, by combining volumetric film + mixed reality

Location Based
Develop a model for location-based storytelling, specific to this building

Non-invasive
Non-invasive in our approach, i.e. no physical changes to the building needed

Adaptable
Strategy and workflow to be adaptable to other locations, buildings and stories

Scalable
Provide scalable solutions, i.e. method can be applied elsewhere

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■ Research Questions

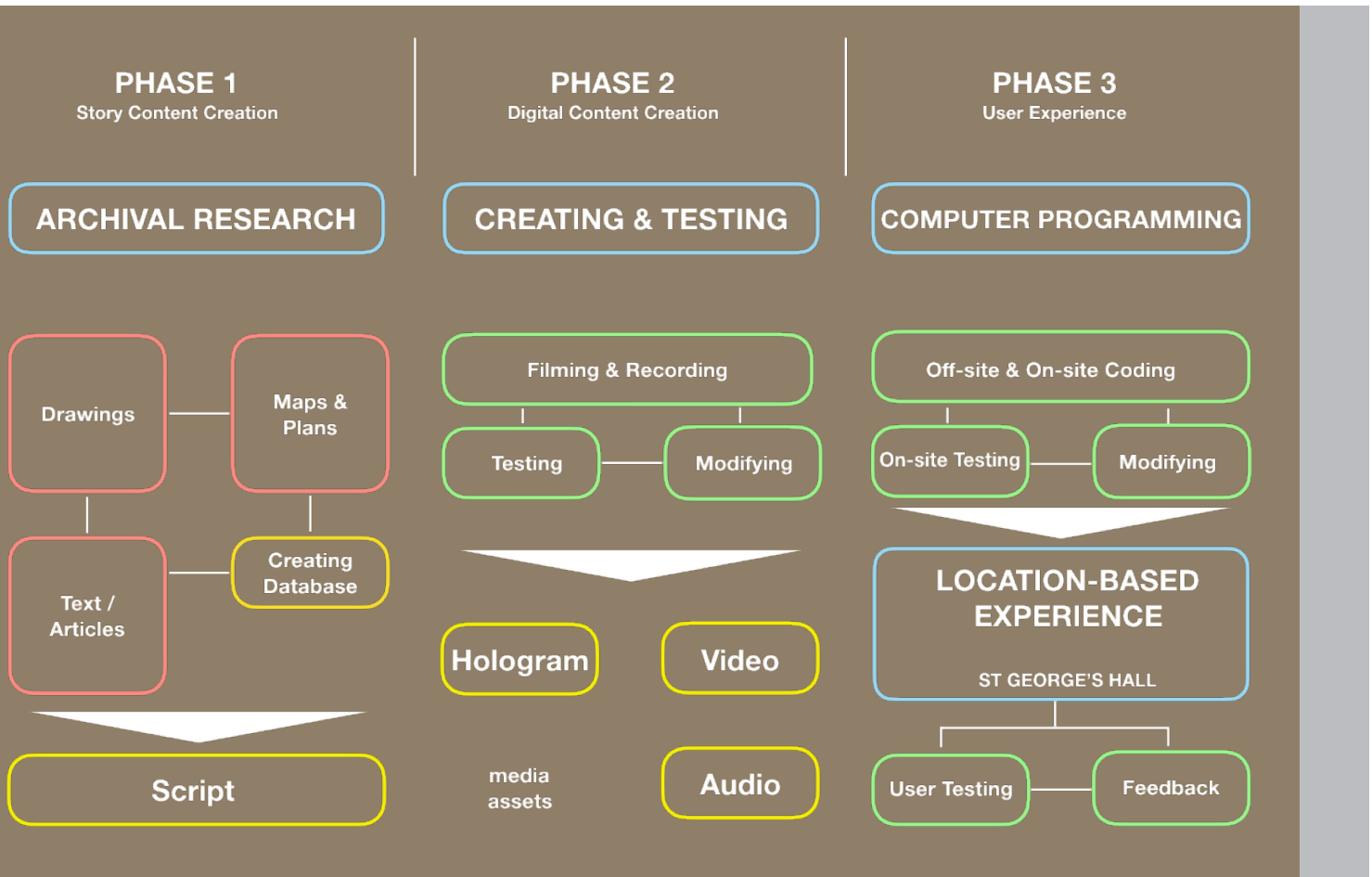| RQ 1	1. Value Proposition: How can volumetric film (3D holograms of real people) be used in an architectural heritage context to offer/engage audiences a valuable, immersive, location-specific experience?
RQ 2	2. Problem Definition: What are the implications/limitations (technology/audience engagement) for volumetric film (holograms) and other AR/VR immersive technologies in the context of "location-specific" heritage experiences?
RQ 3	3. New Method: What new "workflow" is necessary to combine "volumetric film" with AR headsets (Microsoft HoloLens), allowing the audience a fluid interaction between real space, audio/visual content and virtual characters?

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Methods

The design research was underpinned by an iterative process in which a series of research methods were employed, such as:

1. **Archival research**, producing a comprehensive historical study of the building and its changing functions over time, to create an understanding of the architectural/socio-historical and narrative potential of St George's Hall.

2. **Creating and testing** of bespoke story/storytelling systems and content (e.g. with audio/video/3D- holograms) to effectively communicate the architecture/social history of the space/time.

3. **Computer programming** (e.g. Unity) and authoring of narrative content, stitched directly into the historical setting/ space; to dynamically respond to specific spaces (location) and people's journey (movement) through the building.

PHASE 1
Story Content Creation

PHASE 2
Digital Content Creation

PHASE 3
User Experience

ARCHIVAL RESEARCH

CREATING & TESTING

COMPUTER PROGRAMMING

Drawings

Maps & Plans

Text / Articles

Creating Database

Script

Filming & Recording

Testing

Modifying

Hologram

Video

media assets

Audio

Off-site & On-site Coding

On-site Testing

Modifying

LOCATION-BASED EXPERIENCE

ST GEORGE'S HALL

User Testing

Feedback

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St George's Hall
Queen Victoria visit 1886
Image Source: Illustrated London News. With kind permission of Mary Evans Picture Archive

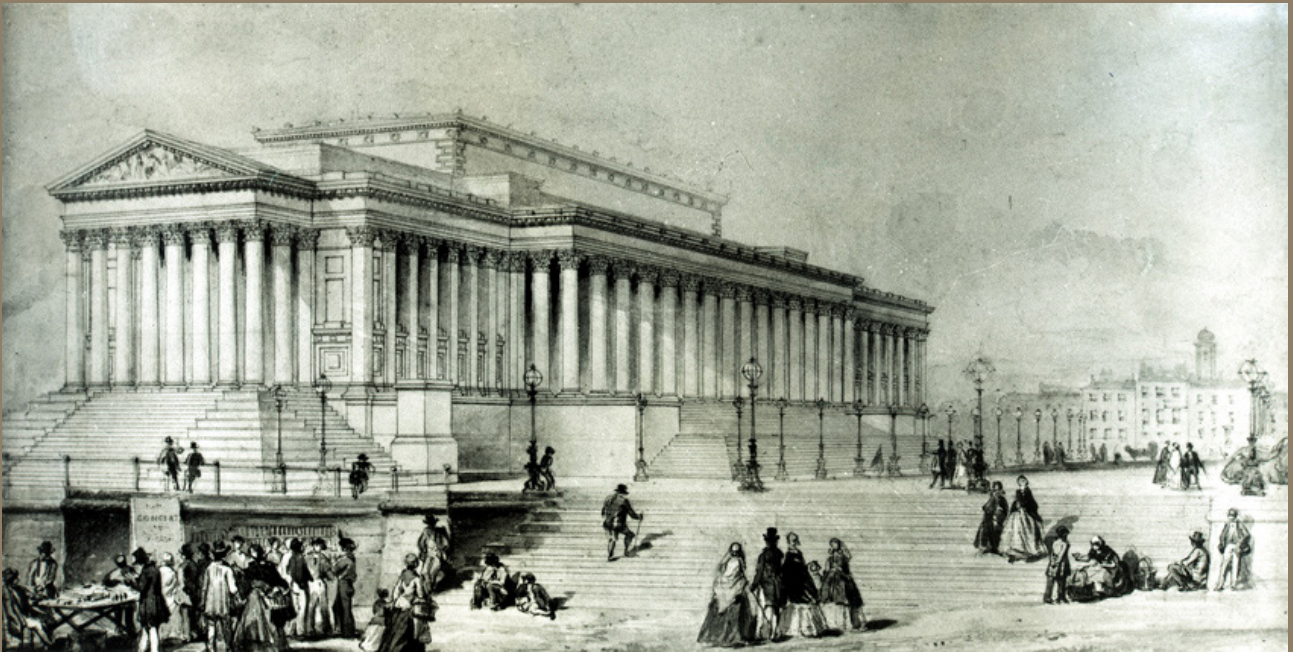HER MAJESTY APPROACHING ST. GEORGE'S HALL TO RECEIVE THE ADDRESS OF THE CORPORATION.

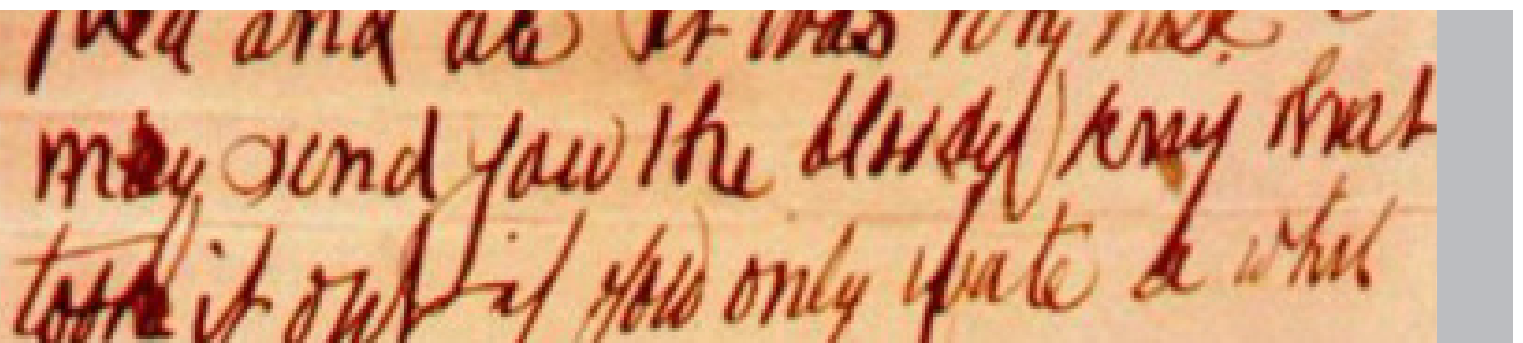Image Source: Liverpool Public Library
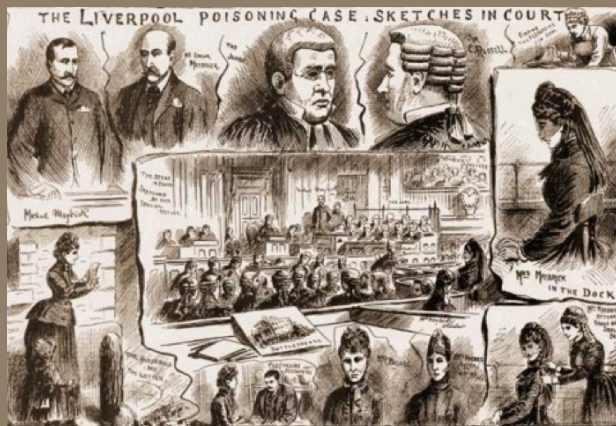
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▪ Process 1-8

Process 1

ARCHIVAL RESEARCH

Florence Maybrick (1862-1941) was an American woman married to a Liverpool cotton merchant named James Maybrick. In April 1889, she was accused of administering arsenic to her husband which subsequently led to his death. That same year, and under much attention from the public, she was tried at a court hearing in St George's Hall. Historic accounts suggest she was not provided with the proper means with which to defend herself. After only a short trial, the Liverpool judge sentenced her to death (later reprieved after diplomatic pressure from her native USA). The case is still held up as an example of the harsh Victorian judiciary system to this day. In fact, her case resulted in the introduction of the appeal system in British legal history. Many questions remain unanswered and the case continues to be discussed in the media (e.g. Guardian 25 Feb 2014).

We structured our archival research into two parts. Firstly, the location and examination of all materials (including interviews) in relation to the use of space inside St George's Hall, such as the court room, prison cells, and holding cells. Secondly, the sourcing and studying of material relating to the Maybrick court case, including newspaper cuttings, letters and visual representations.

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PROCESS 1: ARCHIVAL RESEARCH

Database for the collection of drawings, maps and text

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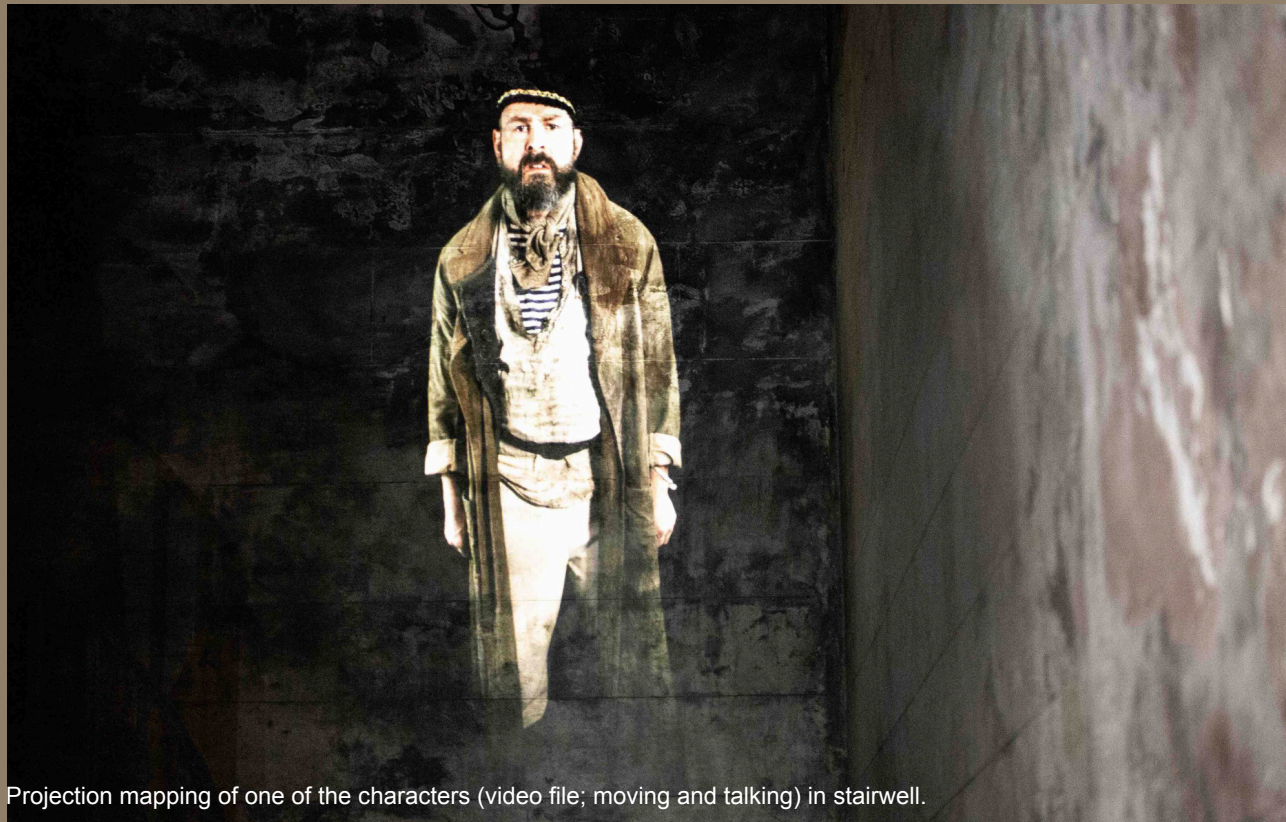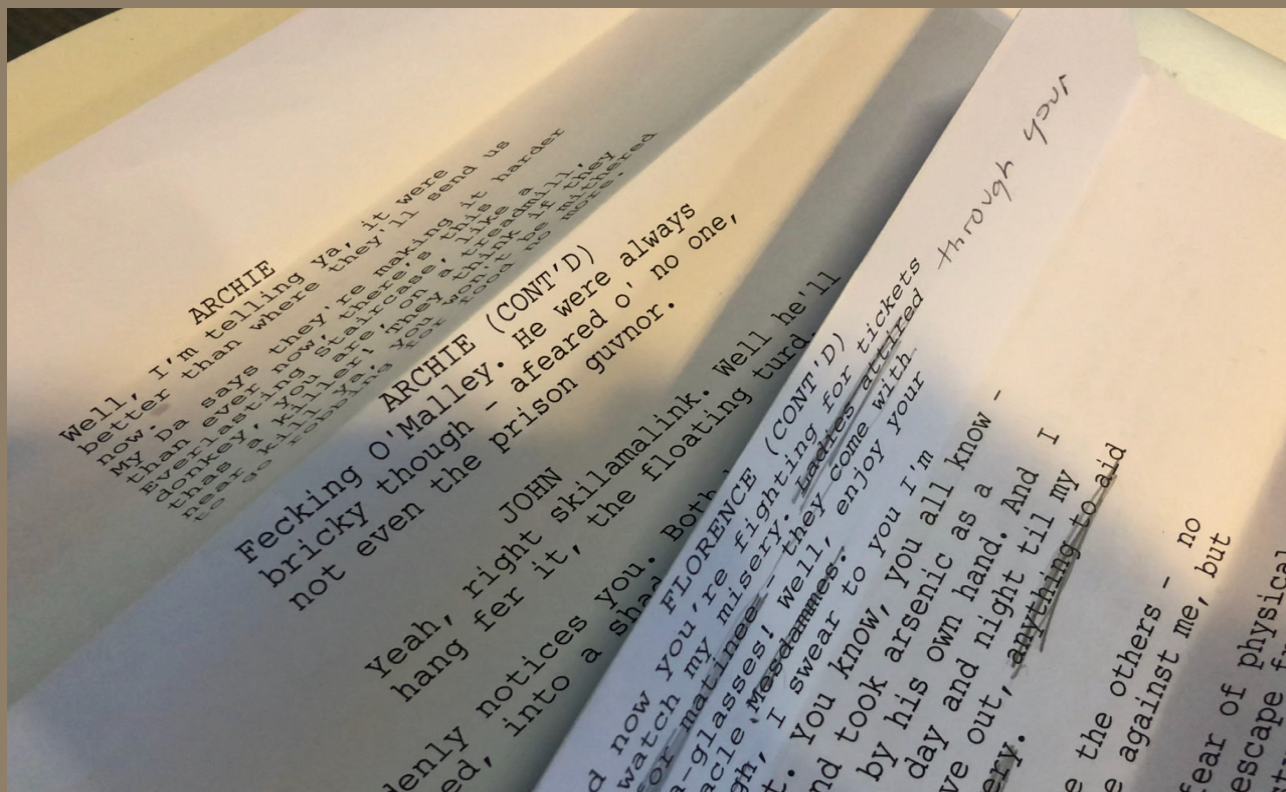## Process 2.1

2.1 STORY & CHARACTER DEVELOPMENT (SCRIPT)

Following on from our archival research, we worked with BAFTA award-winning writer Rosemary Kay on the development of the storyline for the mobile walking tour to be taken inside the building (mixed reality experience). The narrative element was expressed through five characters and would later be geo-stitched directly into the spaces of St George's Hall (contextual experience), bringing the story/characters to life through a combination of:

1) location-based sound (hidden speakers)
1) augmented reality (mobile devices; Android phones)
2) virtual reality (mobile VR headsets; Oculus Quest)
3) mixed reality (mobile MR headsets; Microsoft of (HoloLens)
4) holographic displays (Looking Glass Pro)
5) projection mapping (Madmapper; Lightform)
6) live action (on-site actors)

This complex approach gave us the opportunity to test and compare (through user experience) the full spectrum of digital audio-visual methods to link people and stories within an architectural setting.


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Projection mapping of one of the characters (video file; moving and talking) in stairwell.

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Process 2.2

2.2 VOLUMETRIC FILMING – CAPTURE TESTS

We believe that mixed reality (MR) and spatial computing will re-imagine the physical world and transform traditional media. With this in mind, we decided to partner-up with a worldwide leading innovator in the field – Dimension in London – who provide revolutionary volumetric production studios for the creation of next generation digital humans, XR content and virtual production. Small details are key in the complicated process of creating a full-sized, moving human hologram. A bespoke, historically accurate costume, designed with reference to original archive image sources, was made for our actress. This costume needed to be tested to ascertain whether the studio's light sensors could pick up the reflecting signal. We also experimented with different make-up and hairstyles (trial and error) to optimise light sensitive volumetric capture. The results from this process fed back into script development and the final direction of the first scenes.

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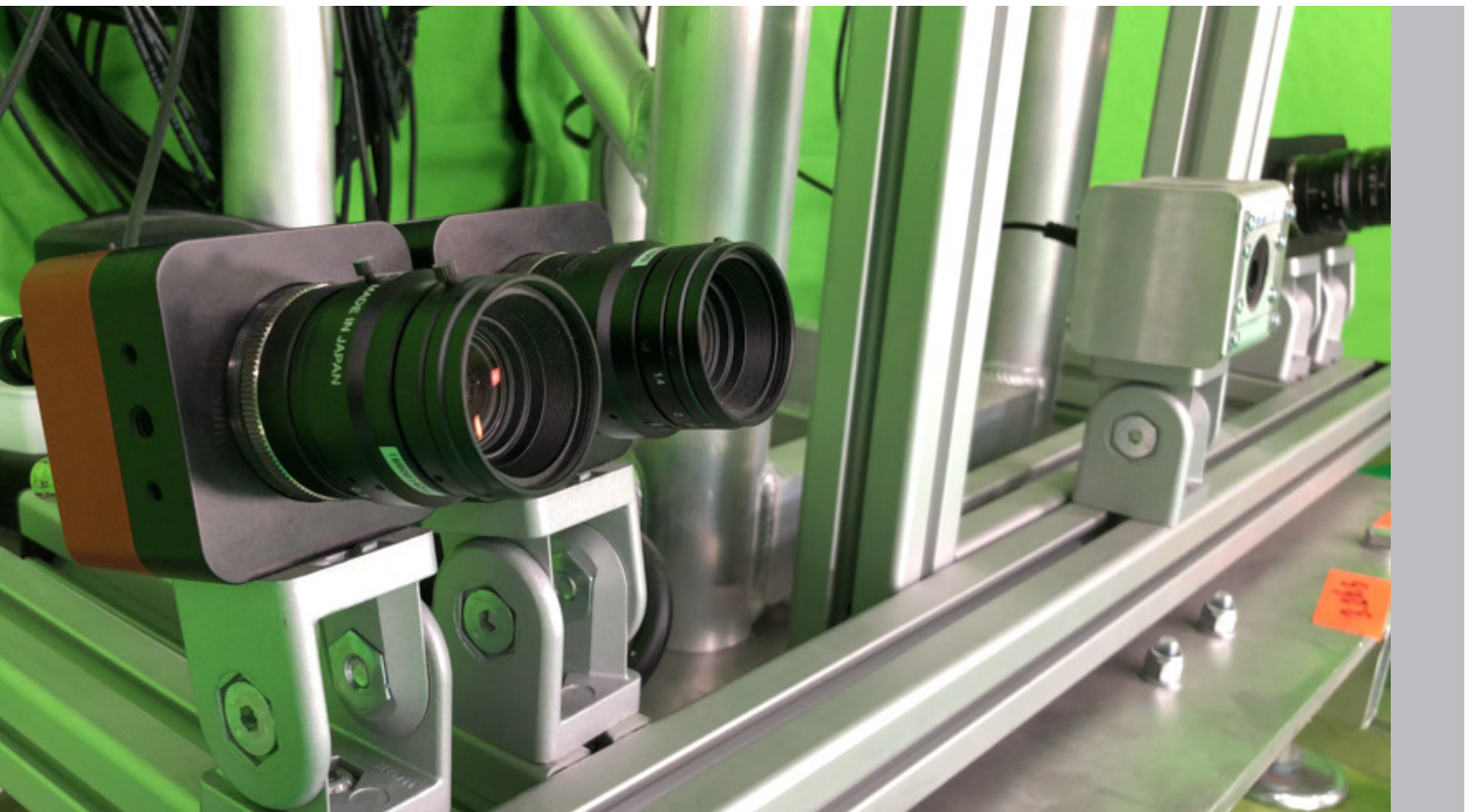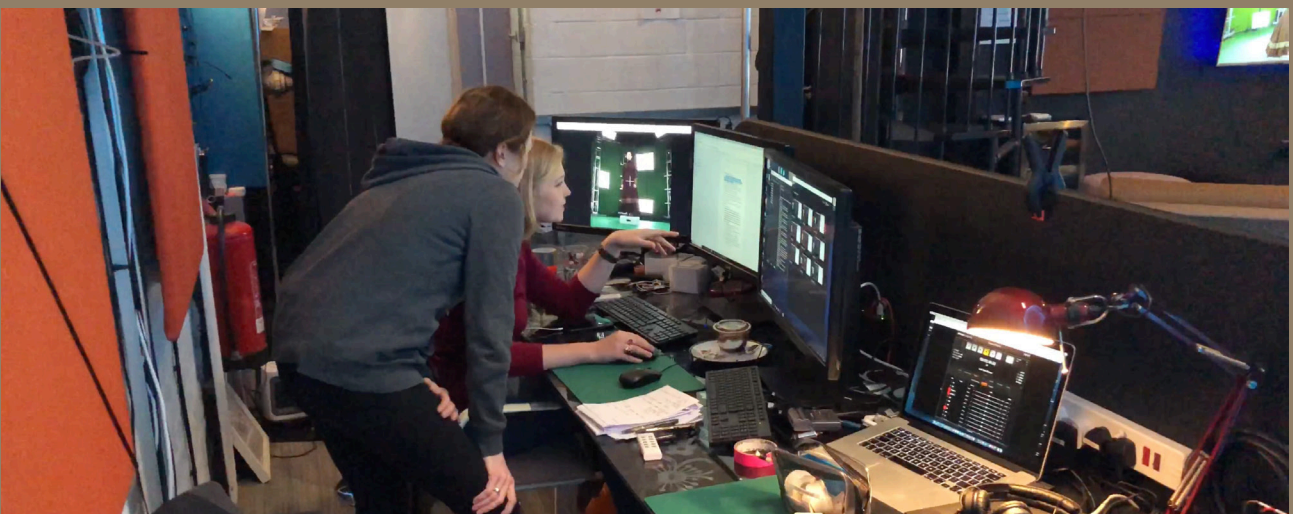
PROCESS 3: VOLUMETRIC FILMING (3D-HOLOGRAM)

Process 3.1

3.1 VOLUMETRIC FILMING (3D-HOLOGRAM)

The images below show the filming of one of our actresses (Jessica Pritchard as Florence Maybrick) in Dimension studio's purpose-built rotunda in London. 160 individual 2K cameras and sensors captured her image and movement at 60fps. Our film/TV director Philip Wood is seen here giving "Florence" guidance for the scene. Not only was our actress required to perform remotely from the real, physical context of the building (green screen studio), but her position, lines of sight and other factors also needed to be measured and calculated during the filming process, to allow for later matching with the physical location inside St George's Hall (e.g. position of the judge, audience, or children in the gallery).


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Process 3.2

3.2 VOLUMETRIC RENDERING

After shooting the initial scenes, we needed to produce test renders to review the quality and smoothness of the moving hologram (e.g. polygon count tests and textures). The results of this process fed back into the following scenes. This was followed by multiple re-shooting and optimisation of, for instance, costume details and fluidity of movement. This iterative workflow was essential since the volumetric rendering is very time consuming and costly. For example, one minute of footage takes circa 24-hour render time and incurs of cost of almost £10,000. Dimension provided an APK (Android Package File) which however, turned out to not be suitable for an import into a mixed reality headset (Microsoft Hololens). The result of our process generated a "living hologram" of a historical figure; a full-sized, moving and talking 3D character.

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PROCESS 3: VOLUMETRIC FILMING (3D-HOLOGRAM)
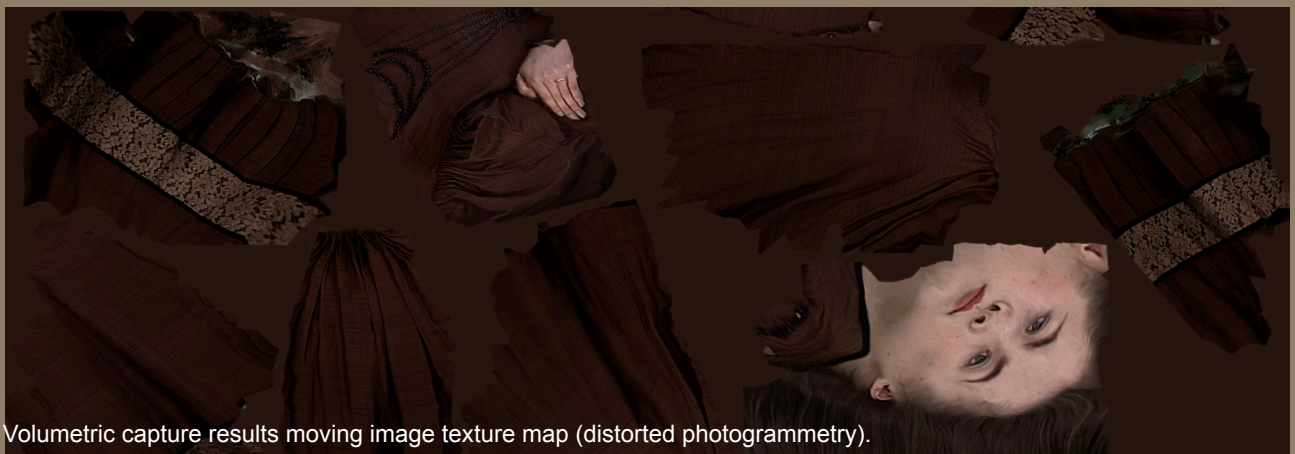
Volumetric capture results moving image texture map (distorted photogrammetry).

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PROCESS 4: 2D-KINECT FILMING (DEPTH MAPPING)

Process 4.1

4.1 CAMERA / SENSOR CALIBRATION AND LIGHTING

Not only did we produce a three-dimensional character (living hologram), we also experimented with a less expensive process to create realistic historical characters for later use as part of the mixed reality headset experience, and projection mapping within the building. To achieve this, we used a Kinect sensor for our depth mapping, which created an image channel containing information relating to the distance of the surfaces of scene objects from a particular viewpoint. We chose this process because we expected at the time (an expectation which has since been confirmed) that similar technology would soon become available in newer version smart phones (such as iPhone 12). This meant that our proposition would soon become scalable. In our case however, we required a careful setup (physically measured; with calibration markers), in order to calibrate the sensors, cameras and lighting for each scene, enabling image keying to take place later, in post-production.

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# PROCESS 4: 2D-KINECT FILMING (DEPTH MAPPING)

Process 4.2

4.2 KINECT SENSOR MOTION CAPTURE & DIRECTING

After the calibration, we shot five actors (including 2 child actors) against a green background. We used the Kinect sensor for the 3D-Motion capture (through depth mapping) and image capture with professional high-end 4K film production cameras (filmed by award-winning cinematographer Monika Koeck). The results were previewed to make sure that the performance and the position of Kinect 3D-Motion capture would later match up with live performances and the actual space in St George's Hall. In this stage of the process, particular emphasis was placed on the performance of the actors. Film/TV director Philip Wood fine-tuned the performance elements of the process (acting and dialogue) to ensure the storyline (script) was adhered to, whilst capturing the pre-determined emotional tone of the piece.

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PROCESS 4: 2D-KINECT FILMING (DEPTH MAPPING)
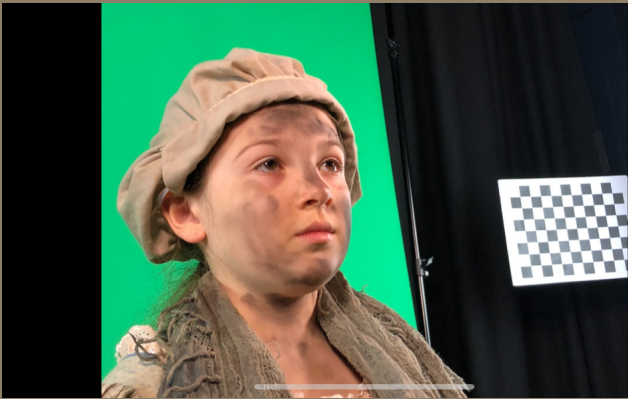
Process 5

5. SOUND RECORDING & MIXING

The final mixed reality experience required attention not only to the visuals but also, crucially, to sound. In fact, during our experiments we discovered that much of the architectural and sensual quality of the spaces encountered by visitors (scale, materiality, emotion) was transported through the experience of sound. This impression was further enhanced by the use of headsets capable of playing stereo which responded in real-time to position and head movement. The result was a "spatial sound" that enabled us to create an entire sound landscape for the building. As a result of this finding, we therefore took more time than originally anticipated to record and mix a diverse set of sounds (background sounds, crowds, noises and dialogues), working with young student volunteers from the Liverpool Institute for Performing Arts (LIPA) to this end. Again, this was a highly iterative process that required us to adapt and match individual scenes (remotely recorded) to the equivalent situation in, for instance, St George's Hall courtroom and the basement prison cells.

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Process 6.1

6.1 3D MAPPING OF ST GEORGE'S HALL (COMPUTER VISION TECHNOLOGY)

The immersive experience we devised for the building entailed the visitor, wearing a headset, moving through space to trigger a geo-fenced area, that in turn would activate a particular media file (e.g. the sound of prisoners shouting), which would then play within the headset. To achieve this type of responsive scenario, we had to find a way to composite and geo-position ("stitch") our media assets (images, hologram, depth mapping, audio, sound etc.) into the real space of St George's Hall. We knew that we needed to create a 3D scan of the user journey (mapping) inside the building. We discovered, however, that conventional methods such as laser scanning would have created incompatible files too large for the Microsoft headset. We therefore used the headset's own internal sensors to create such a 3D map that stretched over two floors of the building.

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Process 6.2

6.2 SITE-SPECIFIC AUTHORING OF DIGITAL CONTENT

The process previously outlined, based on computer vision and an algorithm, allowed us principally to connect all media assets with their approximated geographic location within the building. For the fine-tuning of the experience (storytelling), however, we discovered that constructing the experience remotely would not produce the desired results. Tests had shown that the actual, final authoring needed to be carried out on site (on location) in the building itself. This meant that a programmer (computer vision expert) and storyteller (creative expert) had to work collaboratively on site to embed and test the delivery of the media contents in relation to a very precise location (e.g. at a corner within a corridor). This process required an element of trial and error and eventually led to a workflow model that could be applied for the rest of the building, but potentially also to any other building or space.

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Process 6.3

6.3 PAIRING OF 3D-VOLUMETRIC HOLOGRAM WITH HOLOLENS HEADSET

The next stage, following the previously described process of mapping and geo-locating the media content, centred around the paring or "assembly" of the entire system. At this point, we encountered a major technical issue which, after we solved it, led to a significant research outcome. After installing all the final updates and loading all assets into the headset (as a composited audio-visual experience), we discovered that it was not possible to play our 3D Hologram inside the Microsoft MR headset (Hololens). After a long process of troubleshooting and eliminating possible causes for the problem, we in fact discovered that nobody before us had tried to incorporate a high-resolution 3D moving/speaking hologram into the Microsoft mixed reality headset. There was no existing API (application programming interface) that would allow the integration of such a large and complex file. To resolve this issue, we collaborated with Microsoft's Mixed Reality headquarters in San Francisco, who worked with us to script a new Unity plugin.

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Process 6.4

6.4 FINAL SITE INSTALLATION & TESTING OF HOLOGRAM
After some trial and error, we were able to install a new, bespoke code called "SVFUnityPlugin_1.2.18 (1). unitypackage". By using this new computer script, we were able to import our 3D content and prove its applicability in real environments. This raised a series of related questions. Computer vision is sensitive to surrounding light conditions. Would the system recognise the environment and deliver the hologram effectively? How well would the system respond to head movement (tracking)? How clear would the vision be inside the headset in challenging lighting conditions (e.g. with bright sunlight outside)? We were the first research group able to ask such questions, as nobody before us had been able to play such a high-polygon hologram within an industry-leading headset such as Hololens. We were able to run a series of tests to see how the hologram world work under such situations, e.g. in interior and exterior spaces. As can be seen in the image, the system worked extremely well.

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Process 7.1

7.1 AUDIO-VISUAL EXPERIENCE

As a final stage, we user-tested the entire visitor experience (with questionnaires). Once the visitors had their headset mounted by a guide, they could walk around freely, listen to 'conversations' and observe the scenes, before walking into the next room. We created a hybrid narrative space in which the building of St George's Hall, a storyline and digital contents overlapped seamlessly. The experience was described as "cinematic" in the sense that it was movement-based and consisted of an audio and visual impression, rooted within a clear story. Below is an example of a visitor exploring a seemingly empty prison cell. The visitor, while wearing the headset within the space however, would encounter a life-sized, moving and talking hologram of Florence Maybrick, which would appear to speak directly to him. Simultaneously, the headset user would also hear the voices of other prisoners having conversations and shouting in the adjacent cells and courtroom. Spatial sound was a key element that led to a successful outcome. The headset recognised the user's every head movement and mixed a spatial sound accordingly.

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Process 7.2

7.2 MOVING THROUGH THE BUILDING (ARCHITECTURAL PROMENADE)

The physical movement of the user was a key element in the experience. As mentioned before, we benefitted from having worked with BAFTA award-winning writer Rosemary Kay, who helped us script the visitor experience. Not only did the architectural promenade format create a sense of experiential connection to the fabric of the building, but users also felt further engaged by a sense of the building itself actively responding to them. This was vital to our storytelling strategy. It was in part achieved by the movement of the user through the space and the consequent (sensor-based) triggering of events and a story journey dependent on their physical location. Crucially, visitors reported a sense of involvement and participation in the development of the storyline itself, with some likening it to being an 'explorer' of the building's history, with their own actions unlocking the information they received. This later led us to conclude that we had succeeded in revealing some of the narrative potential of St George's Hall.

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Process 7.3

7.3 INTEGRATION OF LIVE ACTION

The process of designing the experience also revealed the potential danger of being overly reliant on digital technology. With this in mind, we decided to add one more element to our "mixed reality" experience by integrating live action into the otherwise digital experience. This not only added a sense of realism, but also helped blend the hybrid (physical/digital) elements.

In our public shows for instance, a guide (an actor playing a historical character such as a prison guard) led members of the public through the building, where they encountered our digital characters (2D and 3D holograms). While our visitors were wearing and looking through our holographic headsets, the actor would grab them by the arm and talk to them about prison inmates and the trial of Florence Maybrick. True to our historical sources (e.g. archival records and etchings), we populated the courtroom with our characters, from the judge sitting on his chair (**projection**) passing sentence on the defendant, to Florence Maybrick standing in before him (visible in the **mixed reality headset experience**) and spectators in the courtroom gallery (**live action**). For the visitors, this meant for instance, that the two children of Florence Maybrick, who had previously appeared as digital holograms outside the prison cell earlier in the visitor journey, now re-appeared, live (child actors) in the courtroom's gallery, speaking to the hologram of their mother who was standing trial.

Such carefully designed and choreographed strategies created a blurring of boundaries between the virtual and real world that went far beyond the mere use of an extravagant digital headset.

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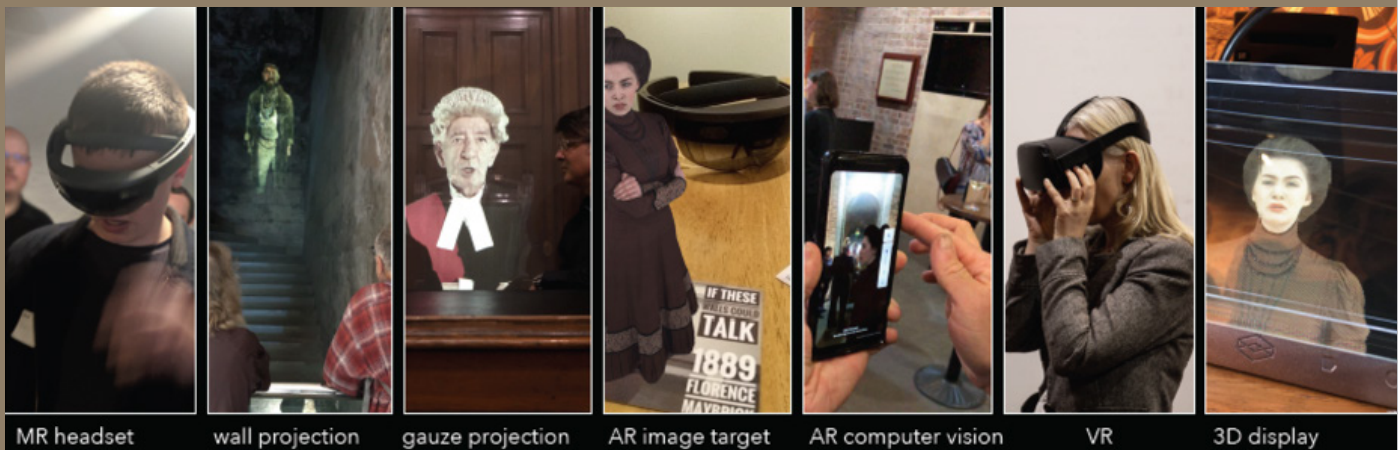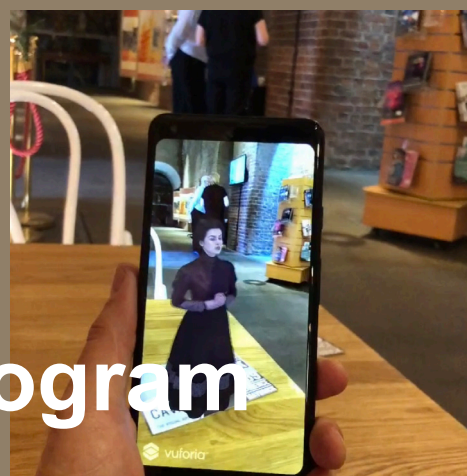
Process 8

8 ADDING MORE CHANNELS

It was important for our research not only to create a new, groundbreaking, location-based mixed reality experience, but also to compare such a headset experience with other types of visitor/audience engagement projects within a historical architectural setting, including those incorporating more commonly used audio-visual digital methods. In other words, we also wanted to see if it was technically possible to adapt a hologram, which is relatively complicated and expensive to make, to other digital distribution channels and platforms, in order to make our system much more economically viable. The result was the creation of a whole fleet of additional channels, all of which utilised the same assets. These included wall projections, gauze projections, a mobile AR application that was based on the recognition of an image target, a second mobile AR application that used computer vision to place our full-scale hologram into any space, a VR installation showing Florence in a reconstructed prison cell and holographic displays with the figure of Florence inside (Looking Glass). We demonstrated all of these at several public events and collected invaluable user feedback.

MR headset | wall projection | gauze projection | AR image target | AR computer vision | VR | 3D display

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VR Headset
Sharing a Prison Cell with Florence Maybrick

Gauze Projection
Moving and Talking Hologram + Spatial Sound Installation

Mobile AR with Hologram
From Image Target

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3D Display with Hologram

Looking Glass Pro

AR Computer Vision

Hologram requires no Image Target

Wall Projection

Projection Mapping

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◢ Significance

We see the significance of the project as inherently linked to our research findings. Whilst mixed reality technologies are currently in a nascent stage of determining their conceptual and contextual value, our heritage interpretation project considered the notion of "immersion as narrative form" as emphasised by Bazelgette in his report. Our project showed that the notion of "storytelling" is severely neglected in existing heritage buildings such as St George's Hall and indeed is frequently omitted from academic as well as industrial discussions regarding human/computer interaction. We think this is particularly unfortunate considering the obvious opportunities for experimentation using media such as AR, VR and other immersive technologies. Furthermore, and as we believe our practice-based project has shown, immersive technologies can be seen as "spatial mediums", acting as tools inherently suited to finding new and meaningful ways of addressing "spatial storytelling".

Whilst some authors have addressed this aspect in relation to locative sound (Dow et al, 2005), we found that there is very little existing practice-based work in reference to what this means in the context of mixed reality "headset devices" with more sophisticated spatial computing and volumetric abilities. We believe this to be a missed opportunity for technology companies, who should be working more directly with arts and cultural organisations, venues and other spatial content makers, on issues surrounding narrative. Further findings can be directly related to our research questions, as set out at the beginning of our project.

1. **Value Proposition:** We were able to demonstrate that volumetric film (3D holograms of real people) can be used in an architectural heritage context to offer/engage audiences an immersive, location-specific experience. This new kind of heritage proposition holds a high value, as some of the testimonial from our interviews and questionnaire-based survey showed. User comments include:

"This was a mind-blowing experience, it deepened my understanding of this space as a place."

"The mixed reality experience transported me back to 1889. I felt like I was there and actually felt the dread and hopelessness prisoners must have felt. It also reminded me that similar situations are still going on around the world today".

"Brilliant work everyone involved, such a great way to show off the stories hidden in the building."

"Brought St Georges Hall to life. Felt I was back in the Victorian Era. Made me look at St George's with new mesmerised eyes. Mrs Maybrick lives!!!"

2. **Problem Definition:** We gained invaluable insight into the creation of a location-specific, mixed-reality visitor experience situated within an iconic Grade I listed building, utilising emerging technologies such as real-time media, computer vision and holograms to engage with our audience. Perhaps more importantly however, we also learned valuable lessons regarding the technical limitations and audience engagement implications of new media such as volumetric film (holograms) and other AR/VR immersive technologies.

This was only possible by engaging in a creative design and development process (research through design). It allowed us to better understand the "problem", before searching
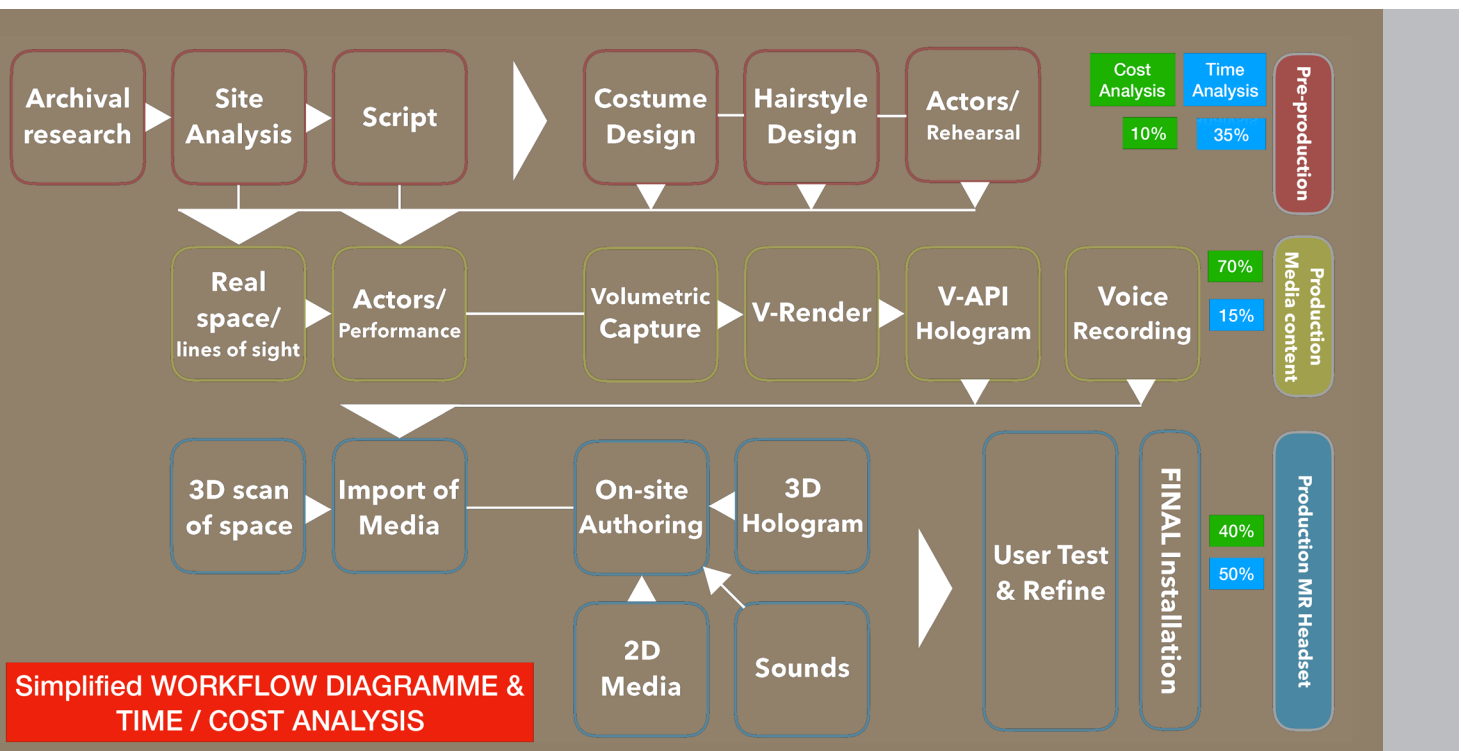
◢ Prof Richard Koeck

SIGNIFICANCE

for solutions. In doing so, we began to see clearly how a heritage interpretation project such as ours formed part of a wider "network of interdependencies" (systems approach). After witnessing first-hand how good storytelling and media technology can be integrated into heritage buildings, we also felt that the definition of "mixed reality" should be revisited. Whereas the term commonly refers to a headset experience, we felt that in our case it could mean much more, due to our inclusion of audio installations (in real space + in the headset), projections (in real space + in the headset) and many other elements.

In addition to a series of technical and creative innovations (e.g. 3D holograms of historical characters) and new knowledge in terms of pioneering a new workflow for volumetric MR content creation and display, our practice-based research has proven that it is possible to create immersive, responsive, location-based experiences in a non-invasive way within a sensitive Grade 1 listed building such as a St George's Hall (1841). Furthermore, our research led to the creation of a code/plugin (**SVFUnityPlugin_1.2.18 (1).unitypackage**), which will allow other researchers to repeat and improve upon our pioneering work in this field.

3. **New Method:** Due to the novelty of our approach to create a volumetric mixed reality tour through a heritage building, there was no precedent for how one would build such a visitor experience. Our objective was of course to allow the audience a fluid and engaging interaction between real space, audio/visual content and virtual characters. While we and our partners possessed the principal know-how and expertise regarding how to complete the individual work packages (such as archival research, scriptwriting, filming etc.), we had no knowledge of how to bring these disparate, multi-disciplinary elements together into a unified experience.

Furthermore, there was virtually no existing knowledge available to us that explained the process of importing our volumetric capture data into a mixed reality headset. Considerable significance of our work, therefore, lies with the fact that we established a new "workflow" model. This outlined not only the different stages necessary, but also the overall process (including costing estimates) to combine "volumetric film" with AR headsets (Microsoft HoloLens).
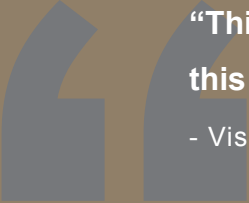

Simplified WORKFLOW DIAGRAMME & TIME / COST ANALYSIS

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41

SIGNIFICANCE

Expand the project. Possibly add phone based AR exterior to St Georges too so say for example the experience could start from Lime Street where lots of visits arrive in Liverpool to the entrance at St Georges.

Make the through-put of the Hololens experience better

The audio of the projection on the wall around the corner - it was hard to understand what the characters were saying. Plus, tourists who do not have good understanding of the English language might struggle and skip the experience altogether. Enhancing the audio via dolby sorround might render the story more powerful. Otherwise, just improving it through individual headphone sets.

it is difficult to give a specific opinion, but surely the margins of improvement are unlimited, so continue to experiment and innovate

more headsets, there was a queue

Describe if and how you see the potential impact of Augmented Reality technology becoming a future means of audience and visitor engagement?

11 responses

Its a growing market and acceptance will take time but big leaps like this will advance our undertstanding of its potential

It can be very engaging its just having the right content and keeping it simple and more 'inception' style achitectural dream worlds or portals

Education as described above. In visitor centres, historical venues, schools, universities etc. Especially useful if rolled out in hospitals and places where people have limited access to outside experiences.

This technology permits visitors to see live new types of experinces in museums and streets

This technology will be used in the future everywhere, to deepen experiences of space/place, launch events, theatre performances...everywhere where you need the spectator to participate.

It is highly intuitive and natural and can add enormous value to otherwise static displays. It is generally far better to present a 'natural reality' rather than a board with some text. It is also generally more accessible to a wider demographic, including international visitors.

Hugely. Add in 5G and come on Liverpool lead the digital revolution to shpowcase Liverpool in all it's glory!

It will be good for museums and public places

Yes, definitely, especially for young people.

I think it will be something that in the future will increasingly be part of visitor engagement in museum and communication spaces, because people often feel the need to be involved in what they see

will be good to enhance the visitor experience, especially if it can be personalised

If you wish to leave a comment about the quality the work which we might use for promotional purposes; please leave it here.

9 responses

Absolutely dedicated team of individuals and highly talented

Great goal for VR/Ar and a milestone for everyone involved im hoping to get involved from an interior design point of view this digital rennaisance is only just starting!

An excellent immersive experience which leaves you wanting to find out more!

CAVA's pioneering 'If Walls Could Talk' immersive experience prototype offers an exciting vision for the future of place-specific heritage interpretation and engagement. Clearly leading the field in its skilful blending of emerging technologies and traditional historical content, the experience offers the potential to appeal to a range of future audiences, whilst putting Liverpool firmly on the map as an international leader in immersive heritage experiences.

The work was outstanding and excellent to me

This was a mind-blowing experience, it deepened my understanding of this space as a place.

Inspired me to enter the world of late Victorian justice system. Brought St Georges Hall to life. Felt I was back in the Victorian Era. Made me look at ST Georges with new mesmerised eyes. Mrs Maybrick lives!!!

the quality of work and innovative research is very high and the level of involvement during the performances is a proof of this

brill work everyone involved, such a great way to show off the stories hidden in the building

Anything else you'd like to say?

10 responses

Thanks very much for the experience

Thanks for the hard work you guys put in

Thank you!

Thank you for this effort, work like this is promising to change the meaning of visit to any place

Amazing creative team behind this!

Please develop, PLEASE

All good

🖂 Prof Richard Koeck

Testimonials

"This was a mind-blowing experience, it deepened my understanding of this space as a place."
- Visitor 1

"The mixed reality experience transported me back to 1889. I felt like I was there and actually felt the dread and hopelessness prisoners must have felt. It also reminded me that similar situations are still going on around the world today".
- Visitor 2

"Brilliant work everyone involved, such a great way to show off the stories hidden in the building."
- Visitor 3

"Brought St Georges Hall to life. Felt I was back in the Victorian Era. Made me look at St George's with new mesmerised eyes. Mrs Maybrick lives!!!"
- Visitor 4

"Clearly leading the field in its skilful blending of emerging technologies and traditional historical content. The experience offers the potential to appeal to a range of future audiences, whilst putting Liverpool firmly on the map as an international leader in immersive heritage experiences. "
- Visitor 5

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▪ Originality

According to Microsoft and other experts in the field, we have built the **WORLD'S FIRST MIXED REALITY HERITAGE EXPERIENCE AT A UNESCO WORLD HERITAGE SITE.**

Led by a team of industry professionals from Liverpool, London, San Francisco (Microsoft Mixed Reality Lab), "If These Walls Could Talk […]" is the world's first volumetrically filmed (hologram), mixed reality (HoloLens) heritage experience with the added value that it was created for a Grade 1 listed building and with a UNESCO World Heritage Site. It is internationally recognised, by our EU funders and beyond, that our team created an immersive mixed reality experience, combining 3D projection mapping, Virtual Reality, Augmented Reality and Live Performance to produce an entirely new kind of digital visitor experience.

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▪ Dissemination

Dissemination 1

TWO PUBLIC INSTALLATIONS (FULL EXPERIENCE; LAUNCH EVENTS)
We installed the full public exhibition during two events in June 2019. This included Hololens Headsets, VR headsets, mobile AR, 3D displays, projection mapping, location-specific sound installations and live performances throughout the building.

Dissemination 2

PERMANENT MUSEUM INSTALLATION (FREE ACCESS, OPEN TO PUBLIC)
Since December 2019, a permanent sound and projection mapping installation from our project has been situated in St George's Hall, open to the public and free to access. Prior to Covid-19, St. George's Hall attracted circa 250k visitors p.a.

Dissemination 3

TWO DOCUMENTARY FILMS
We produced two films, documenting the process of the volumetric capture and other filming that contributed to the making of the hologram of Florence Maybrick, together with an explanation of how we worked with the public to demonstrate the experience and gain feedback. The first film shows the behind-the-scenes production of the volumetric film and other media content. The second film covers one of the inauguration events at St George's Hall itself, providing an impression of the installations we created, while illustrating how visitors tested and gave feedback on our work.

◼ Prof Richard Koeck

Dissemination 4

ACADEMIC KEYNOTES AND INVITED LECTURES

Since launching the project, we have received requests from other cities and industrial partners wishing to explore a similar application elsewhere. Richard Koeck has given several keynotes and invited lectures worldwide, including in London, Cambridge, Kent, Dessau, Singapore, Melbourne and Zurich. His most recent keynote was given at the AMPS conference entitled *Exploring Heritage, Architecture, Cities, Art and Media* (University of Kent, June 2020). Furthermore, Koeck represented Liverpool City Council at the *Rock Open Knowledge Week* (University of Bologna, October 2020), where our work on the St George's Hall project was recognised as a best practice example of how other cities in Europe and across the world could approach similar heritage interpretation opportunities. See:

https://www.youtube.com/watch?v=tn0rOj7p82s&feature=youtu.be

IMPACT PATHWAY

IMPACT

In October 2020, The Department of Culture Media and Sport announced that it is going to award £250,000 for the creation of a new XR visitor attraction at St George's Hall. This new immersive experience is directly related to the research outcomes and findings of Prof Koeck's project.

2020	K	University of Kent	AMPS, Exploring Heritage, Architecture, Cities, Art, and Media, Jun 2020
2019	IL	University of Cambridge	Seminar, Digital Heritage Placemaking, Nov 2019
2019	IL	University of Anhalt; at Bauhaus/Dessau	Seminar and workshop, Cinematic Urbanism, COOP Masters Programme
2019	K	National University of Singapore (NUS)	Living in the Age of Convergences: Affect, Affordance, Agency, Dec 2019
2019	K	University of Kent	MeCCSA. Shaping Knowledge: Encounters betw. Word & Image, Jun 2019
2019	IL	National University of Singapore (NUS)	Visual Communication of Immersive Spaces, School of Architecture, Mar 2019
2018	IL	Monash University	Immersive Design, SensiLab, Nov 2018
2018	IL	Deakin University	Visiting Professorship, Research Seminar, Nov 2018
2018	IL	King's College London	Immersed in the Image of the City, Nov 2019
2018	IL	AA London	Film and Architecture Parallax, 27 Apr 2018.
2018	K	NC State European Center in Prague	Of Being Virtual, "Virtual Presence in a Networked Society", 15-17 Mar 2018
2017	IL	ETH Zürich	Department of Architecture, gta Institute, Prof Dr Laurent Stalder

Prof Richard Koeck

Project Links

CAVA Website, http://www.cava-research.org/research-projects/st-georges-launch

St George's Hall Project Page, https://www.stgeorgeshallliverpool.co.uk

VIDEO 1: Behind the Scenes, https://vimeo.com/426223544

VIDEO 2: Launch Event, Highlights, https://vimeo.com/340534379

VIDEO 3: EU-Rock Conference Animation, https://youtu.be/YvUsc5V_g4g

> **St George's Hall and Liverpool City Council are delighted with the digital project Professor Koeck and his team have achieved at St George's Hall. The digital installation has now led to a new tranche of work that will lead to digital immersive experiences providing the future vision for heritage interpretation of the hall. The use of new technology will continue to provide new and innovative platforms for a heritage venue like St George's Hall to develop new and dynamic avenues for creating new experiences and generating new income streams.**

- Alan Smith, Managing Director, St George's Hall

Prof Richard Koeck

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