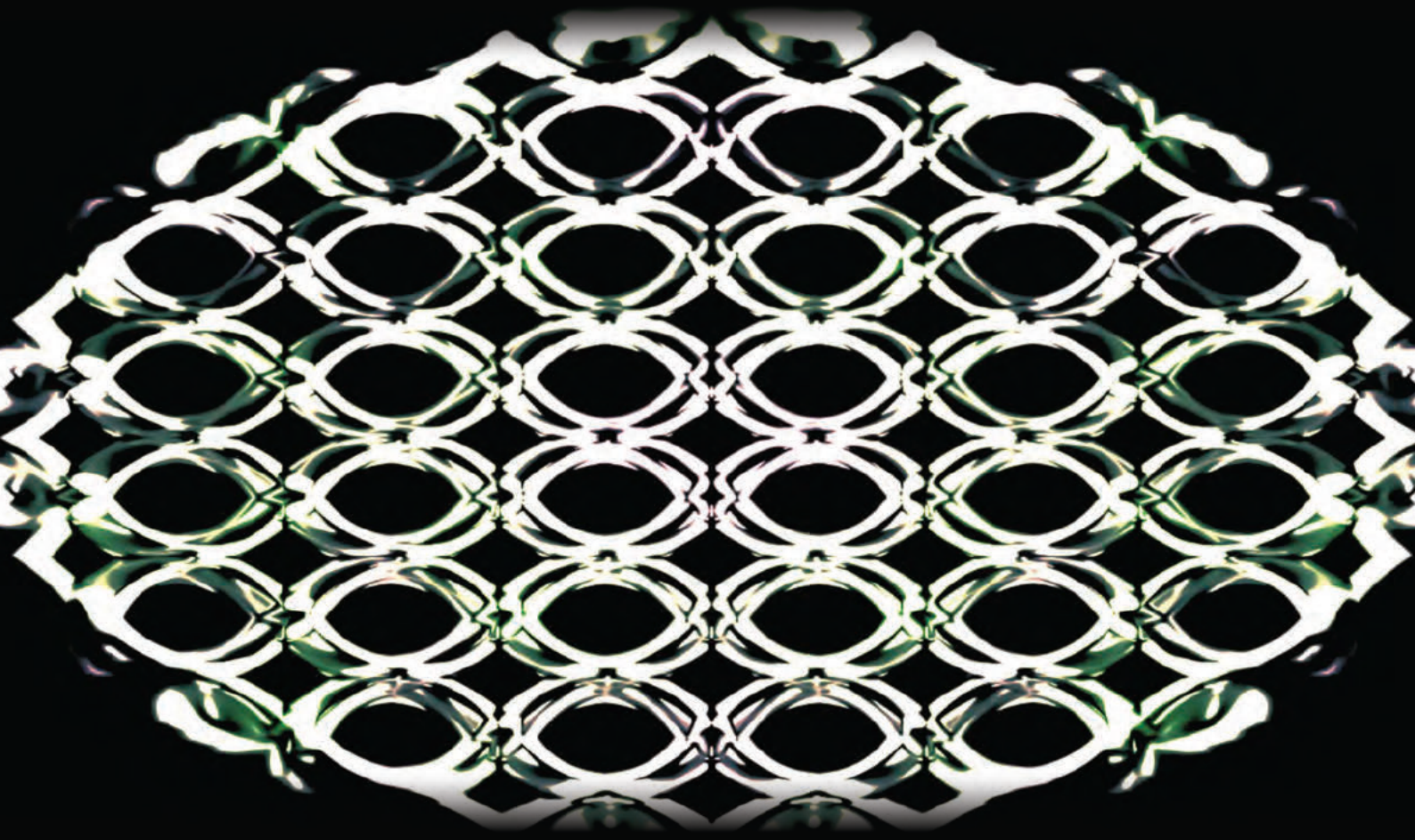
Insomnia

The Affordance of Hybrid Media in Visualising a Sleep Disorder



Insomnia: The Affordance of Hybrid Media in Visualising a Sleep Disorder

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Statement of Authentication

I hereby declare that this exegesis is my original work and has not been submitted for a degree in any other university or institution. The research and analysis presented in this exegesis have been conducted by me, under the guidance and supervision of my supervisor, and represents my independent and original work.

In this exegesis, all utilised sources have been suitably acknowledged and cited, adhering to the American Psychological Association (APA) guidelines for citation and referencing. I acknowledge the intellectual contributions of others in my field and have given due credit to their work in the form of citations, image captions, and references.

Finally, I attest that this exegesis has not been previously published or submitted for publication, in part or in full, in any other form or medium, and that it conforms to the standards and requirements set forth by my university.

Behrad Rezaei
March 2023

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Online Exhibition

For an in-depth examination surrounding the notion of insomnia, I invite you to access the virtual exhibition hosted on the dedicated online platform: https://www.insomniart.art. This exhibition aims to elevate comprehension and offer a profound understanding of insomnia's multifaceted intricacies. As a convenient alternative, consider scanning the accompanying QR code to efficiently access the exhibition.

Visit: https://www.insomniart.art

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Abstract

The integration of visual and numerical abstraction in contemporary audio-visual communication has become increasingly prevalent. This increase reflects the evolution of computational machines from simple data processors. Computation and interface have augmented our senses and converged algorithmic logic with cultural techniques to form hybrid channels of communication. These channels are fluid and mutable, allowing creatives to explore and disseminate knowledge through iterative media practice. *Insomnia* is an auto-ethnographic case study that examines the affordance of merging Brain-Computer Interfaces (BCIs) and node-based programming software (TouchDesigner), as a hybrid media system (McMullan, 2020). As a system, *Insomnia* compiles my archived brain activity data and processes it through a custom designed generative visualisation interface. Documenting and 'processing' a sleep disorder is filtered through key concepts of media archaeology, cultural techniques, and practice-led research allowing Insomnia to inform discussion of the affordance of hybrid media. *Insomnia* is presented as a virtual exhibition with a supporting exegesis. The methodology and outcomes of the project form a framework that bridges science communication and creative practice and points to continued development for interactive installation design.

Keywords

Media Archaeology, Affordance, Hybrid Media, Cultural Techniques, Remediation, Insomnia, Brain-Computer Interfaces (BCIs), TouchDesigner, Muse Headband, Media as an Extension of Man, Knowledge Inscription.

Introduction

In 2022, I conducted auto-ethnographic research focused on visualising my sleep patterns to illustrate insomnia. My research is based on Brain-Computer Interfaces (BCIs) (Steinert et al., 2019) and iterative practices (Brown, 2022) in experimental digital design. Insomnia is a sleep disorder caused by various psychological factors such as anxiety, stress, and obsessive-compulsive disorder (Abbott, 2016). Individuals with insomnia face difficulties such as lack of sleep, concentration, and other physiological symptoms (Abbott, 2016; Meaklim et al., 2015). According to the findings of the Sleep Health Foundation's 2022 report, a substantial proportion of the Australian population, estimated at one in ten individuals, suffers from insomnia. This study endeavours to explore my symptoms of insomnia through the media of generative design practice, which offer unique opportunities to communicate complex data analysis in accessible and engaging ways. By bringing together the challenges of communicating in-depth data, like that found in scientific analysis and creative practice, this project aims to facilitate participatory spaces that encourage dialogue and facilitate the co-creation of knowledge via speculative innovation in data visualisation (Patterson et al., 2020).

Recent advancements in computational technologies such as node-based programming and wearable interfaces (Giaccardi & Redstrom, 2020) have enabled designers to integrate various forms of media into formalised channels of communication, conveying complex messages through composited data processing and curated experiences. This fusion of media can be referred to as hybrid media. For this study hybrid media refers to the amalgamation of diverse media that results from the integration of their distinct linguistic systems. This integration is achieved through the reciprocal exchange of attributes, leading to the formation of novel structures and interactions that occur at the deepest levels of computational logic (Manovich, 2013, p. 103). Hybrid media's key affordance is inherited through its actants within

a network, thereby facilitating fluidity and enabling the remediated media to serve as building blocks for novel channels of communication (Bolter & Grusin, 2000, pp. 45, 54; Manovich, 2013, pp. 163- 167). It is this premise of hybrid media that has guided and integrated with my *Insomnia* project.

The structure of this exegesis is underpinned by the development and production of *Insomnia* informed by key media theory throughout. First, I describe key affordances of hybrid media in creative practice using media archaeology (Friesen, 2010; McMullan, 2020; Parikka, 2012) and practice-based research methodologies (Black, 2019; Brown, 2022). Subsequently, an exploration of media art archival practices is conducted through various case studies to help define the qualities of hybrid media affordances important to this study (Kittler, 1990; Manovich, 2013; Siapera, 2012). Next, I explain the methodology of my practice via key technical steps and alignments to media theory while discussing the creative rationale behind *Insomnia*. It's important to note that the insights gained from theory, and reflection on my creative practice, are dispensed throughout my rationale and analysis sections. Finally, I explore the potential for future development of the project, including the challenges and benefits of my hybrid media outcomes, which can provide a framework for designers to utilise hybrid media in their own practice.

1. Media Studies: Hybrid Media

Hybrid media play a significant role in identifying and imagining methods to archive and disseminate knowledge. Consequently, they shape our existence socially, politically, and economically (Friesen, 2010; Parikka, 2012; Siapera, 2012; Tucker et al., 2019). In general, hybrid media refers to the combining of traditional and digital media forms to create a more engaging and interactive experience for audiences (Grusin & Bolter, 2000; Tucker et al., 2019). This includes the use of traditional or culturally concrete media platforms, such as television, newspapers, and radio, in conjunction with digital platforms, such as social media, websites, and mobile apps

but also forgotten, imagined and speculative media assemblages. Hybrid media present a means for creatives to attain engagement with audiences across multiple platforms, thus enabling a more comprehensive and personalised experience. Such an approach fosters the generation of knowledge (Patterson et al., 2020). Examples of hybrid media in mainstream culture include interactive television shows, augmented reality newspapers, and radio programs with accompanying social media content. Examples, in more speculative production contexts include immersive gallery experiences and experimental research platforms in data visualisation that combine disparate channels and signals. The following section is divided into three subsections that encapsulate a definition of hybrid media via key media theorists 1.1) “Archaeology of Media: Old and New” via Kittler, Parikka and Manovich, 1.2) “Hybrid Media and Cultural Techniques: Softwarization of Experience” through Stiegler, McLuhan, and Manovich, and finally, 1.3) “The (proto-) Affordances of Hybrid Media in Archiving Experiences” that refers to the thinking
of John McMullan.

1.1. Archaeology of Media: Old and New

Media archaeology is a field of study that looks at past and present developments of media and communication technologies. It involves analysing the material aspects of media and communication and the cultural and social contexts in which they are used. Communication is a primary technique of human existence. We adopt fundamental media systems such as writing, reading, and speech to archive and share our experience (Parikka, 2012; Siapera, 2012). In his book “*Gramophone, film, typewriter* (1999),” Friedrich Kittler classifies media into Symbolic, Technical, and Digital. Symbolic media is based on assemblages of culturally manifested symbols (semiotics). Alphabets, musical notations, writing, speech, and art that involve human sensory skills are also considered symbols (pp. Xi-xli). We write what we hear and

read what we see. Therefore, humans are agents within a symbolic media system. To support this statement, John McMullan (2020, p. 290) identifies symbolic media as an: "Artefactual Foundation Medium," as they produce artifacts (physical objects). By the late nineteenth and early twentieth century, technical media such as gramophones, telegraphs, and photography were introduced into artifactual media systems. Technical media expanded the capacity of artifactual media through analogue processes, such as recording sound as physical grooves on vinyl plates or capturing light on film. Edison's phonograph (Tucker et al., 2019, p.18) and John. L. Baird's Nipkow Disk (Parikka, 2012, p. 42) are early examples of how technical media have merged with artifactual media.

In the late twentieth century, media studies expanded by considering software and computational design (McMullan, 2020). Since 1977, the introduction of portable computational machines by Alan Kay and Adele Goldberg has helped us expand our modes of communication (McMullan, 2020; Tucker et al., 2019). These developments alter the course of algorithmic evolution, but the primary evidence can be found within the discourse of media immediacy (Friesen, 2010; Grusin & Bolter, 2000; McLuhan, 1964; Parikka, 2012). Immediacy refers to the ability of any given medium to convey information to the audience in real-time or near real-time. It measures how quickly data can be delivered and consumed by the audience. The higher the immediacy, the faster the audience can receive and engage with the message (Tucker et al., 2019). According to Siapera (2012, p.9), in his seminal 1990 work, "*Discourse Networks 1800/1900,*" Kittler suggests that the introduction of digital media has resulted in a notable escalation of the immediacy of communication, leading to a fundamental transformation in modes of knowledge dissemination. Consequently, the affordance of digital media revolutionised contemporary communication practices and altered traditional means of knowledge propagation. This affordance occurs by remediating all media forms into a unified binary code. A fluidity of media is offered and can be utilised to explore new forms of media within one digital bitstream environment (Manovich, 2013). Thus, this led to identifying computational machines as a meta medium (Kay & Goldberg, 1977; Manovich, 2013; Tucker et al., 2019).

The term meta medium was first introduced by Alan Kay and Adele Goldberg in 1977 (as cited by Manovich, 2013, p.176). In his book "*Understanding Media*" (1964, pp. 3-7), McLuhan anticipated the emergence of a type of media that would reshape our perceptions of the past, present, and future, and ultimately transform communication channels within society, well before the advent of digital media. In his work "*Technics and Time*" (1998, p. 94), Bernard Stiegler describes instruments that have the capacity to enhance and expand our comprehension of time and memory. McLuhan and Stiegler both reenforce the significance of thinking of media as meta without describing it as such. According to Manovich (2013, p.102), the term meta medium refers to a medium that is capable of replicating and converging all other forms of media. Notably, the meta medium does not inherently possess any communicative functionality, but rather it utilises previously accumulated media in innovative ways as it converges other forms of media. For instance, Adobe After Effects, a motion graphics and visual effects software that facilitates the creation of animation, compositions, and special effects, is considered a meta medium as it permits the interaction of various forms of media (both old and new) within a single platform (Manovich, 2013). The emergence of the meta medium enabled media to no longer be constrained by societal or economic platforms, and in this novel context, various forms of media acquire new attributes while still retaining their culturally established identities. To illustrate, the use of a traditional two-dimensional letterpress typeface as a symbolic medium within After Effects is converged with other forms of media, thereby engendering a new kind of typographic digital media's attributes. For example, similar to the process described by Manovich (2013) and Tucker et al. (2019), a typeface with new three-dimensional properties, thus, distinguishing it from the original medium.

The meta medium possesses an inherent affordance to imagine, experiment with, and test media amalgamations. Meta media can subsequently serve as a fundamental tool for the development of novel and imaginary media (Kay & Goldberg, 1977; Manovich, 2013; Parikka, 2012). Imaginary media does not rely on predictions or science fiction, but rather it represents an unexplored territory between reality, innovation, and technology. In his book, "*What is Media Archaeology?*" (2012), Parikka

posits that “imaginary media is not a predictive medium, but there appears to be a systematic relationship between innovation, imagination, and the emergence of a scientific-based modern media culture, which has yet to be discussed in scientific terms” (Parikka, 2012, p. 45). Imaginary media can emerge from a plethora of domains, such as literature, art, and film, and these imaginary media can be used to expose cultural and social tensions and yearnings for new media (Parikka, 2012). Therefore, imaginary media can be viewed as a by-product of the meta medium and can be utilised as a means of communication innovation and knowledge generation (Kittler, 1990; Parikka, 2012) in fields utilising speculative creative practice.

According to Siapera (2012, p. 10), via Kittler (1999, p. xxxv), the concept of new media emerges from a tension between technologies. In this concept, media no longer display their descriptive qualities. Instead, the meta medium sets the methods of communication. For instance, an image generated on a computer screen is no longer analogue media it is a computational cultural object. For example, the digital image stands beyond the technical trace of a photograph. Now, the image derives meaning through algorithmic and intellectual (symbolic cultural techniques) processing (Titmarsh, 2018). Thus, the new media object forms a hybrid that possesses the capacity to influence our perception of reality by means of algorithms and of cultural techniques of semiotics and other forms of cultural knowledge associated with symbolic data processing (Dünne et al., 2020, p. 15; Titmarsh, 2018).

Marshall McLuhan describes hybrid media as the “meeting of two media, fusing functions of established technologies into new technological forms, causing a break that institutes a new system of environmental side-effects [that] impose themselves willy-nilly as a new form of culture (McLuhan, 1964, p. 49).” Hybrid media play a significant role in developing new tools to expand our perception of reality. A good example of hybrid media to illustrate McLuhan’s claim is an interactive project called “*Run like a refugee* (2017)” by Thijs Biersteker (Figure 1). This project combines various forms of imagery, graphics, maps, and other media through virtual reality (VR) technology to disseminate the unique experience of an Iranian refugee’s struggle for

freedom. Users can experience anxiety and danger through a hybridised medium involving their mental ability and physical capabilities via their body movements on a treadmill. This project is a vivid example of the augmentation of our perception and senses (McLuhan, 1964) through the hybridization of media including the cross-fertilising of software and cultural techniques.

Hybrid media is not simply multimedia. There is an important fine line between the two. In simple words, hybrid media refers to integrating different forms of media, such as text, technical, and digital, into a single platform or binary codes (Manovich, 2013, pp. 166-176). This integration affords new opportunities to engage and archive knowledge in a novel way. For instance, hybrid media platforms such as Instagram and YouTube allow users to create and share images, texts and audio files, creating new opportunities for creativity and self-expression. In contrast, within multimedia systems, documents, interactive applications, and contents appear next to each other with a dedicated decoder. For instance, a webpage is a multimedia platform that can shelter text, video, data, and images next to each other—each medium has a unique user interface to be decoded and operated individually (Manovich, 2013, p.171).

The notion of hybrid media hinges on the tension and feedback between old and new media and is made clearer when approached through the lens of media archaeology. However, media archaeology is intimately connected to the theory and practices of cultural techniques. Specifically, the cultural techniques of inscription and knowledge dissemination. Thus, a discussion of cultural techniques follows, as it also entails the consideration of emergent mediation, including the previously defined integration of diverse forms of past and present media and the technological means to produce new modes of perceiving and articulating reality.

Figure 1-Top) Still from "***Run like a Refugee***" Project by Thijs Biersteker. "Run Like a Refugee is a VR experience combined with a treadmill where people could experience the horrible journey of a refugee coming to the Netherlands" (Biersteker, 2017).

Figure 1–Bottom) Screengrab from the user's interaction with the hybrid design (Biersteker, 2017).

1.2. Hybrid Media and Cultural Techniques: Softwarization of Experience

For this study, cultural techniques refer to the various practices and technologies employed to produce, disseminate, and consume media to transcribe knowledge and experiences (Dunne et al., 2020). Additionally, Bernard Siegert's (2015) exploration of cultural techniques transcends conventional interpretations of communication and aesthetics and must be acknowledged. As Siegert posits, cultural techniques consist of "the ensemble of those practices that make distinctions operational by tying them to inhuman conditions" (p.14), for instance the utilisation of grids, filters, doors, and other elements as cultural techniques. Parikka corroborates Siegert's perspective by asserting that cultural techniques encompass not just media devices for communication, but also practices and procedures that establish distinctions and differences, such as those between human and animal, or nature and culture, and subsequently associate them with diverse material circumstances (2013, pp. 148–149).

Stiegler refers to cultural techniques as: "Technics of externalizing experience," and he coins the term "Epiphylogenesis" (Stiegler, 1998, p. 243). Media archaeologists widely value this concept as a methodology to understand how media technologies shape our society. In her article "*The Cultural Techniques of Time Axis Manipulation*" (2006), Sybille Kramer suggests that the emergence of novel media technologies has engendered a cultural transformation. Kramer echoes Kittler's assertion that media technologies are instrumental in shaping our perception of reality, thus assuming a central role in contemporary cultures as cultural techniques (pp.1-17). Before Kittler, McLuhan also developed the concept of "the medium is the message" in his book "*Understanding Media: The Extension of Man*" (1964). He argues the medium of communication, such as a book or television, is more important than the content it conveys in shaping our understanding of the world (pp.7-24). McLuhan's thinking preludes more recent discourse of cultural techniques but aligns well, reminding us

that the qualities of a medium and its use can be examined to tell us more about a mode of communication than the signal within a channel on its own. Ultimately, for this study cultural techniques highlight how media technologies shape our perception, not only through the perception provided by engaging with the world through a specific device or system but the wider cultural practices that surround a medium or assemblage of media.

There is a risk of media determinism if we give way to technology shaping our perception. Stiegler, in his book "*Technics and Time*" (1998), accepts the agency of technology in influencing cultural techniques. However, unlike how Kittler and McLuhan might be read, Stiegler argues that technology and cultural techniques are developed in parallel to each other. Like pointed to by Siapera (2012, p. 13) Stiegler's methodology helps us view the evolution of technology and cultural techniques simultaneously without bias towards one or the other. Stiegler refers to this bond as "Technics as prosthesis," which is drawn from Jacques Derrida's theory of "Originary Technicity", from his book "*Of Grammatology*" (1967). Read via Siapera (2012), Stiegler argues that, technology is not a mere instrumentality but rather a way of exposing. For example, what is revealed by technology is not the 'meant', not the instrument but the signification. Technology is essentially prosthetic. It is not a supplement, but a metonymy of production. It is not an adding on but an extending of the body (Stiegler, 1998, pp. 151-154; Siapera, 2012, pp. 11-12). The point here is that technology and practices of the body should not be considered individually and reinforces that cultural techniques and media should be considered together.

The concept of hybrid media can be examined analogous to cultural techniques, as both pertain to the ways in which media shape our understanding of reality. Manovich can be used to connect the concepts of hybrid media and cultural techniques. For example, it could be argued that the proliferation of digital media has led to the "Softwarization" (Manovich, 2013, pp. 45-46) of culture, whereby software algorithms and data structures play an increasingly prevalent role in mediating cultural production and consumption. It should be noted that hybrid platforms are not unique

to digital media, but digital platforms have augmented the democratisation of long-standing cultural techniques. For instance, the operation of searching an archive, has moved from institutional physical indexation to online meta data searches, to now asking a chatbot to find the information for you.

This study utilises the key concepts of archiving knowledge and exteriorising it through the "Softwarization" of cultural techniques, as discussed through Kittler, McLuhan, and Stiegler above. By combining these approaches to media and analysing their differences, the *Insomnia* project aims to better understand the relationship between hybrid media and cultural techniques. To do so, the study expands upon the unique affordances of hybrid media and cultural techniques through algorithmic logic (visual programming and software) and developing novel ways of archiving and displaying knowledge. To guide these aims a "Proto-affordance" methodology will be defined and utilised.

1.3. The (Proto-) Affordance of Hybrid Media in Archiving Experience

The "Proto-affordance" methodology developed by John McMullan (2020) is a practical method for identifying the affordances of hybrid media. As proposed by McMullan, the concept of proto-affordance refers to the potential uses and meanings that a media object or technology may possess prior to its utilisation (2020, pp. 294-296). For this reason, it's necessary to continue a discussion of hybrid media and cultural techniques via the notion of affordance. As mentioned earlier, hybrid media can refer to the convergence of old and new media formats using algorithmic logic (software) (Manovich, 2013). This convergence affords fluidity and interaction among other actants forming a hybrid media within software. This paves the path for novel methods of knowledge inscription (Latour, 1990). Hybrid media can augment our senses and enable humans to reach a vast amount of information by overcoming time

and space (Tucker et al., 2019). For example, Google maps is one of the most well-known precedents of hybrid media in our time (Figure 2). It converges the traditional technique of map making into the logic of software and bypasses spatial and temporal barriers in disseminating geographical information to its users (Google Maps, 2023; Latour, 1990, pp. 65–71). According to McMullan, the proto-affordance of hybrid media can be linked back to its converged media within its network. For instance, the Google Map example (Figure 2) inherits the proto-affordance of artifactual mediums such as traditional mapping and navigation techniques through its reproducibility and shareability, as well as the instantaneous nature of technical mediums through hardware and digital screens (Manovich, 2001; McMullan, 2020).

For another example, the use of Augmented Reality (AR) in marketing like Ikea's shopping mobile app (Figure 3) and Netflix's series and episode, "Black Mirror: Bandersnatch" (Figure 4) showcase proto-affordances of hybrid media. The incorporation of AR encompasses the proto-affordance of digital immediacy of web platforms. For example, the Ikea AR app absorbs the characteristics of online shopping. This proto-affordance emphasises the importance of content interaction over the media platform, consequently leading to heightened user engagement by overcoming spatial barriers. Similarly, Netflix's "Black Mirror: Bandersnatch" serves as a prime illustration of the effective employment of digital platforms' proto-affordances and television as a technical medium in the development of groundbreaking communication channels. The integration of digital media's inherent instantaneousness with the intrinsic immediacy of television as a technical medium generates a unique and immersive storytelling experience. By allowing viewers to make decisions that directly affect the narrative's trajectory and outcomes, this method promotes an innovative form of audience engagement and interaction. Hence, the affordance of hybrid media can be associated with remediation through digital meta-media (Manovich, 2013). It is crucial to note that this affordance is not solely generated by the meta-medium, but rather inherited through the contributed media.

The ability of inheriting mutable media such as symbolic or technical media into a system through softwarization meets immutable mobiles within a hybrid media network (Christianson, 2020). The concept of immutable mobile, introduced by Bruno Latour, refers to objects or representations that maintain their fundamental attributes and significance, even when combined, duplicated, or transformed. This constancy enables them to function as dependable information channels that can be utilised and disseminated by multiple actors across diverse media, without compromising the integrity of their data. Immutable mobiles encompass a range of examples, such as diagrams, maps, texts, photographs, and film (Latour, 1990, pp. 65-72). In very general terms, hybrid media in conjunction with cultural techniques affords a flexibility between subjective and objective media actors when communicating data. In other words, data does not change but hybrid media affords fluidity in its expression via the trace of mutable media (Hughes, 2018, pp. 227–259; Latour, 1990). With this thinking, immutable mobiles can serve as building blocks for new forms of media (Grusin & Bolter, 2000; Tucker et al., 2019) as they survive in complex networks or systems of hybrid media.

To sum up this discussion it is proposed that the unique proto-affordance of hybrid media allows creative practitioners to archive and disseminate their input data without focusing on the perception of structured data concerning the output. In other words, to convey a message to an audience the creative output does not necessarily need to convey a comprehension of the origin of data or its structure to be comprehended or have effect (Bell, 2022). The product (experience) itself can be engaged with via both mutable and immutable traces of media actants as an expression of data. Thus, for *Insomnia*, data becomes easier to share and reproduce for creative practice as it is manipulated with integrity relative to the project's archive (the utilisation of immutable data and media processes) but communication and expression of data hinges on the mutability of media. Such media flexibility points to a democratisation of access and distribution, allowing a diverse range of individuals to engage and contribute to the collective archive of knowledge (Paterson et al., 2020) via expressions of data that are not weighed down by objective representations of data (as in a scientific method) but can assist in the communication or expression of large or complex data sets.

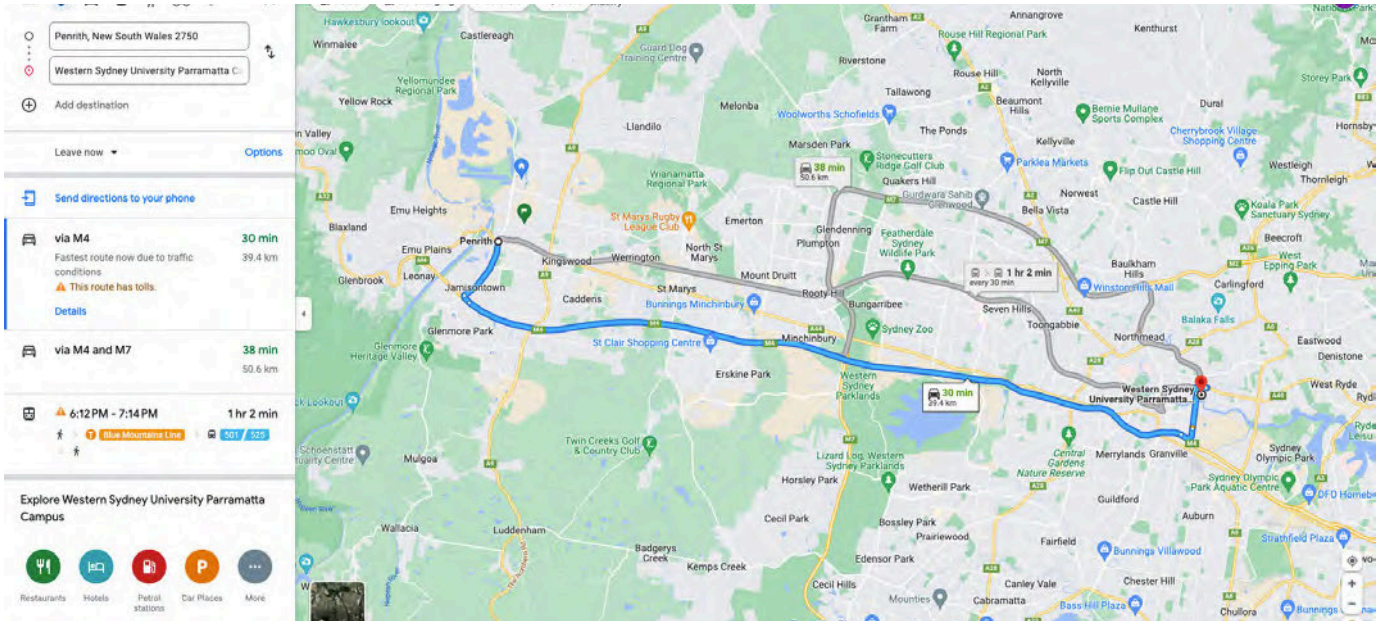


Figure 2-[Screengrab] screen grab from “Google Maps” by Google” - (Google Maps, 2023)

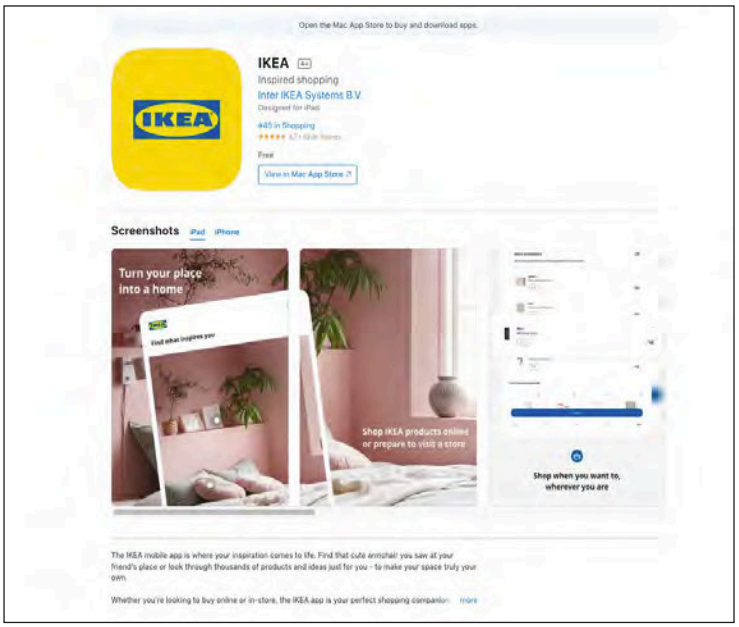


Figure 3- [Screengrab from Ikea’s], The mobile application highlights augmented reality (AR) as a marketing tool. The advert on the mobile application page promotes the app’s AR feature, enabling users to visualise Ikea products within the context of their homes before making a purchase decision - (IKEA, n.d.)

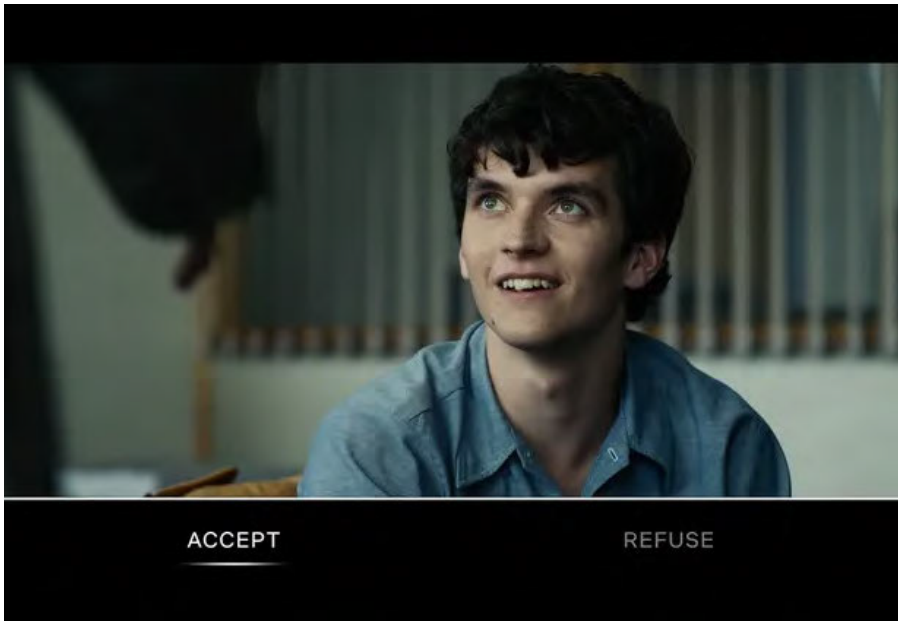


Figure 4- [Image by Netflix], A scene from the critically acclaimed television series “Black Mirror” highlights the program’s interactive features. Through audience choice, the program allows viewers to shape the narrative and alter the course of the story. - (Damiani, 2019)

2. Hybrid Media: A Bridge Between Theory and Creative Practice-led Research

This section examines hybrid media's role in creative design research. It is important to consider the concept of creative practice, as it encompasses not only traditional forms such as painting and writing but also the fusion of theoretical knowledge (cultural techniques) and creative skills (design techniques) to produce socially compelling outcomes (Chang & Ivakhiv, 2020, pp. 1–7). A successful creative practice utilises media as a culturally known object to stimulate curiosity through the integration of experience and technological innovation (Giaccardi & Redström, 2020). While theoretical and literary studies are crucial components of knowledge, they may not be visually tangible enough to generate experience beyond their text. In some instances, they may not be considered effective "catalysts" for stimulating curiosity on their own (Paterson et al., 2020). Humans generate knowledge based on their experiences (Paterson et al., 2020, p. 5) and can be more capable of comprehending information visually (Christianson, 2020, p. 2).

Visual experiences and representations wield significant influence as they evoke a sense of realism, engaging the viewer and stimulating inquiry among creative practitioners (Christianson, 2020). This process of inquiry and creation constitutes a continuous cycle, culminating in the generation of knowledge (Dixon, 2019). In "*Experiments in Experience: Towards an Alignment of Research through Design*" Dixon examines John Dewey's Pragmatism (2019, p.7). He delves into Dewey's notion of inquiry, highlighting that it entails the systematic transformation of an indeterminate situation into one characterized by specific distinctions and connections, ultimately integrating the elements of the original situation into a unified whole. This viewpoint emphasises the importance of inquiry in the creative process. For *Insomnia*, the integration of hybrid media can be viewed as a means of merging meta-media as a cultural catalyst to enhance data-oriented creative inquiry and help generate new

forms of knowledge (Brown, 2022). To gain a deeper understanding of hybrid media being a catalyst for fusing cultural techniques of inquiry and creative practice, I have selected two precedents for examination: 2.1) the “01100110 01101111 01110010 01100101 01110011 01110100 [forest]” by Danielle Svehla Christianson (2020) and 2.2) “MB>CO2” by Thijs Biersteker (2022).

2.1. 01100110 01101111 01110110 01100101 [forest]

Figure 5- [images by Christianson], a point cloud representation of the “Red Fir Study Site” in California’s Sierra Nevada. The “KeckCAVES is an immersive 3D environment (i.e., virtual reality)”. The user can interact with a 3D generated point cloud version of the forest. (Christianson, 2020).

Christianson’s “00011110011 [forest]” interactive installation investigates the relationship between technology and nature. The project offers an opportunity for environmental scientists to interact with the installation through computer-generated scenes, which simulate a forest environment. The project aims to examine the potential of computer-generated models in facilitating the examination of microclimate impacts on tree seedlings within a digital forest setting (Christianson, 2020) (Figure 5).

The precedent of “00011110011 [forest]” serves as a point of reference for *Insomnia*, as it addresses key themes related to the integration of cultural techniques, such as mapping, and archiving to overcome obstacles in the creative process (Latour, 1990). Additionally, the precedent illustrates the convergence of traditional theoretical frameworks with meta-mediums to develop a new form of inscription and a novel experience (Dixon, 2019). The work comprises two distinct stages of hybrid media integration: LIDAR sensors and three-dimensional (3D) point cloud software. According to Christianson (2020), LIDAR sensors provide a means of transforming traditional imaging to dynamic and flexible objects via geo-spatial codes. As a result, images are no longer confined to two dimensional pixels, but instead serve as a portal to a large body of fluid spatial references and knowledge (Titmarsh, 2018). By utilising LIDAR sensors, objects can be translated into software as data coordinates (NOAA, 2023). The geo-spatial codes then allow for algorithmic logic to represent the object in either 3D or 2D form (Christianson, 2020; Hyde et al., 2006) (Figure 6). In the context of hybrid media, the subsequent image captures the progression and interaction of remediated media.

Furthermore, the media convergence in “00011110011 [forest]” extends on visual representation to provide a unique and immersive experience via the scale and novelty of the hybrid media assemblage. The creative process behind the project enables associated researchers or users to have a bird’s-eye view of the study site by utilising KeckCAVES AR technology (UC Davis, 2015). The user can interact with the 3D objects by annotating, removing, and virtually navigating the site (Christianson, 2020). This approach represents a novel method for studying forests and is consistent with Stiegler’s “technics as prosthesis” theory, which argues that meta-mediums and algorithmic logics (software) facilitate the renovation of conventional media into new modes of communication and representation (Manovich, 2013, pp. 101–106; Siapera, 2012, pp. 11–13).

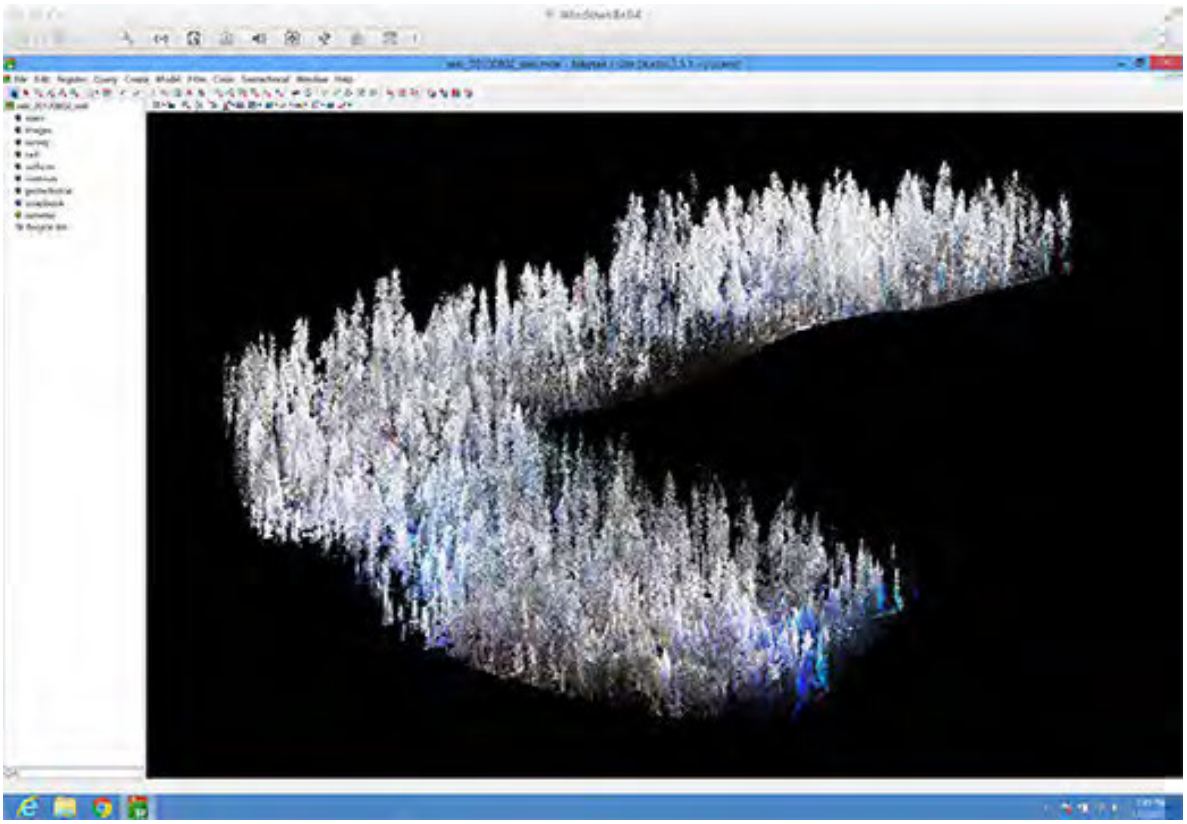


Figure 6- [Image by Christianson] “In I-Site Studio software, the user can zoom in and out, rotate the point cloud, add points, select points manually or via selection rules, modify groups of points (e.g., delete points, move point position, change point colour), model lines or surfaces, etc. Other datasets, like my surveyed georeferenced tree seedling location data, can be imported to analyse with the scanned data.” (Christianson, 2020).

“00011110011 [forest]” highlights an intersection between the body and technology that *Insomnia* aspires to, specifically meta-media, resulting from the creation of a unique hybrid media assemblage. The media convergence in “00011110011 [forest]” has led to the development of an innovative method for inscribing knowledge and constructing new visual realities. This process is achieved through the assembly of immutable mobiles, which are connected in such a way that their movements, transformations, and interactions produce new meanings (Latour, 1990) when combined with mutable media. The combination of meta-mediums and algorithmic logic (software) affords the remediation of traditional media into novel ways of communication and inscribing knowledge (Manovich, 2001). The integration of hybrid media in “00011110011 [forest]” showcases the potential for technological advancements to augment traditional methods and provide new perspectives for exploring complex issues.

2.2. MB>CO2

Figure 7- [Image by Thijs Biersteker], “MB>CO2” is a public interactive installation that aims to uncover the hidden impact of the internet on the environment. The installation features an interface (ZOOM) to make video calls and visually monitor the amount of CO^2 generated during the call (Biersteker, 2022).

Thijs Biersteker is a highly regarded experimental interaction and experience designer from the Netherlands. He is renowned for his collaborations with leading design agencies and his efforts to raise awareness of social and environmental issues (Biersteker —About, n.d.). Biersteker’s work serves as a connection between scientific research and immersive hybrid media. The “MB>CO2” project (Figure 7), which was completed in 2022, aligns with my *Insomnia* project concerning the context of data and meta-media convergence to create a communicative experience that is informed by factual references (data) and technologically explorative. The aim, aligned to Biersteker’s work here, is to communicate and inscribe knowledge via a unique design and experience to meet Dixon’s perspective of inquiry—the systematic transformation of an indeterminate situation into one characterized by specific distinctions and connections (2019).

The “MB>CO2” project aims to address the rising global impact of carbon dioxide emissions resulting from internet usage. Research indicates that a megabyte of data transfer or storage contributes approximately 20 grams of CO^2 to the atmosphere (Travers, 2021). The main contributors to these emissions are online video streaming and video calls. According to Biersteker, a single Zoom meeting is equivalent to140 meters of travel using a petrol car and a Netflix night results in 900g of CO^2 emissions (Biersteker, 2022).

Figure 8- [Image by Thijs Biersteker], This installation uses two digital displays to track the quantity of data and the emissions produced during the video calls made by the users (Thijs Biersteker, 2022).

Biersteker’s installation is a summation of the hybrid media, media archaeology and cultural techniques discussed so far. “MB>CO2” can be regarded as a hybrid medium. It not only integrates media types, but it facilitates crosstalk between interconnected disparate communication channels. For example, the literal biological representation of knowledge through the installation’s output can be considered an analogue display and real-time data computation. Additionally, the work can also be

classified as traditionally “multimedia”, as each medium possesses its own “decoder” (Manovich, 2013, p.169). For instance, the installation includes two classifications of foundational media with clear decoders: digital (the video call component decoded via digital display) and technical (mechanical components for releasing CO^2 into the chamber decoded by electronic hardware and biological display). While each type of media necessitates a unique decoder to process and execute incoming data, they are all regulated through remediation within the hybrid system. Additionally, as a reminder, according to Manovich (2013, pp. 170-171), multimedia platforms, such as an HTML webpage, function as a container or display site that houses various forms of media. However, while “MB>CO2” contains multimedia qualities, especially if we consider the gallery space a housing medium, the work clearly also exemplifies meta-medium characteristics. The work features the functionality of both a hybrid and multimedia platform. It creates a multimedia medium by aggregating data through a hybrid structure merged with algorithmic data translated into technical information (Geoghegan, 2019, p. 14).

The “MB>CO2” project has inspired a methodology that embraces the notion of practice-based design research for *Insomnia*. The creation of a complex media assemblage has little choice but to acknowledge iterative creative practice to uncover novel communication pathways. Consequently, my research outcome is moulded through constant experimentation and ongoing inquiry, enabling the work to be fine-tuned until the inquiry reaches a demonstrative conclusion. The “MB>CO2” project encourages *Insomnia* to delve deeper into the subject matter of sleep and its surrounding media constellations for a heightened insight of my sleep disorder. The cyclical nature of practice-based design research enables the researcher to continually reflect on their work, making modifications as necessary and fostering a sense of growth and development over time. The structure of this exegesis, with reflection throughout, echoes this methodology. Ambitiously, via this approach *Insomnia* aims for a high-quality final product and a deeper understanding of the subject matter, making it a valuable platform to share with creative media practitioners. (Bell, 2022; Brown, 2022; Dixon, 2019).

3. The Affordance of Hybrid Media in Data Visualisation

Data visualization is a method of decoding archived knowledge into a visually comprehensible format. According to Ware (2013, pp. 1–3) and Wright (2008, pp. 78-86), data can be composed of remediated mediums and cultural techniques transformed into numerical values. However, it is important to remember that data does not necessarily have to represent a subject strictly (especially for a creative project like *Insomnia*). Due to the fluidity of hybrid media the affordance of data is amplified by the affordance of its visualisation. Here, data visualisation can be thought of as a remediated result of converged cultural techniques through the process of Softwarization, as suggested earlier in this exegesis via Manovich (2013) (Figure 9).

The concept of hybrid media, as outlined via Kittler and McLuhan, and further developed through Latour and Manovich, plays an essential role in data visualization. The hybridisation of media and data results in amplifying and amputating human sensory experiences, for this study, referred to as media immediacy (McLuhan, 1964, pp. 7, 54). Figure 9, a taxonomy of visualisation by Colin Ware (2013, p. 6), will be used to explain this. To start, a cave painting, illustrates the immediacy of paint as an analogue medium that amplifies visual sensory skills, allowing the audience to imagine the event while also amplifying other senses such as hearing and touch via association. To speculate, in the context of hybrid media, a meta-medium becomes a threshold for new media. This speculation is informed by a reading of Mark Titmarsh's idea that contemporary digital images are a result of software and conditioned by meta processes (Titmarsh, 2018). For example, in the realm of digital hybrid media, data visualisation can subsume traditional (analogue) representations of data. In this new context, data gains a binary code identity, and its content is infused with

other media through hybridisation to form knowledge through a wider collection of symbolic and sensory experiences (Siapera, 2012; Wright, 2008). For these more complex modes of visualisation the immediacy of paint on a cave wall gives way to the immediacy of algorithmic symbols and technical processing as prosthesis (Figure 9) suggesting a deeper level of sensory immersion.

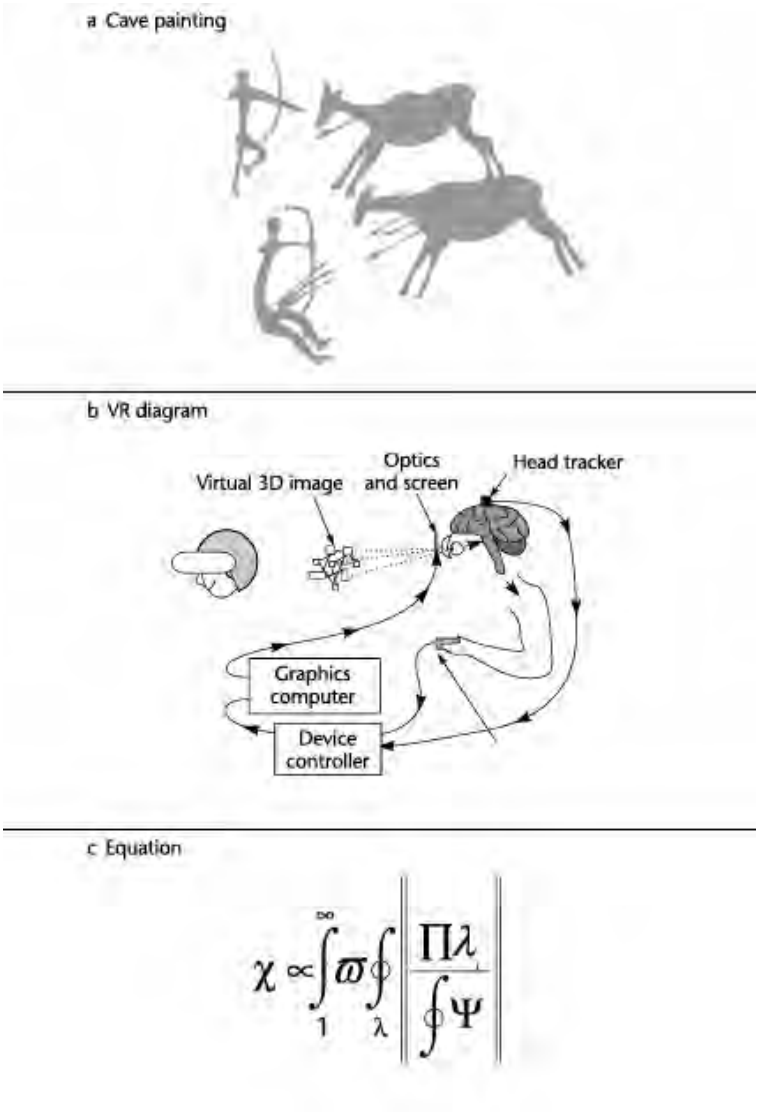


Figure 9- [Visualisation by Colin Ware], Three forms of visualization produced by humankind showing distinct approaches to archiving knowledge across three distinct cultural periods and varying design techniques. These forms include A) visualization of information gathered during hunting and the utilization of carving by cave dwellers to archive their experiences; B) visualization of a Brain-Computer Interface (BCI), which illustrates the technical feedback loop between the user and software; and C) a mathematical formula that visualizes scientific knowledge. Despite the differences among these forms, they are all encompassed within the overarching domain of data visualization. (Ware, 2013, p. 6).

Richard Wright (2008) highlights in his article "*Data Visualization*" that the term is commonly used to represent digital data in visual forms such as charts and infographics (p.78). However, it can be argued that any form of digital processing remediated into a rendering can be considered a visualisation. For instance, the typographic treatment of text in a terminal window is a visualisation of the alternating switches among transistors (Figure 10) (Wright, 2008, pp. 81–85). Visualisation provides a valuable tool for comprehending large amounts of information, as the human visual system is capable of detecting patterns and structures within data (Ware, 2013).

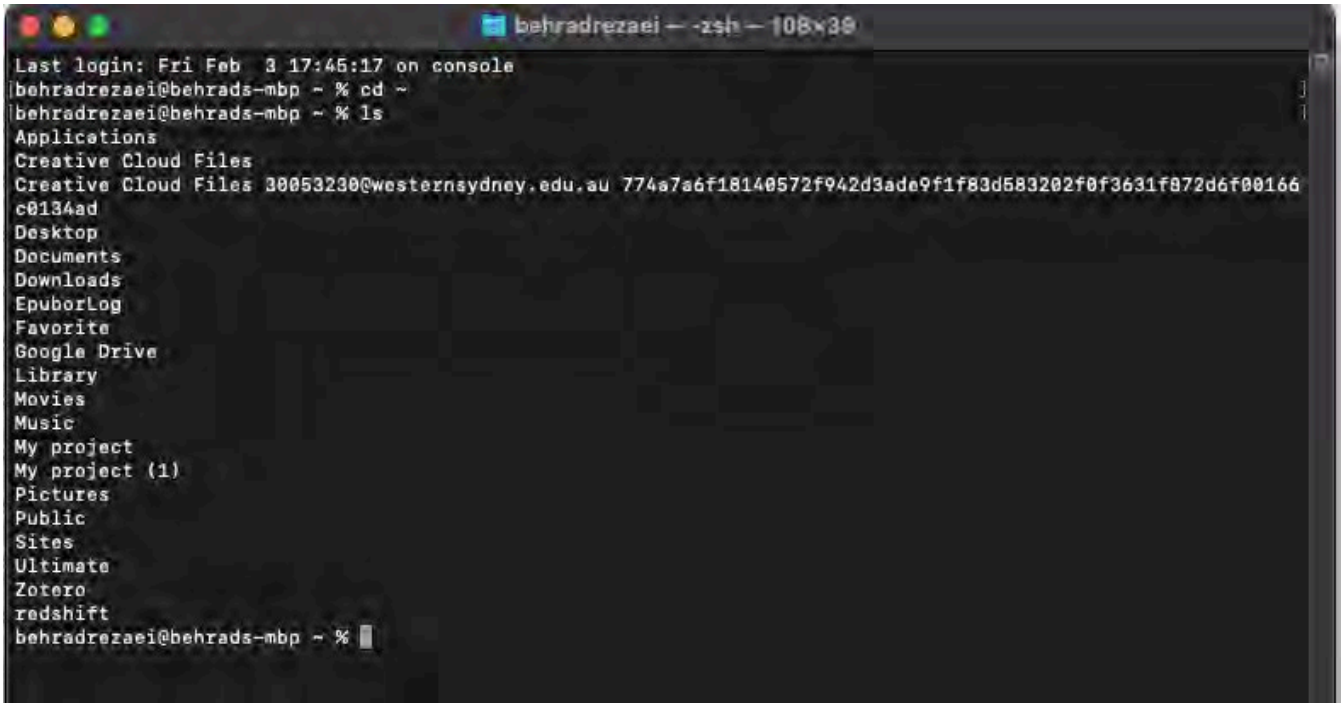


Figure 10- [Screengrab], Mac OS Terminal listing Desktop Folders. The typography serves as a visual aid in effectively representing the archived data in a comprehensible manner. According to Wright (2018), the type is data visualisation.

Data visualisation has evolved beyond symbolic numbers, with hybrid media taking data from a passive archive to an active participant in a communication network (Siapera, 2012; Titmarsh, 2018; Wright, 2008). Thus, the inherited affordances of hybrid media such as, computation, instantaneity, and storage, enable data to serve as a building block for enhancing or creating new media (Manovich, 2013, pp. 102–106; McMullan, 2020, pp. 294–295). “The Meandering River” by Onformative (Figure 11), created in 2018, serves as a noteworthy example of the exploitation of the proto-affordances of hybrid media. In this case, to visualise the ubiquitous and imperceptible alterations brought about by rivers to their surroundings (Onformative, 2018). This installation showcases real-time visuals generated by a computer algorithm and sound produced by an artificial intelligence system. The primary objective of this project is to depict the changes within a given landscape due to natural forces, such as rivers, while providing the viewer with a dynamic and engaging experience (Geoghegan, 2019; Sedition, 2019).

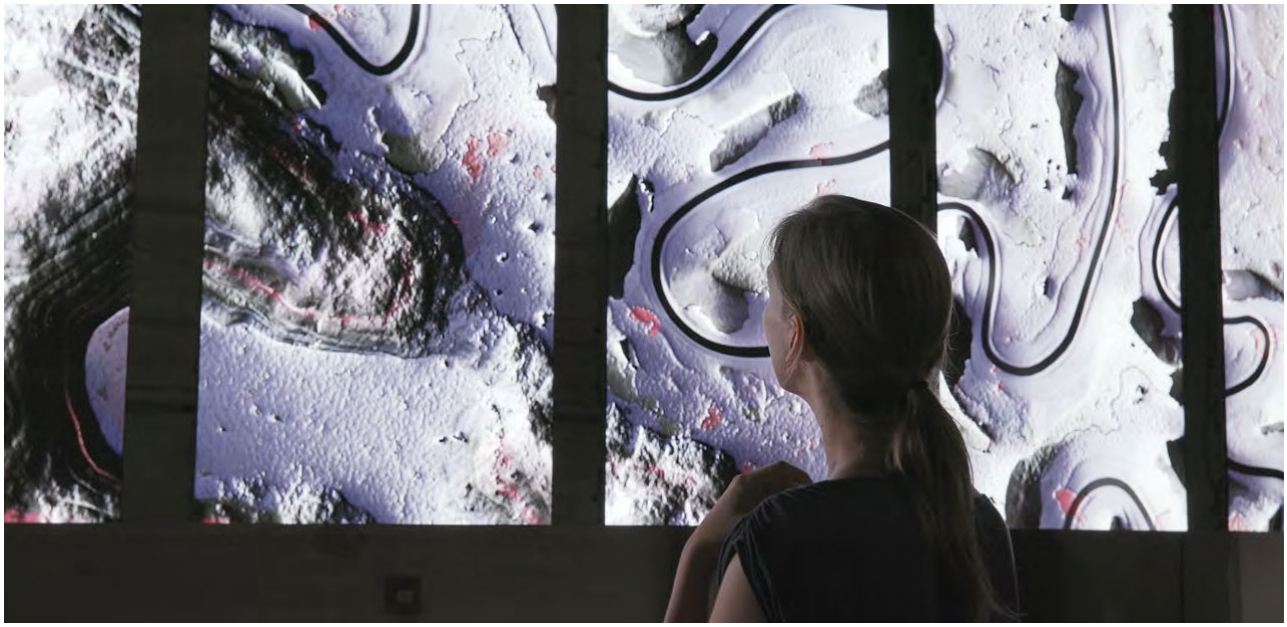
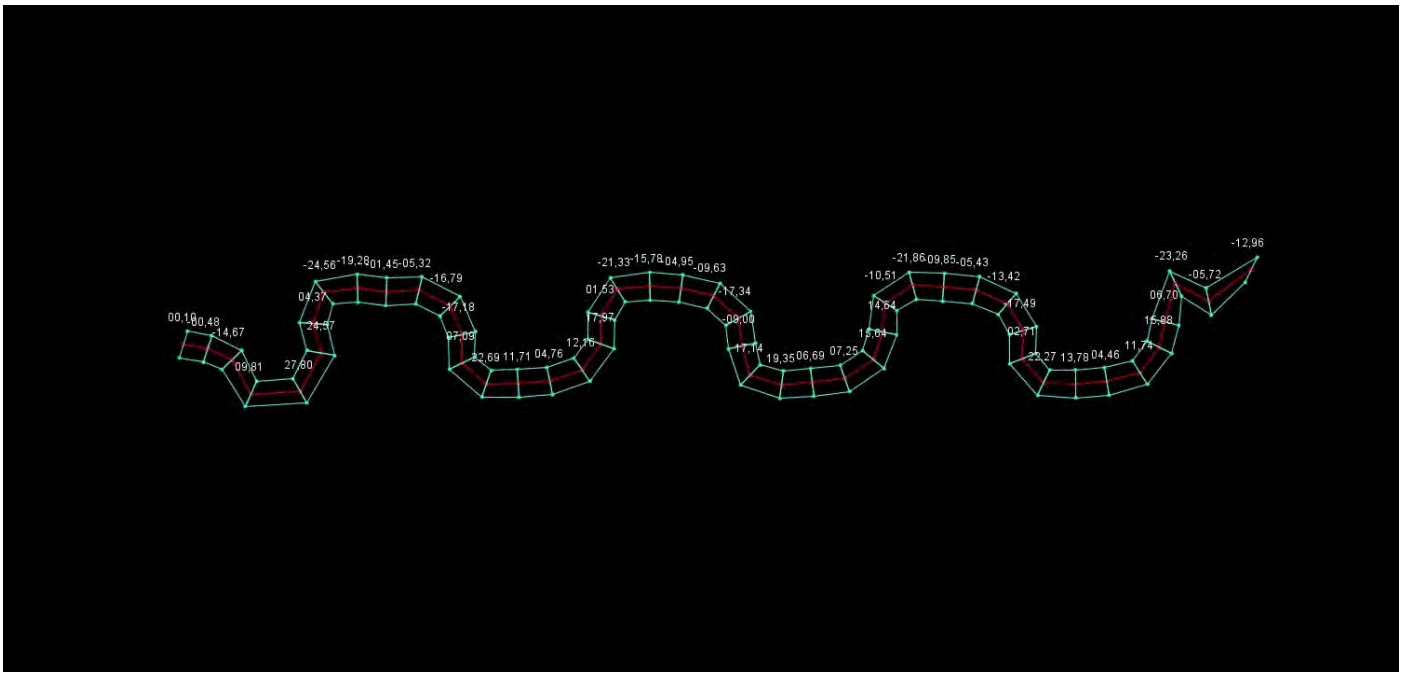


Figure 11- [Image by Onformative], A user interacting with the installation. (Onformative, 2018)

"The Meandering River" project offers an immersive data visualization experience within a broader framework of hybrid communication channels. The designers employ the proto-affordance of the hybrid media to establish a feedback mechanism between collected data and a deep machine learning algorithm (AI) to produce a visually artistic representation of the changes in the landscape, displayed across six screens (Onformative, 2018; Sedition, 2019). The data collected from the river was first transformed into a binary format to facilitate its processing through the software and generate a dynamically rendered animation (Figure 12 A, B). The data's structure within the software is spatial in nature, as opposed to temporal, which enables the merging of changes over time in visual representation (Wright, 2008, pp. 78-86). As a result, the data becomes a medium that is detached from its original source and becomes dependent on its algorithmic processes. Additionally, this data transformation into a medium facilitates its use for artistic expression, as seen in "The Meandering River" installation. The capability of software to serve as a knowledge mediator, rather than just as a device for its illustration, empowers it to assist human cognitive processes and distinguish minute changes in design components. This aspect of data visualization has been referred to as "automatic processing" by Wright (2008, p. 82). Wright characterizes this phenomenon as "a stage of human vision that pertains to the subliminal detection of light, pattern, orientation, and movement" (Ware, 2013; Wright, 2008). "The Meandering River" (2018) is a hybrid media network that employs data, cultural techniques of drawing, mapping, and software to generate and translate knowledge into a visually compelling and immersive format. The work enhances human sensory abilities by presenting an interactive visualization of dynamic change in natural landscapes caused by the flow of rivers without being restricted by geological time. It is this kind of extension of human perception via media assemblage that *Insomnia* aspires.

A



B

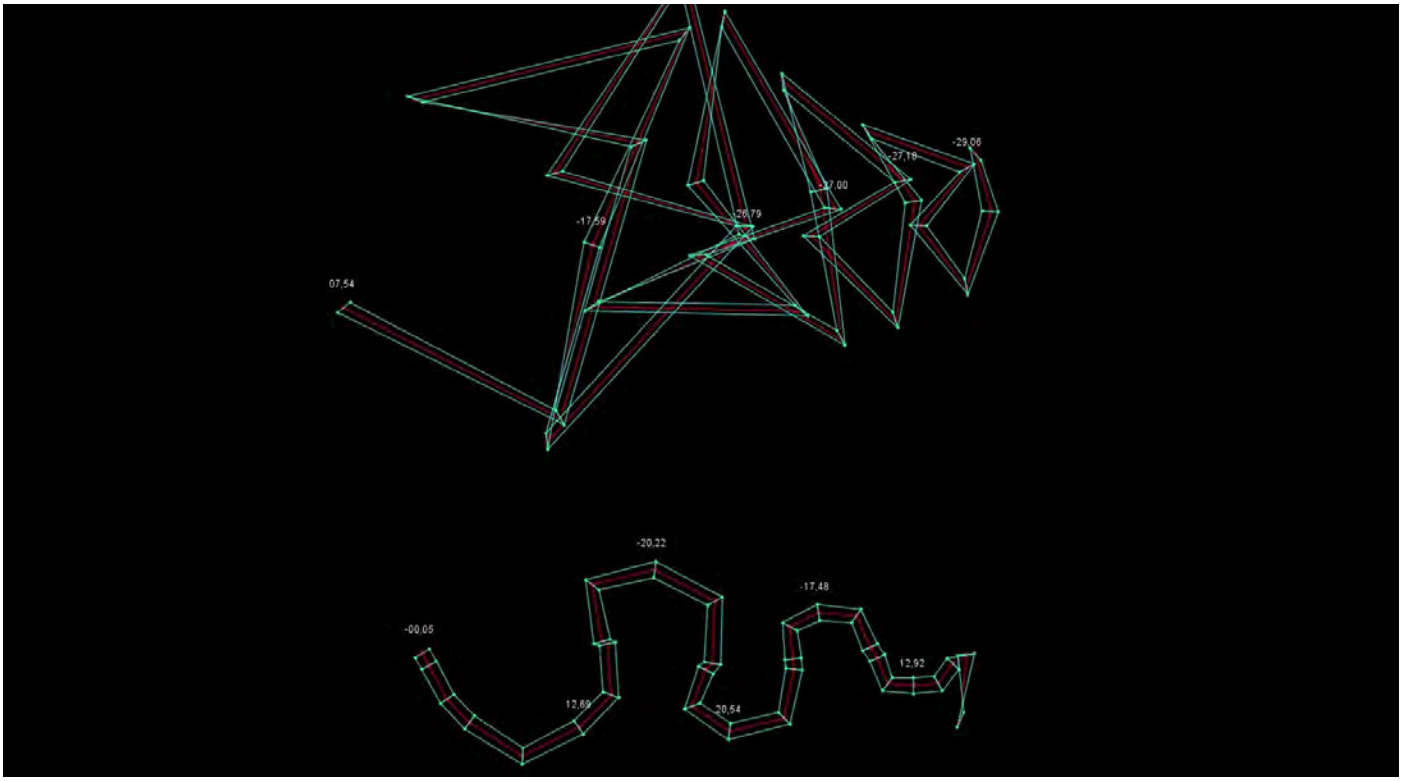


Figure 12- [Image by Onformative], The collected data was integrated into the artificial intelligence system to visualize the river's movements and incorporate computer-generated textures (Onformative, 2018).

4. Visualising Insomnia: The Process

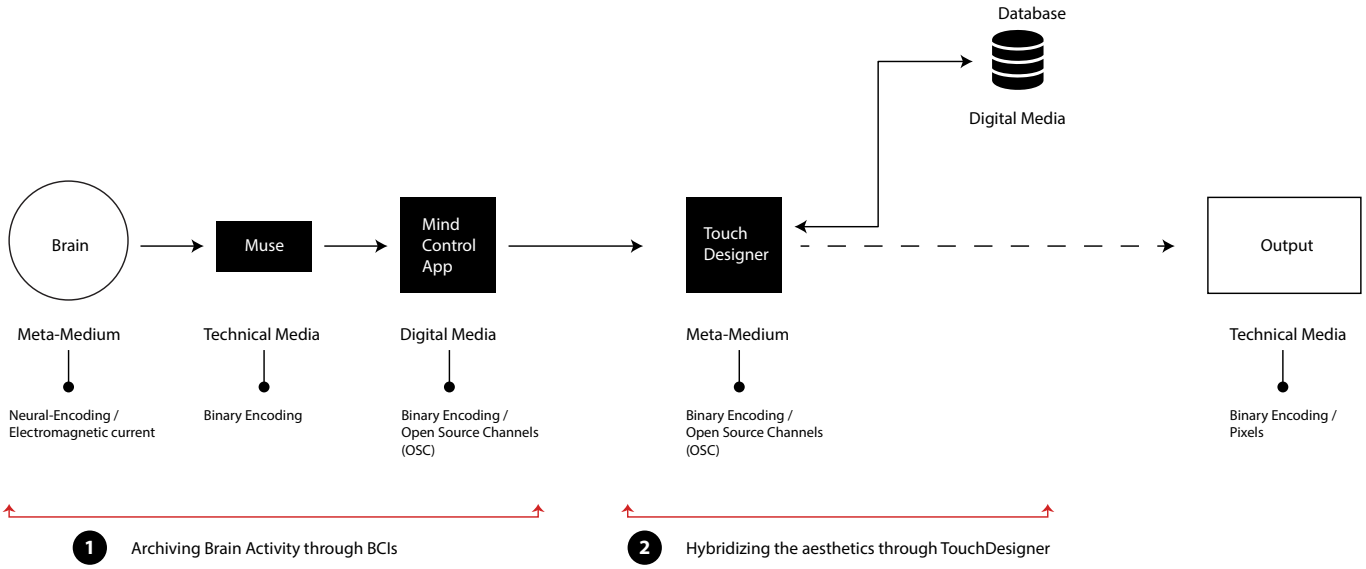


Figure 13- [Infographic by author] A flowchart of the Insomnia project in a simplified linear diagram.

The methodology section of this study endeavours to thoroughly investigate the techniques utilised in the visual representation of *Insomnia* while reflecting on the process and media theory discussed above. This section will delineate the methodology employed to conduct production, including the creative rationale behind the visuals produced, data collection methods, and data visualisation strategies (Figure 13).

4.1. Fetching Brain Activity through BCIs

Insomnia is a sleep disorder that may result from an imbalance of hormones or other factors, such as depression or stress (Abbott, 2016). The characterisation of this phenomenon involves the measurement of brain activity during sleep. The brain, consisting of billions of interconnected neurons forming the central nervous system, communicates through electrical signals ranging from ~0.5 to ~100 Hz (MUSE, 2018; NHS, 2017) (Figure 14).

The process of recording the electrical pulses generated by the brain is referred to as Electroencephalography (EEG). Medical professionals have primarily utilised EEG to study human brain activity (Muse, 2022b; Steinert et al., 2019). Throughout the evolution of EEG devices, medical applications have been the primary focus. However, with improved accessibility and the advancement of computational technology in the early twenty-first Century, creatives have begun incorporating EEG signals as an actant in their design process. EEG signals have been utilised in creative design as a means of connecting body and digital media; a process referred to as Brain-Computer Interfacing (BCI) (Preece, 2019). BCI constitutes a feedback loop between the human brain and a meta-medium, enabling the execution of actions or contributions, as an interface. The typology of BCI can be categorised as Active, Passive, and Reactive (Preece, 2019; Steinert et al., 2019; Wolpaw, Jonathan R & Wolpaw, Winter., 2012; Zioga et al., 2018).

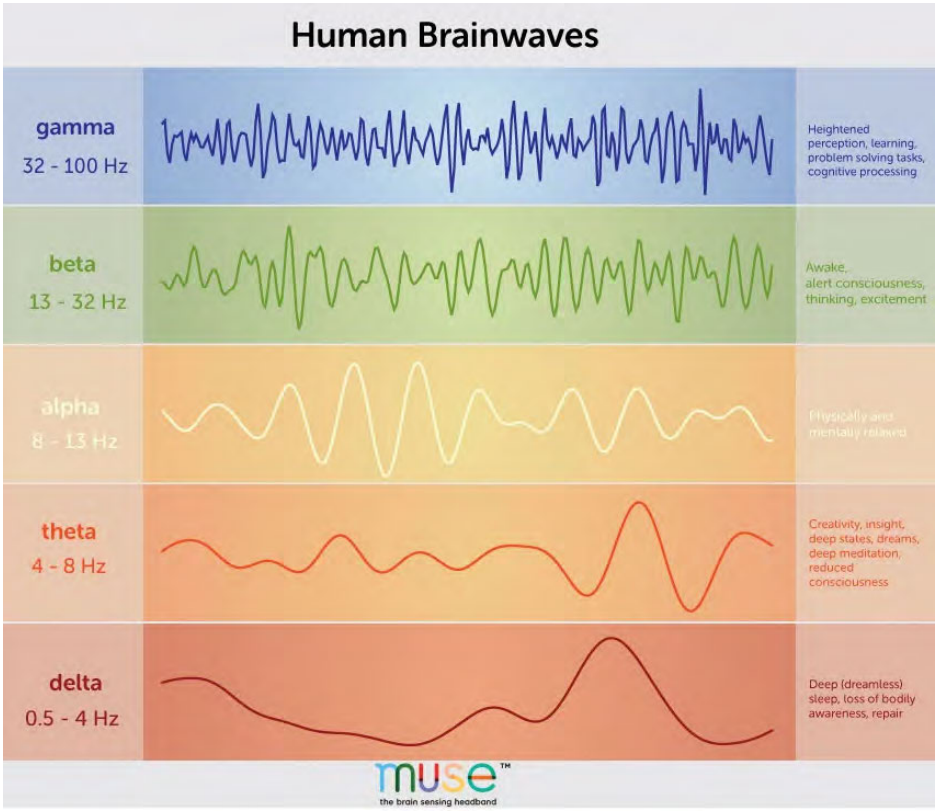


Figure 14- [Visualisation by MUSE], The five primary brain waves studied during Electroencephalography (EEG) (MUSE, 2018).

Steinert et al., in their publication "*Doing Things with Thoughts: Brain-Computer Interfaces and Disembodied Agency*" (2019, pp.460-461), discuss the latter forms of BCIs as follows:

- Active BCIs involve the conscious generation of signals by the user, such as through a mental effort, to control a device or interface.

- Reactive BCIs involve the system's response to alterations in the user's brain activity, such as variations in attention levels or emotional states.

- Passive BCIs operate without direct control from the user and involve the monitoring of brain activity to deduce the user's intent or state. This information is then utilised to control a device or interface.

According to Steinert et al., the most appropriate Brain-Computer Interfacing (BCI) method for visualizing Insomnia and collecting data is the Passive BCI method, because brain activity during sleep is inherently involuntary (p. 461). There are several BCI devices that are utilised by creative individuals, including the Mindwave Mobile 2 by NeuroSky (priced at USD$109.99 + shipping) (NeuroSky, 2022), the Muse 2 by InteraXon (priced at $317.88) (Muse, 2022a), and the NeuroBIT by BITalino (priced at €210,00 + shipping) (pluxbiosignals, 2022).

After conducting research and considering various options, I decided to shortlist Muse 2 (Figure 15) and NeuroBIT for further testing (Figure 16). Due to the timing of deliveries and shipping, I ultimately selected Muse 2 and NeuroBIT. During the setup process, I discovered that the Muse 2 is significantly easier to use, as it operates through a Bluetooth connection, which enhances its mobility and facilitates seamless connectivity. However, the data collected through the device must be transformed into a standardised format compatible with other platforms to broaden its accessibility and utilisation. On the other hand, NeuroBIT also runs on Bluetooth technology. Still, it utilises its own interface, known as "Opensignals" (Plux BioSignals, 2022), which

requires a certain level of advanced knowledge in Python to establish a connection to third-party software.

The Muse 2 Headband (Figure 15) is a Passive BCI device that records and assesses the electrical activity of the brain through its seven accurately calibrated sensors. The sensors are positioned on the forehead (AF7, AF8, FPZ), behind the ears (TP9, TP10), and three additional referencing sensors (Muse, 2022a). A limitation of the Muse 2 is its inability to link to third-party software through Bluetooth directly. To address this issue, I discovered a third-party mobile application developed by James Clutterbuck called “Mind Monitor” (priced at $25) (Clutterbuck, n.d.). This application is readily accessible for Android and iOS platforms, and it provides the capability to connect to any Muse device through Bluetooth and transmit the data via OSC (Open Sound Control) streaming to any third-party software (Figure 17). OSC is a communication protocol that has been optimized for contemporary networking technology and is utilised for interconnectivity between computers, sound synthesizers, and other multimedia devices. OSC provides a versatile and efficient method of transmitting control data between computers and related devices compared to the Musical Instrument Digital Interface (MIDI) protocol (Philips, 2008; Matt & Stanford University, 2021). OSC streaming is a real-time data transfer protocol, allowing for the rapid and dependable transmission of control information between devices. This feature is particularly useful in applications that demand low latency and high accuracy, such as audio and video processing, gaming, and interactive installations. OSC streaming can be implemented using various technologies, including Wi-Fi, Ethernet, and USB. It can be utilised to control and manipulate a broad range of devices and software programs (Philips, 2008; Sorkhabi & nVoid Art-Tech, 2019).

Figure 15- [Image by Muse], Muse 2 Headband (MUSE, 2018).

Figure 16- [Image by Plux Biosignal], NeuroBIT Kit. The kit includes two EEG sensors, one ground cable, A pre-assembled BITalino core BT/BLE (MCU+BT+PWR), A 3D printed casing, and a Li-Po battery 700mAh (pluxbiosignals, 2022).

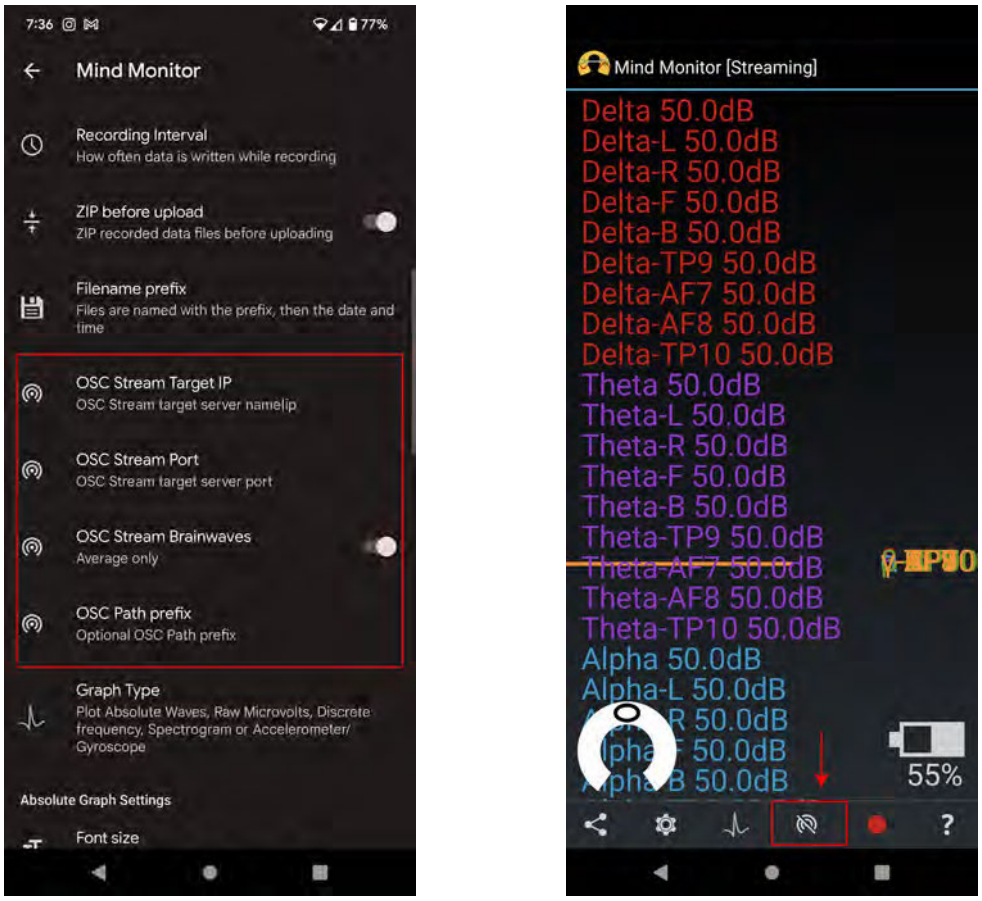


Figure 17- [Screengrab of Mind Monitor App], The image on the left depicts the configuration interface of the application, wherein the user can modify the application's properties, including the designated network IP address and the assignment of a communication port. The image on the right represents the app's primary (home) interface, with the red arrow indicating the OSC switch utilised to transmit the data.

Referring to Figure 18, an infographic representing an early iteration of integrating media theory and applied media for *Insomnia*, it can be argued that brain waves constitute a form of analogue media when measured or captured as continuous signals. The Muse headband and Mind Monitor application represent and introduce noise within the established communication network. Claude Shannon's seminal work on information theory "*A Mathematical Theory of Communication*" (1948) establishes noise as a critical communication consideration in the successful transmission of information. For *Insomnia* noise is generative. Signal noise in recording brainwaves, and converting and processing them, is navigated and explored to help establish the system design used, enabling the hybridisation of media. In this project, the convergence of analogue media (brain waves) and technical media (Muse

and Mind Monitor) gives rise to a fluid data stream, which can be manipulated using targeted software logic (Geoghegan, 2019). The visual coding software TouchDesigner and the Python programming language are the designated meta-media for the *Insomnia* Project.

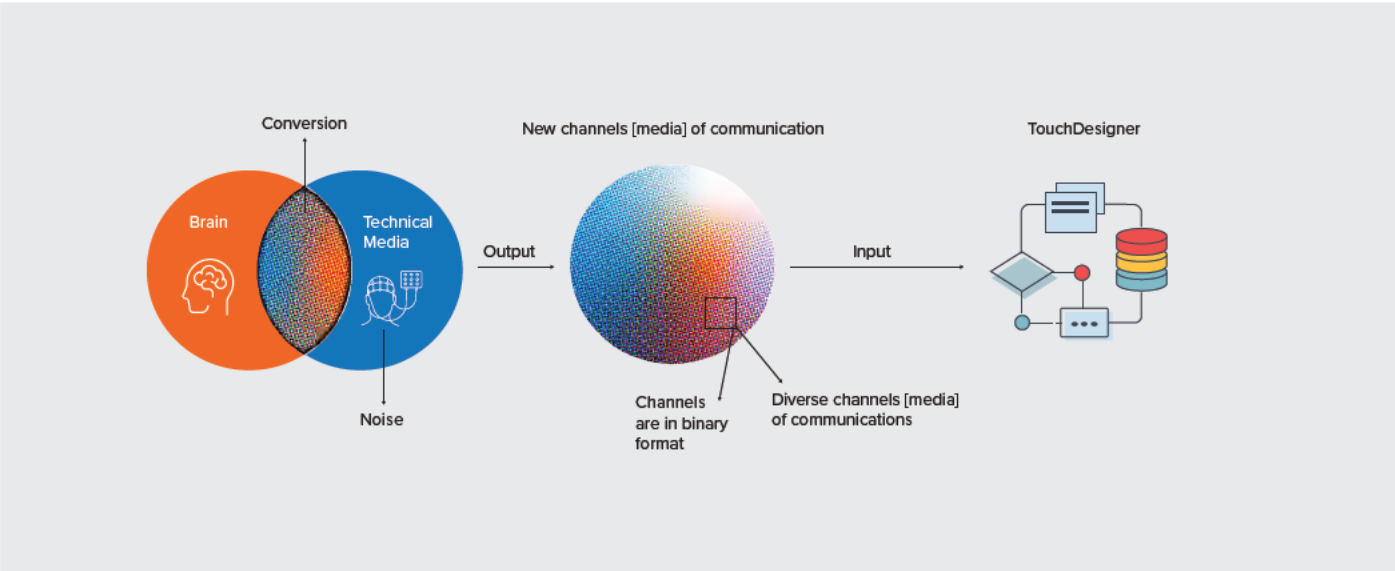


Figure 18 -[Infographic by author], This infographic showcases the intended process of hybridizing analogue media into binary format. The merged halftone region represents the resulting media form that can be executed using software logic. The gradient colour scheme represents unknown novel and diverse channels with potential creative opportunities.

4.2. Softwarizing the Aesthetics: TouchDesigner

During the early stages of my research, I was intrigued by the captivating aesthetics of Ferrofluid art (Figure 19) due to the potential in abstract visual analogies to brain waves. Ferrofluid was created by NASA scientist Steve Pappell in 1963 as a means of facilitating fuel flow in zero-gravity environments (Bennett, 2021; Sands, 2021). Throughout my investigation, I noted a similarity between the unique shapes generated by Ferrofluid interacting with magnetic fields and the concept of Insomnia. Consequently, I sought to create a hybrid platform that utilises Brain-Computer Interface (BCI) data as input to control four electromagnets through Arduino, thereby visualising Insomnia. However, this required a deep understanding of electrical

engineering, which I lacked. As a result, I chose to replicate the aesthetic of Ferrofluid through the TouchDesigner interface instead of pursuing a material-based output.

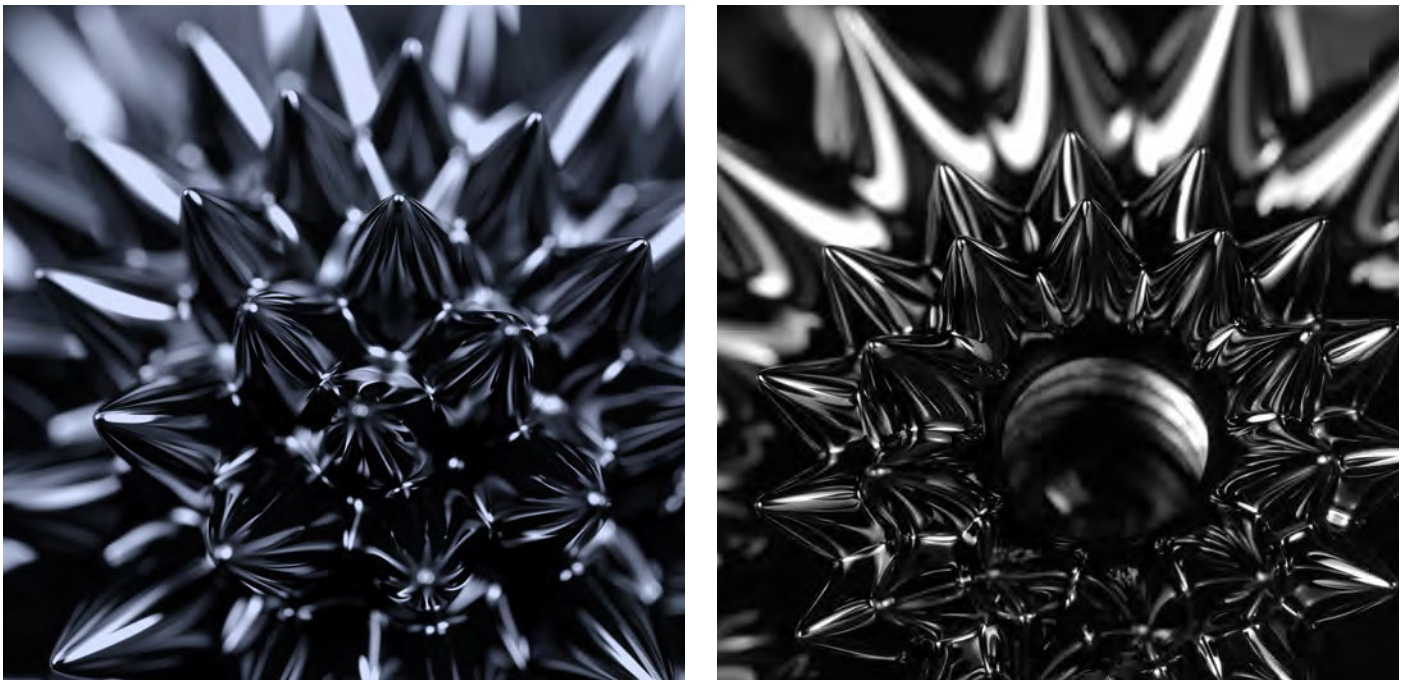


Figure 19- [image by MADDRAT], Close-up photographs of Ferrofluid artistic creations (MADDRAT, n.d.).

TouchDesigner is a visual programming environment for real-time interactive multimedia content and installations. It's used by artists, designers, and technical directors in a variety of industries, including live events, video jockeying, interactive installations, and more. TouchDesigner allows users to create and manipulate graphics, audio, video, and other media in real-time, using a visual interface and a node-based system for building and processing data. The node-based architecture of TouchDesigner represents a distinct characteristic of the platform. This architecture departs from the conventional coding approach by composing text-based code in a text document. Instead, TouchDesigner employs a graphical interface to construct applications by arranging nodes. These nodes, called "Operators" in TouchDesigner, execute specific and finely granulated actions (Derivative, 2017) (Figure 20). The accomplishment of complex tasks is achieved through the collaboration of multiple

nodes. Additionally, it also includes tools for 3D graphics, network communication, and hardware control, making it a versatile and flexible platform for creating a wide range of interactive experiences. When operations are too complex for the main node interface, customisation of operators or custom operators can be created with Python scripts.

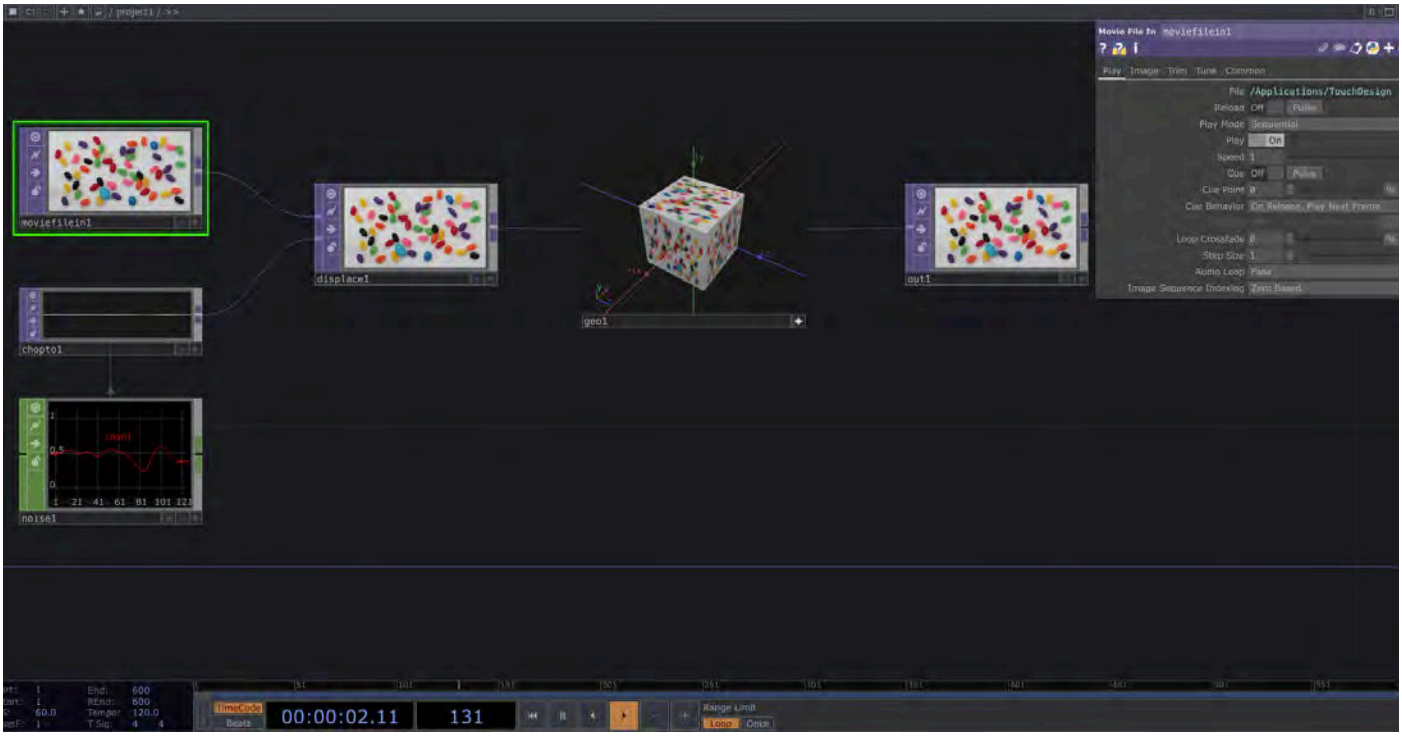


Figure 20- [Screengrab], The standard interface of TouchDesigner features rectangular nodes, referred to as operators, which can be connected to one another through the simple process of dragging a line between them. This node-based architecture is similar to that utilised by other software programs such as MAX/MSP (Grosse, 2019) and Houdini FX (SideFX, 2007).

In order to imitate Ferrofluid, I examined its patterns and observed that the spikes exhibit a high degree of similarity and could be considered instances of a single form that generates the pattern. Through further research, I was able to establish a connection between Ferrofluid and the design techniques employed by M.C. Escher (1898-1972) in his paintings (as seen in Figure 21). One of the defining characteristics of TouchDesigner is its capability to create instances of 3D objects based on other elements (Derivative, n.d.). As a result, a comparison between the cultural technique of pattern making and TouchDesigner can be made. A hybrid media system was beginning to take form for *Insomnia* that linked to the fluidity of a meta-medium and the softwarization of cultural techniques.

Figure 21- ["Lizards" (No.124) by M.C. Escher], (M.C. Escher, 1965). M.C. Escher utilised symmetry and repetition as prominent motifs. These techniques can be correlated with the cultural practices of duplication, repetition or replication throughout history.

4.3. Merging BCI into TouchDesigner

TouchDesigner is equipped with a Channel Operator called the "OSC In CHOP" (Derivative-CHOP, 2022). The OSC In operator establishes a direct connection between the Mind Monitor App and TouchDesigner, facilitating the transfer of all data collected through the Muse 2 headband (Figure 22).

The Muse 2 sensors offer fifteen distinct variables. However, only the relative and absolute channels were utilised for this project due to their significance in visualising brain activity. The distinction between the absolute and relative channels lies in the range of their calculations. The relative channel ranges from -1 to 1, while the absolute channel ranges from 0 to 1 (Clutterbuck, n.d.). The relative values offer

a broader dynamic range and are employed to control colour properties requiring a wider range. On the other hand, the absolute values are utilised for controlling properties that demand an integer value.

Figure 22- [Screengrab of OSC In CHOP], The OSC In CHOP connects to the host server (sender) via the network IP address and the designated port address.

4.4. Visualising Ferrofluid: TouchDesigner Setup

The process begins with integrating data from the Muse 2 device and the intended design technique of pattern making via repetition, to apply a hybrid network of media approach. This network serves to translate data and cultural technique into TouchDesigner (Figure 23). The pivotal stage of this project takes place at this point, where five brain data values (only absolute values) were imported through the OSC In CHOP. These data were utilised to regulate a Ramp operator configured to a circle to imitate individual spikes or points in Ferrofluid (Figure 24).

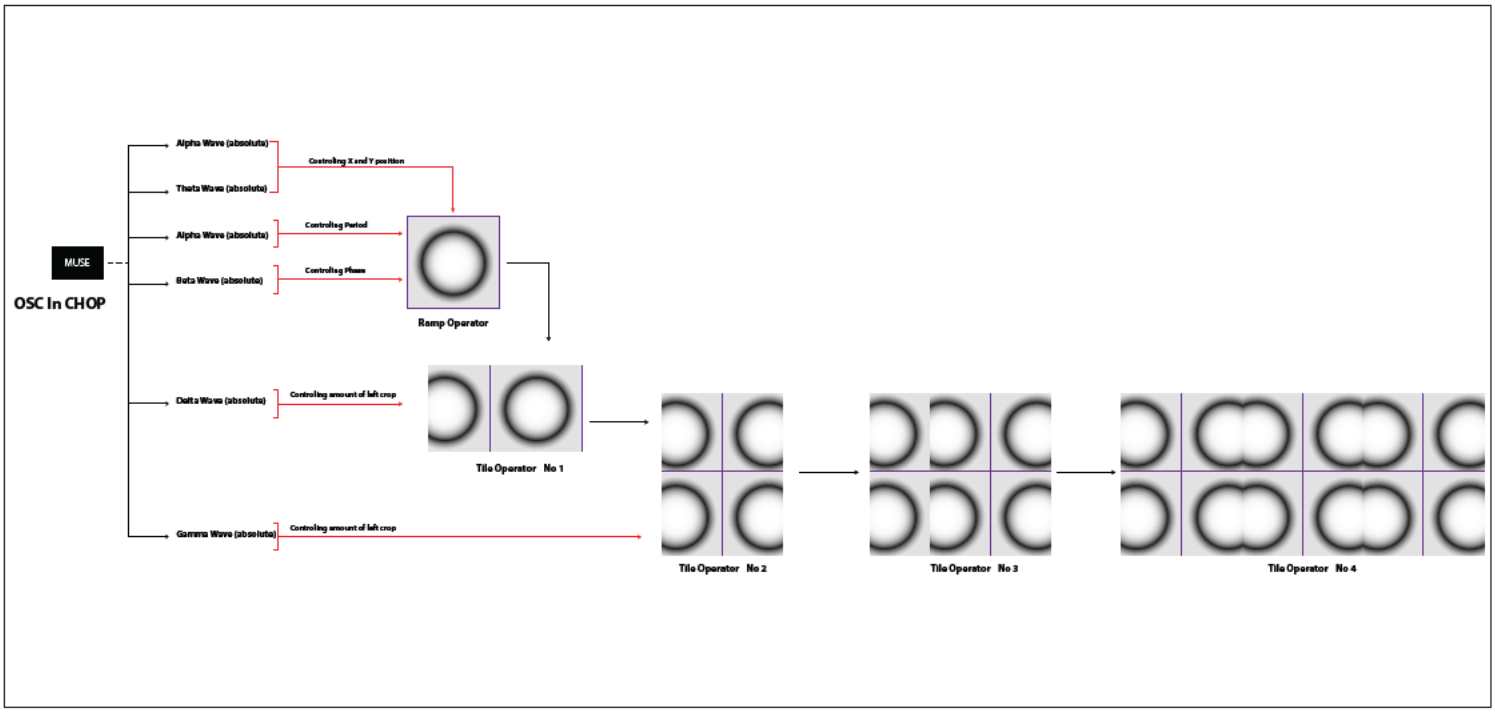


Figure 23- Top [Infographic by author], The flowchart of the Ferrofluid visualization process is presented, with a screengrab from the TouchDesigner interface located at the bottom. This Screengrab illustrates the applied logic depicted in the top diagram.

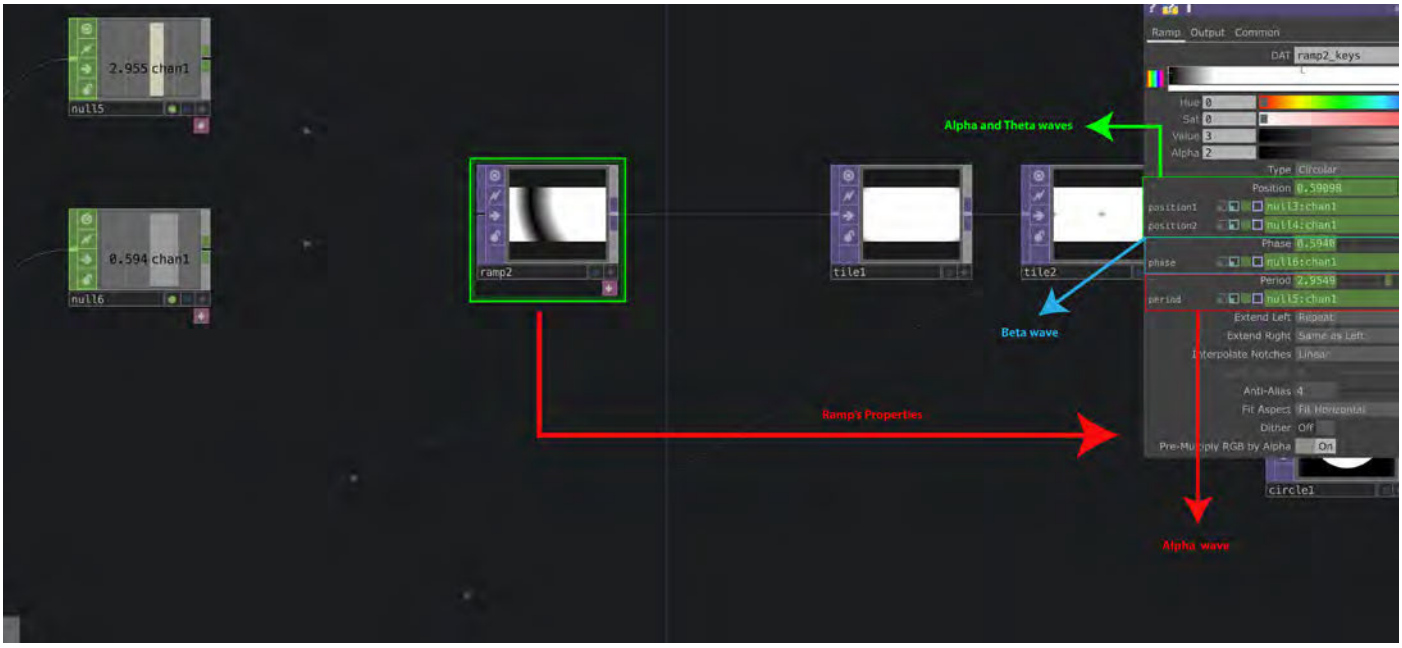


Figure 24- [Screengrab], A screen capture of Ramp Operator properties, annotated with the designated incoming data values.

This study's selection of brain waves was based on their frequency range and the mental state they are associated with, as described in sources such as MUSE (2018) and Muse (2022b). The positioning of the ramp is a critical variable in the generation of dynamic movement in both the Y and X axes. Therefore, for this investigation of insomnia, Alpha and Theta waves were assigned to control the ramp's position. The utilisation of Delta wave data was not incorporated due to its low-frequency rate, which was approximately 0.5 to 4 Hz, and would result in limited changes in the output. These selections are experimental at this stage and based on iterative outcomes from personal sleep trials.

Next, the output from the Ramp operator was directed to four different Tile Operator nodes to replicate a multiplication process. As depicted in Figure 25 via the preview of each operator, the cropping properties of the first two Tile operators were assigned to Delta and Gamma wave data. The output from the second Tile operator was fed to the other two Tile operators. Four Tile operators were necessary due to the limitation of each node to create only two images (tiles). Thus, to achieve the desired result, four Tile operators were utilised, with two others held in reserve.

Figure 25- [Screengrab], A screen capture of a network of Tile Operators with two additional bypassed nodes.

4.5. Visualising Ferrofluid: Hybrid Render Network

A TouchDesigner render network can be compared to a physical film studio setup, with the presence of a light and camera. Similar to native 3D production and animation software, but unique in its node-based environment qualities, TouchDesigner contains a 3D Geometry component (to render 3D objects), materials (shading), and a render operator to render all incoming elements (Sorkhabi & nVoid Art-Tech, 2019) (Figure 26).

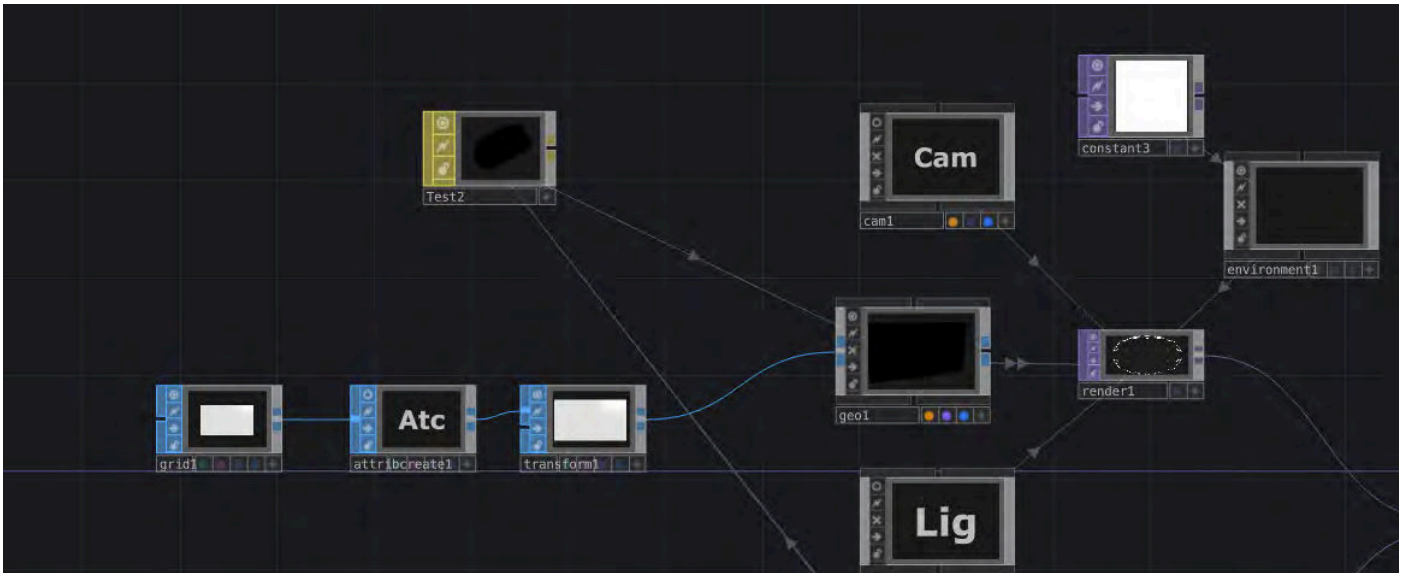


Figure 26- [Screengrab], A screen capture of the render network for this study.

The most crucial aspect of this render network is the Physical Based Rendering (PBR) Lighting model, which is utilised to create materials such as height, cone light, and bumps for 3D objects (Derivative, 2022a; Sorkhabi & nVoid Art-Tech, 2019). PBR can only be applied to 3D objects and is derived through a Geometry component. To imitate the texture of Ferrofluid, two types of maps were created from the output of the final Tile node operator: a height map and a Normal map (Figure 27). The Normal Map top operator generates bumps by identifying the edges within an image, while the height map serves as supplementary data for the PBR operator to carry out parallax mapping (Derivative, 2022).

Figure 27- [Screengrab], A screen capture of the normal and height map feeding into the PBR operator to create a material for the final render.

The function and appearance of a normal map in TouchDesigner can be seen as an emulation of cultural techniques inherit in impasto painting. Impasto is a painting technique characterized by the thick application of medium, creating a raised and textured surface. The technique was famously used by Vincent van Gogh (1853-1890), who utilised heavy layers of paint to produce bold and expressive brushstrokes in his paintings (Shelley, 2019). Normal maps in TouchDesigner can be seen as a contemporary adaptation of this traditional technique, utilising digital tools and techniques to achieve a similar effect in a virtual environment, reminding us again of Manovich's concept of Softwarization, as he states:

> In short, “softwarization” of old media did not lead to their “convergence.” Instead, after representational formats of older media types, the techniques for creating content in these media and the interfaces for accessing them were unbundled from their physical bases and translated into software, these elements started interacting to produce new hybrids (Manovich, 2013, p. 171).

Using the normal map in TouchDesigner points to the evolution of cultural techniques via media expression as creatives and software design continue the iterative facilitation and evolution of digital art and technology.

4.6. An Alternative Visual Concept: The Radar Effect

During my initial exploration of representation options for Insomnia I considered methods of visualisation via my aims to make connections with concrete cultural techniques of data visualisation Through Geoghegan’s (2019, p. 81) description of radar screens (Figure 28) I began conceptualising Insomnia via the radar technique of “frequency feedback” between incoming data and a surrounding environment. As a result, I developed a secondary option that focused on materialising the incoming data into 3D coordinates to form instances of itself by utilising the instance property of the Geo operator. The core component of this concept involves the remediation of incoming data from the Muse headband into dynamic XYZ coordinates, which are then utilised as both the position and number of instances within the Geo operator’s instance options (Figure 29). This setup enables the Geo operator to instance a 3D object dynamically in real-time based on the incoming data without requiring manual replication (Derivative-Geo, n.d.). It is worth noting that duplicating or positioning individual node operators within TouchDesigner can lead to a significant reduction in processing power and may limit output options. However, by utilising the instance properties of the Geo operator, it becomes possible to create multiple versions of a 3D object with various modifications, without compromising processing power.
This approach provides a more efficient and versatile means of generating complex visual content within TouchDesigner (Sorkhabi & nVoid Art-Tech, 2019).

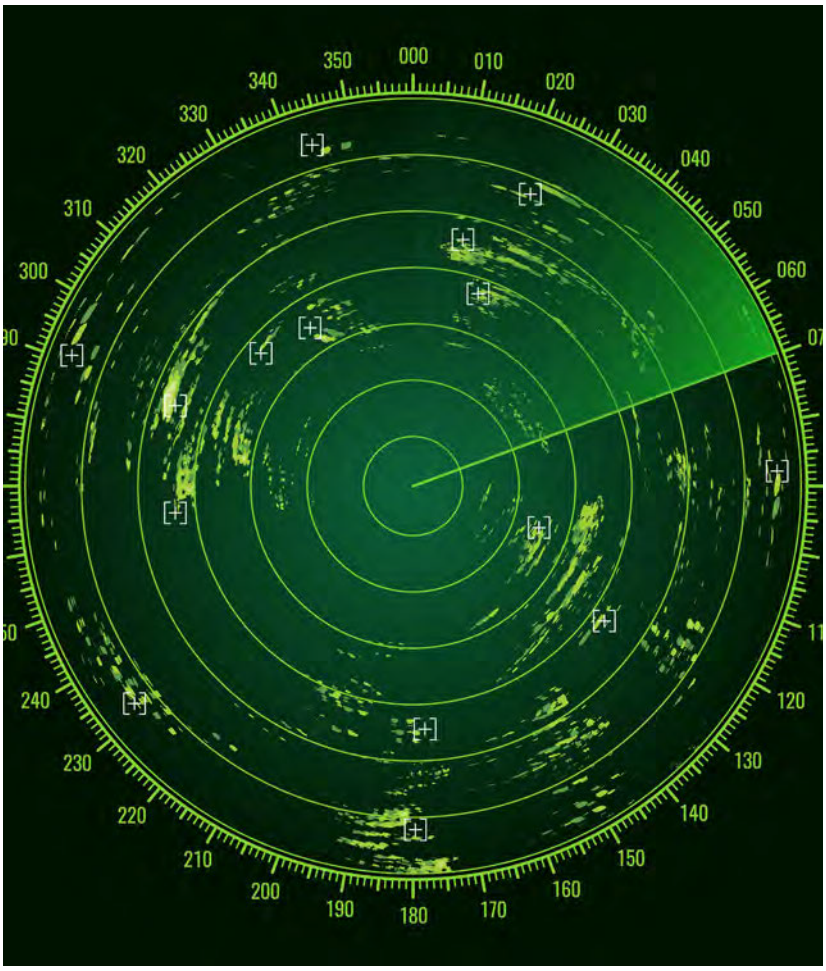


Figure 28- [Image by Adobe Stock] An example of a naval radar system (Adobe Stock Image) that operates on the principle of frequency feedback between the transmission source and the surrounding environment. The system functions by emitting electromagnetic waves reflected by the objects in the environment, which are then received and interpreted by the radar equipment. This process enables the system to determine objects' range, direction, and velocity in their vicinity, thus providing a comprehensive view of the surrounding environment (Geoghegan, 2019).

The render network employed in my radar process is similar to that of Ferrofluid, with the exception that the output of the render operator is passed through a feedback loop to generate a visual representation (Figure 30 A and B). In TouchDesigner, a feedback loop refers to a cyclical flow of data, in which the output of a node is fed back into one of its inputs. This processing chain allowed for the creation of dynamic and evolving system that responded to changing inputs and conditions in real-time. By utilising feedback loops, it became possible to capture the evolution of a dynamic system over time, as illustrated in Figure 30B. The outcomes generated through this process proved to be unexpectedly generative yet challenging to interpret in the context of insomnia. Consequently, I resolved to further experiment with this model solely for the purpose of generating visually creative outcomes, with the intention of undertaking technical development in the future.

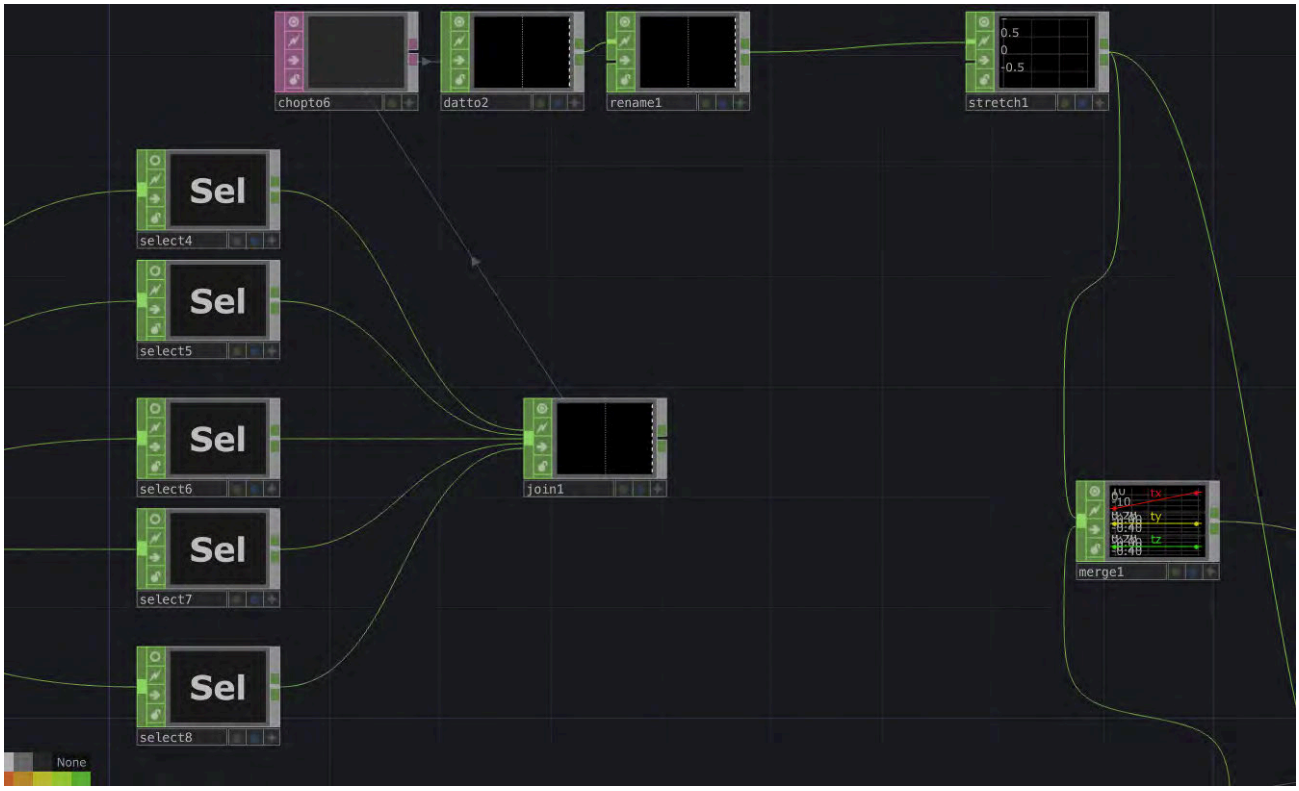


Figure 29- [Screengrab] Presents a screenshot illustrating converting data from the Muse headband into X Y Z coordinates. It is crucial to highlight that this process is facilitated using a Chop to DAT operator (purple colour node), which converts CHOP channel values into a table format within a DAT (Derivative, 2022a).

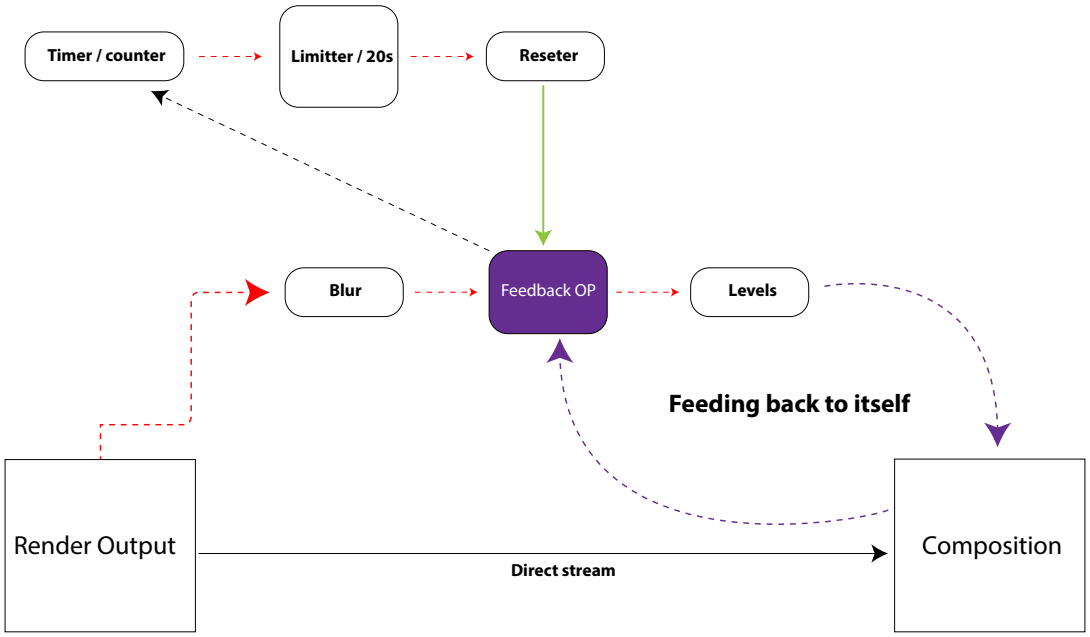


Figure 30 A- [Infographic by author] The operation of a feedback loop in TouchDesigner is depicted. The Composition operator functions as a canvas, like those in Photoshop or Illustrator, by combining visuals through the addition of layers. The Composite node has two inputs, one from the render output and the other through the feedback loop. A timer has been implemented to reset the loop every 20 seconds to prevent the continuous accumulation of layers.

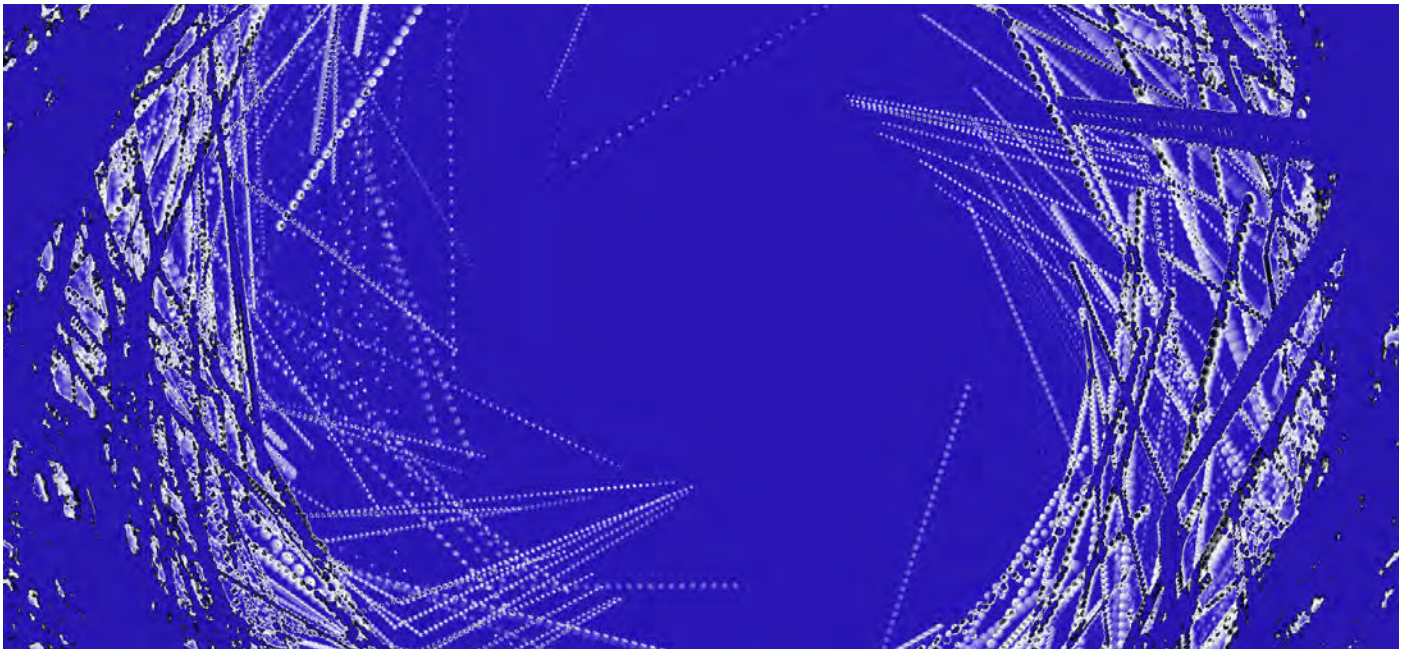


Figure 30 B- [Image by author] The image generated in this experiment is derived from incoming signals, which dictate the rotational orientation and the number of three-dimensional objects via the instancing capabilities within the Geo component.

4.7. Making Insomnia Sound

https://www.insomniart.art/sound

The addition of audio to the visual representation of insomnia was a challenge that I found to be of great interest. I aimed to expand the hybrid media reach of the project via the sonification of insomnia to produce an audio-visual piece. This involved experimenting with third-party synthesizer software, such as VCV Rack (VCV, 2023), to merge data from TouchDesigner and generate sound (Figure 31).

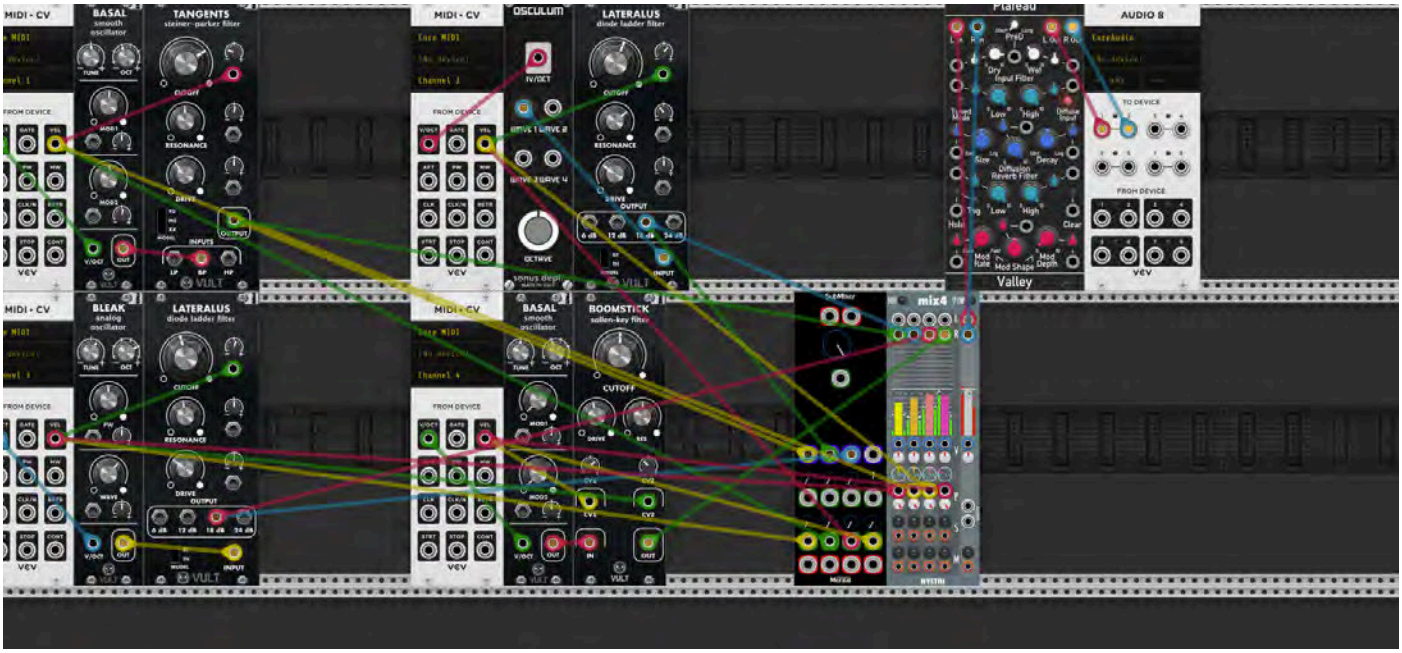


Figure 31- [Screengrab] This experimental patch represents the initial steps taken to import brain waves (Alpha, Beta, Delta, and Theta) into VCV. It consists of four oscillators and a mixer, which generates sound by sending signals into a Plateau reverb patch. The result is a deep and immersive audio experience.

Despite my efforts with the third-party synthesiser software, I remained dissatisfied with the generative output as it was atonal and disjointed and too removed from a representation of sleep and insomnia. Consequently, I sought to create pre-composed sound samples myself by playing the electric guitar and recording them through Logic Pro. This step involved a thorough understanding of the behaviour of each brain wave signal type via empirical research. To assist in this process, the Mind Monitor Application provided a free MS Excel Macro (Clutterbuck, n.d.) that generated a visual chart of the recorded data. A Macro is a pre-defined automated sequence of actions that can be imported into Excel or Word to perform a specific task automatically (Microsoft, 2021).

After evaluating the recorded data obtained from the Mind Monitor application, I selected a recording from December 2022, where I had undergone a period of deep sleep during that experiment. By analysing the amplitude of each wave in a section of the data that showed a higher concentration of alpha and theta waves, I created a soundscape to accompany the deep sleep section of the data (Figure 32).

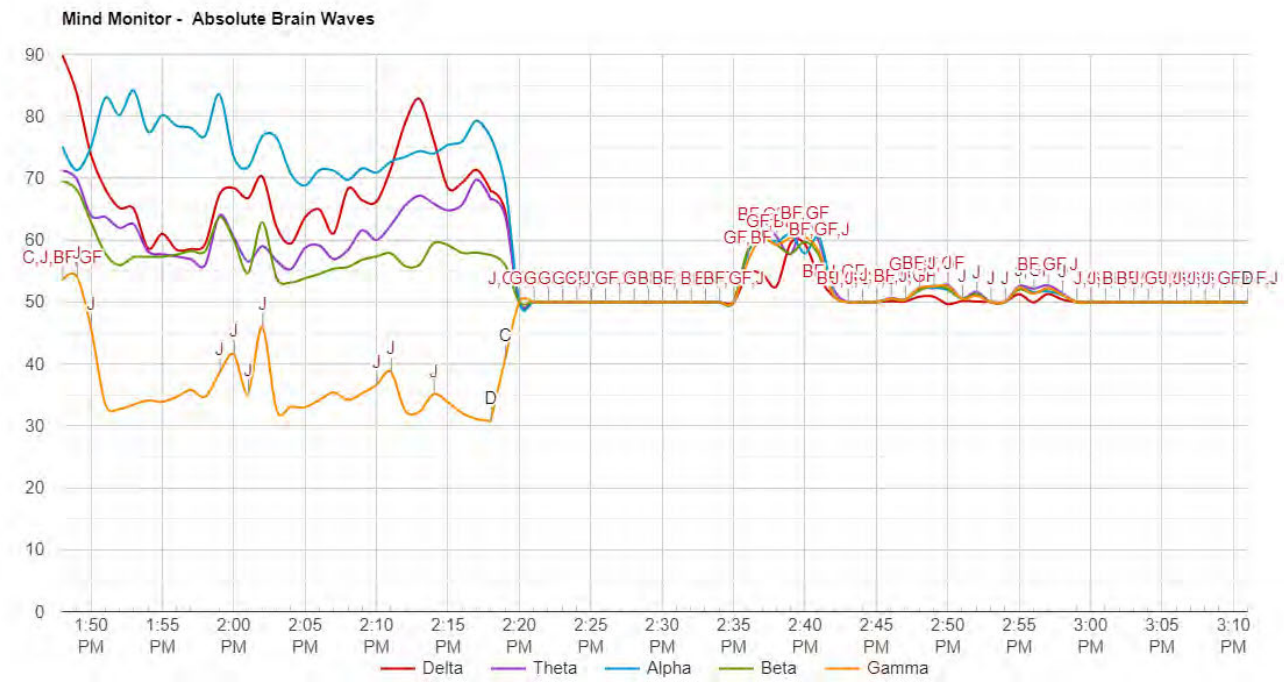


Figure 32- [Screengrab] This chart visually represents sleep data collected in December 2022 using Microsoft Excel. The flat regions indicate disruptions in sensor connections, due to movements during sleep.

The sound effects were crafted in a B minor scale, incorporating heavy use of reverb, delay, and distortion effects (Figure 33). The choice of the B minor scale in this project is subjective and based on personal experience. There is no presentable evidence that the B minor scale is calming or feels calm only to me. The objective was to design a sound symbolising the symbiotic relationship between man and computer, drawing inspiration from Bernard D. Geoghean's article "*An Ecology of operations: Vigilance, Radar, and the birth of the computer screen*" (2019). The Alpha, Delta, and Theta waves' soundscape was influenced by the auditory immersion qualities of the compositional structure and production of Hans Zimmer's *Interstellar* soundtrack (Zimmer, 2014). Conversely, the sound of Gamma and Beta waves, associated with high brain activity, was designed to be unsettling through distortion and vibrato on the guitar to echo disturbance through soundscape design.

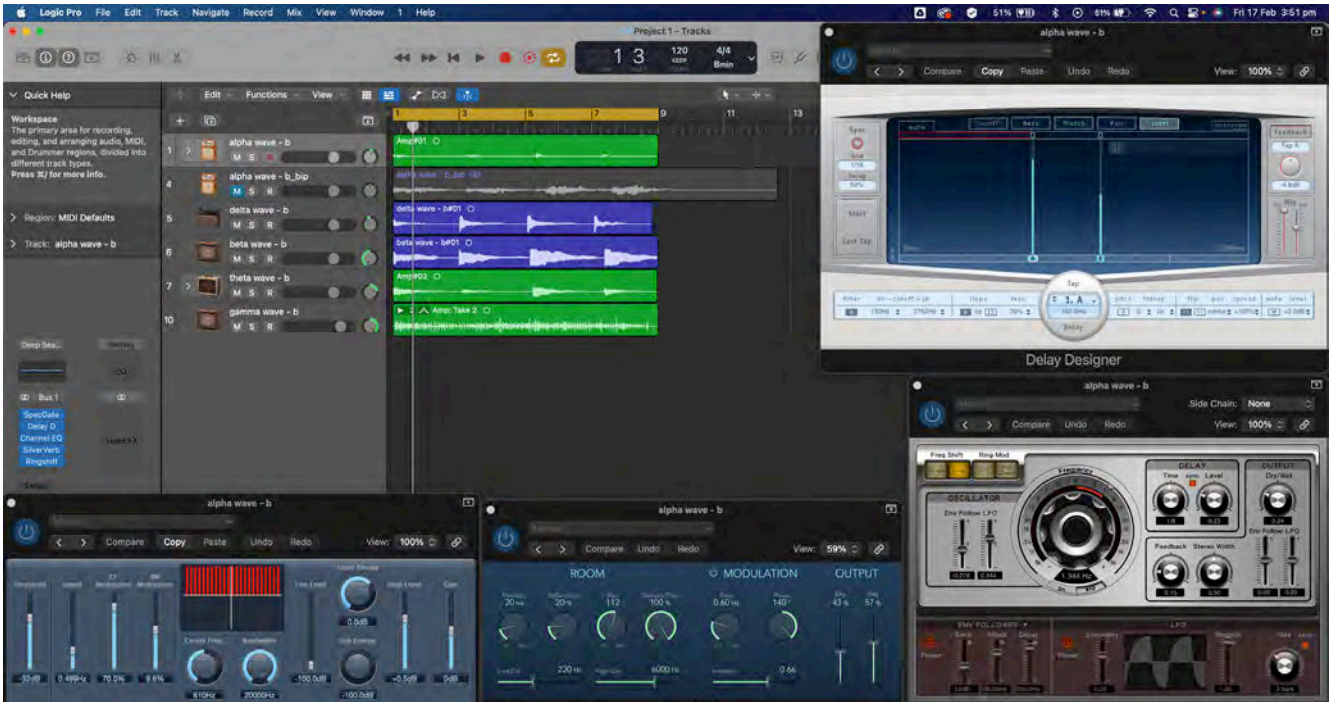


Figure 33- [Screengrab] A screenshot of the Logic Pro workspace displaying all the patches utilised in the process of sonifying Insomnia.

Integrating these soundscapes into TouchDesigner was a challenge, but it was eventually accomplished after researching and seeking guidance from Michela Ledwidge at MOD Studio (MOD Studio, 2023). The process involved using a simple mixer from TouchDesigner's built-in tools and individual inputs derived from the input value of each brainwave via Python coding within TouchDesigner (Figure 34). This digital implementation of a mixer in the software aligns with the concept of hypermediacy, referring back to Tucker et al,. in their article "*Media and Hybrid Media*" (2019), where the physical surface of traditional analogue mixers have been replaced by algorithmic logic to create a more fluid version of the same object (p. 9).

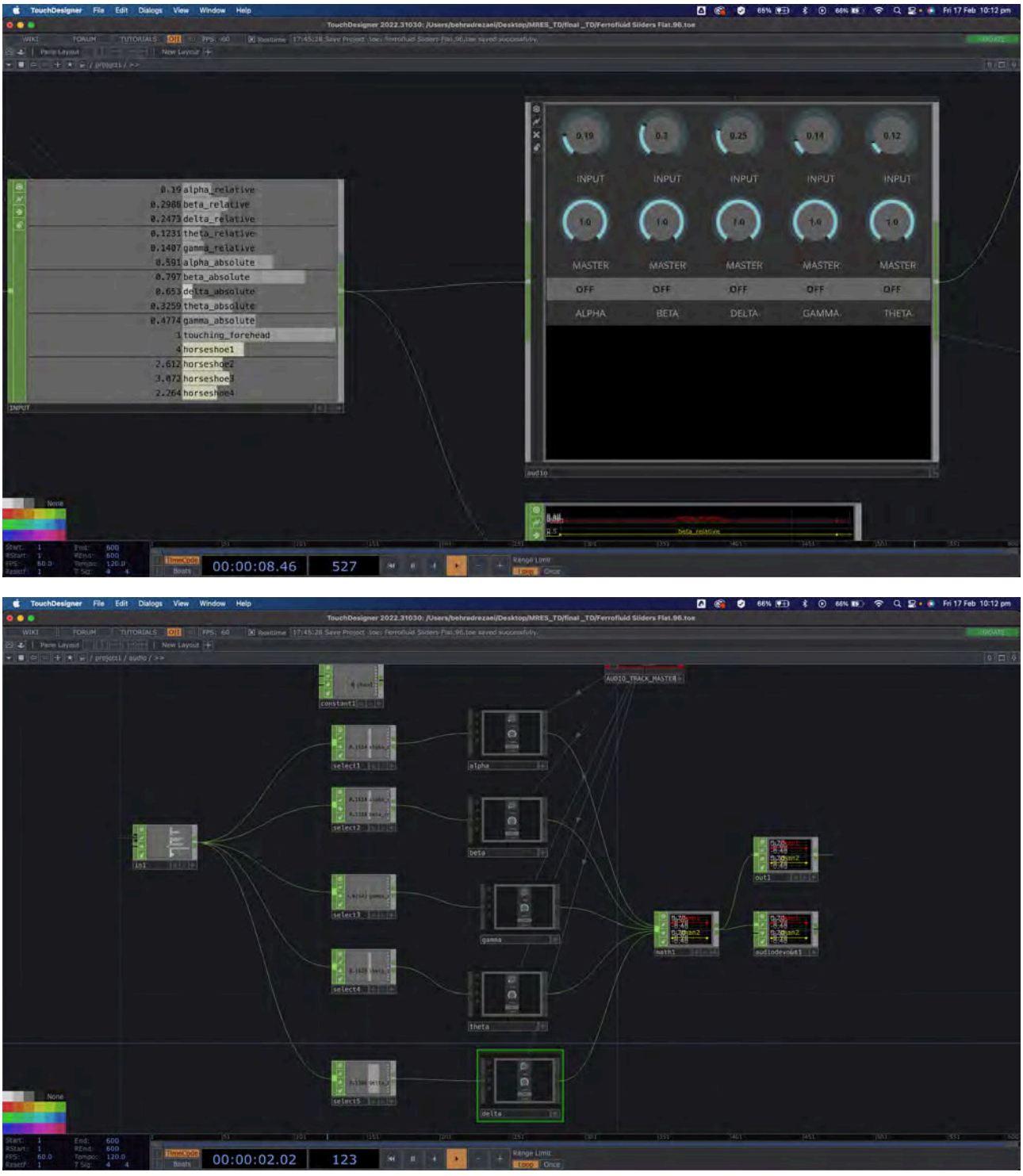


Figure 34- [Screengrab] The top image is a screenshot of the primary user interface of the mixer utilised in this project, featuring individual volume controls. The lower image showcases a screenshot of the underlying nodes connecting the incoming data from OSC to the respective UI elements.

4.8. Real-Time Archiving and Retrieving Data

Archiving and disseminating information is a crucial aspect of *Insomnia* as a hybrid media project. The key affordances of hybrid media as described by Manovich (2001, 2013), such as modularity, automation and transcoding, inspired the archival methodology utilised. It is hoped these iterations of *Insomnia* will allow the inscription and retrieval of my brain waves, including recalling the recorded data through the designed interface “and” flexible manipulation of video output/s. In other words, my own meta-medium of sleep analysis. The user interface of *Insomnia*, which is presented in this section, is a crucial aspect of the project and serves as a gateway for users to access and engage with the data (at this stage I am the subject and the user).

My initial approach to this component was to rely solely on a visual representation of data, where the outcome was limited to visual depictions. This meant that the data and outputs would only exist during real-time events and would lack the ability for independent existence from the software (Wright, 2008). In other words, my data and interface to it needed to become procedural—to record, document, reuse and remix It. Otherwise, my hybrid media system would not have the capability to flexibly retrieve and reproduce knowledge.

This challenge was approached by implementing Latour’s methodology of “cascade of cascades” in hybrid media, as utilised by Christianson (2020, p. 4). According to Christianson, Latour originally posits that a “cascade of cascades” refers to a sequence of interrelated events or processes that build upon one another, leading to a cumulative effect. Essentially, new innovations are constructed upon prior ones, resulting in advancements that shape and transform society. Taking this into account, I have integrated a new data selection hub layer into the original framework. In the updated design, depicted in Figures 36 and 37, my objective is to establish an interface that caters to both this study and future advancements. This interface provides two options for feeding data back into TouchDesigner via the OSC In Chop

(.chan): first, through a live data stream from Muse, and second, by utilising saved data from previous experiments. As a result, the modularity of the entire interface is significantly enhanced.

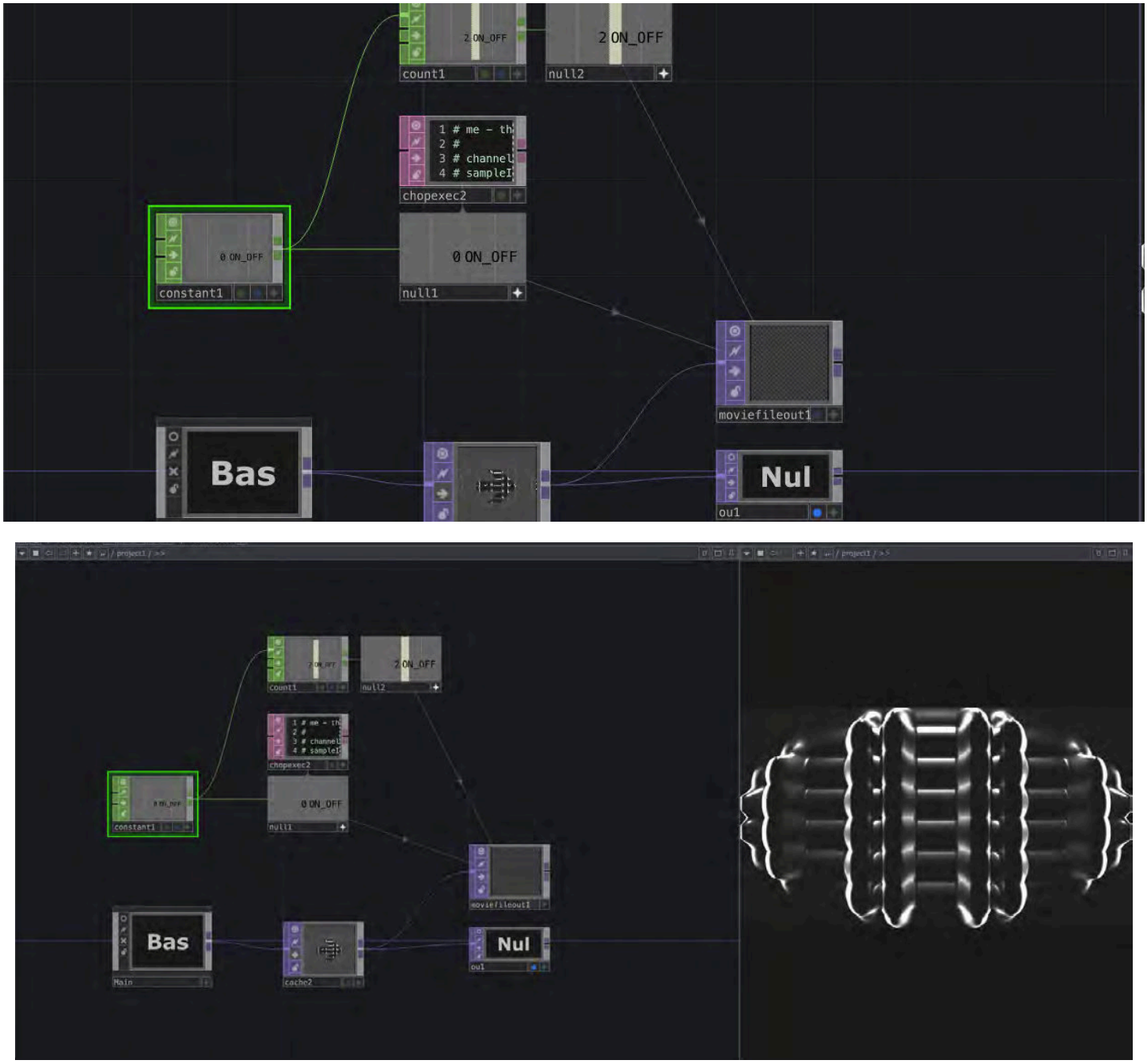
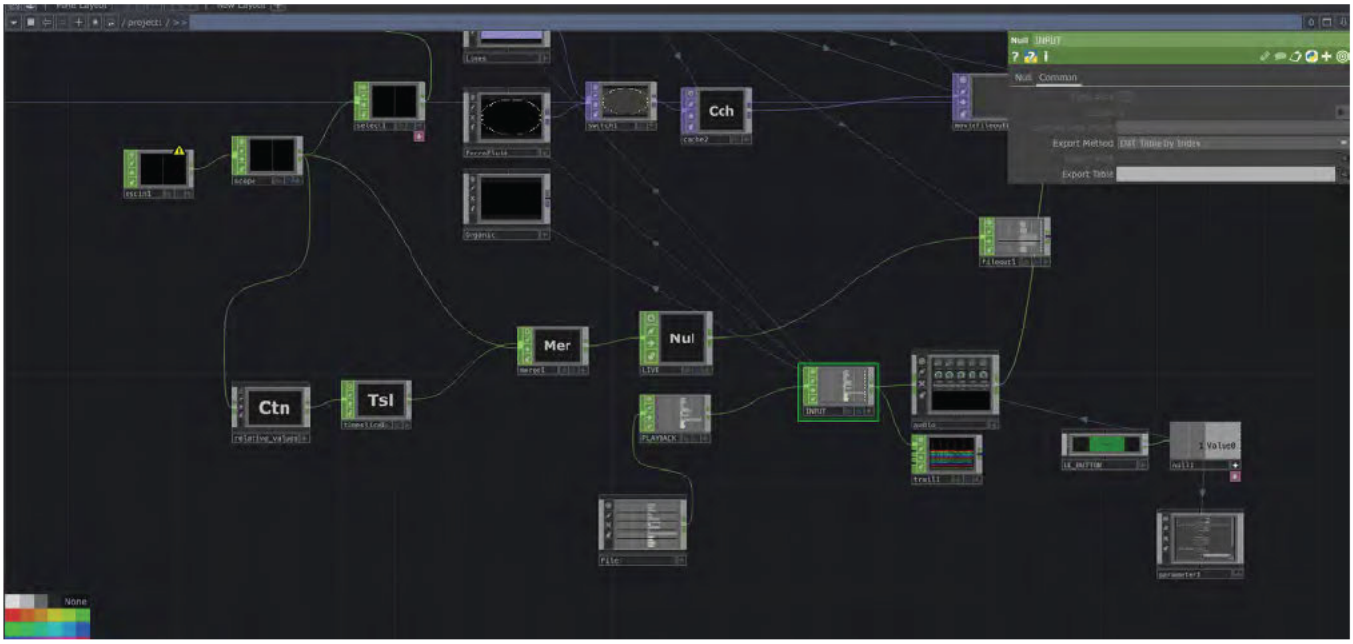


Figure 35- [Screengrab] This screen capture shows the earliest version of the Insomnia project. At that time, the output was limited to flat visuals. As a preliminary experiment, this approach did not incorporate a robust data archiving methodology, which prevented users from being able to retrieve the data for future use or modification.



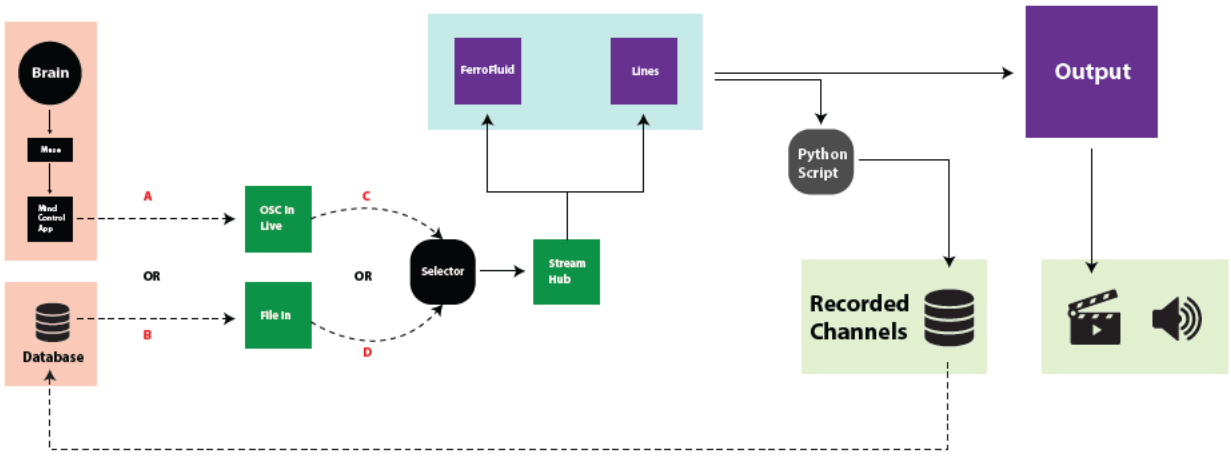


Figure 36- [Screengrab, Infographic by author] The top image is a grab of the node structure in the project, while the bottom image provides a graphical representation of the flow of processes throughout the project. The final output of the project generates a folder containing three different media formats: visual (.MP4), audio (.Wave), and recorded channels (.chan), which can be reused as input data in subsequent processing. It is worth mentioning that the Python Script utilised in this project was a produced in consultation with Michela Ledwidge of MOD Studio (2023).

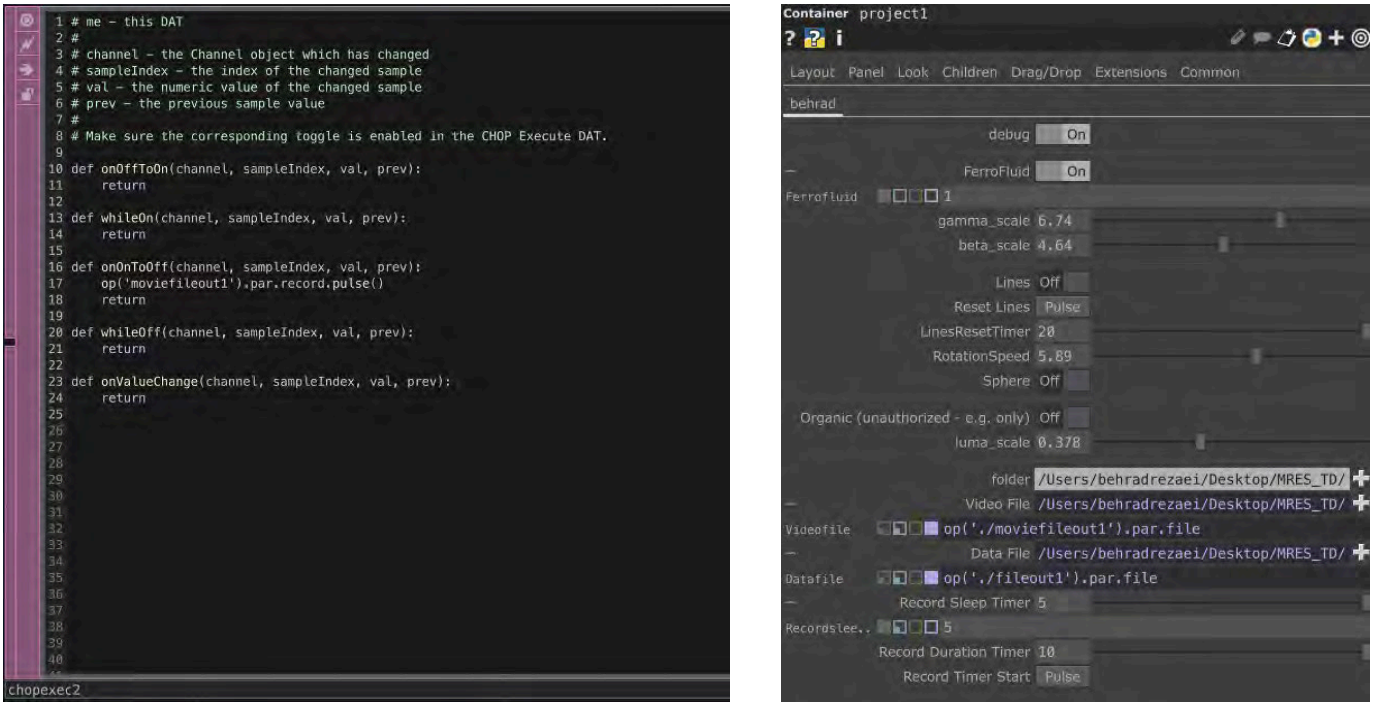


Figure 37- [Screengrabs] The left image displays the execution of a Python Script that facilitates data archiving through the user interface (right image) in an automated manner. This process aids in transcribing the data efficiently.

5. Exhibiting Insomnia

To view the virtual exhibition and review the catalogue statements of *Insomnia*, visit insomniart.art (or click here).

The long-term goal for *Insomnia* is to display the outcome as an immersive interactive experience design piece in a gallery setting. However, building the TouchDesigner *Insomnia* platform and testing its output potential through the development of a series of video pieces is the scope of this study. Additionally, the project started in the depths of COVID lockdown and planning worked to the goal of an online exhibition in website form from its beginning stages. This manoeuvre was to navigate the practical and administrative challenges of a face-to-face public exhibition. A virtual exhibition enables the work to be easily shared and accommodated for review. I have intentionally limited the inclusion of outcome images in this document to encourage readers to visit the *Insomnia* website. The website showcases the project's key data-driven dynamic features and video-based outputs, providing an engaging and interactive exploration of the project. By directing readers to the website, I emphasise the importance of experiencing the project, rather than examining static images in the present document.

6. Understanding Insomnia through Visuals and Data

6.1. The Journal

The journal, illustrated in Figure 38, was utilised to document the date, stage, and wearable materials, such as eyeglasses, that may have influenced the experimentation process. This logbook visualises the activities and sleep patterns, facilitating an understanding of the project's output and the connection between these activities and Insomnia. The journal comprises five headers, including date, type of activity, wearable materials, data collection, and the data qualification to be used in the experimentation, aiding in identifying the severity of factors impacting the study.

Furthermore, this journal highlights the four stages of the project's development. As seen, the data collected in the first three stages were not deemed suitable for the final experimentation due to initial experimentations with various platforms and modules. Additionally, wearable materials such as eyeglasses interfered with the Muse 2 side sensors, causing disruptions in data acquisition and visual generation. Although I aimed to input the data promptly after waking up, I sometimes forgot to do so due to the effects of Insomnia, resulting in approximately four to five missing experimentations from this logbook.

DATE	Activity / State of Mind / location	Glasses	DATA	Qualified DATA
2022/04/29	Preliminary data gathering through MUSE headband	Yes	No	☐
2022/04/31	Taking a short nap	No	No	☐
2022/05/03	Gaming on PS5	Yes	No	☐
	Version 2 / modifying TD variables			
2022/05/05	Listinening to music	Yes	No	☐
2022/05/06	Taking a short nap	No	No	☐
	Version 3 / modified CVC Rack			
2022/06/03	Taking a short nap	No	No	☐
2022/07/20	night sleep	No	No	☐
	Version 4 / Consultation with MOD			
2022/11/25	reading an article about politics / BBC news / recent UN human rights assembly / In bed	No	Yes	☑
2022/11/25	Reading emails and responding to messages sent through social media / At desk	Yes	Yes	☑
2022/11/25	Fixing software issues with my PC	Yes	Yes	☑
2022/11/27	Watching news online	Yes	Yes	☑
2022/11/30	Sleeping during night / struggling with sleeping	No	Yes	☑
2022/11/30	taking a short nap / deep sleep	No	Yes	☑
2022/12/01	taking a short na Sleep Difficulty at the begining	No	Yes	☑
2022/12/01	taking a short nap / deep sleep	No	Yes	☑
2022/12/01	Watching TV	Yes	Yes	☑
2022/12/03	taking a short nap / deep sleep	No	Yes	☑

Figure 38- [Screengrab] The logbook serves as a record of the date, stage of experimentation, and physical materials that may have impacted the process. The chart also displays the selected data collections utilised in this study.

6.2. Examining the Outcomes

The outcomes of this research project offer two opportunities for examination. The first opportunity is through the perspective of iterative artistic practice (Dixon, 2019). The second is through examining the interpretation of sleep patterns through data visualisation. To fully comprehend the impact of this study, it is necessary to consider these two avenues together to correlate changes within the audio-visual piece to reach a solid analysis.

Initially, the analysis of the outputs posed a challenge due to its monochrome scheme. However, in the final iteration of the study, I assigned red to represent Gamma waves and green to represent Beta waves as controllable variables to accentuate changes (Figure 39). This helped to distinguish between the waves associated with heightened awareness and a relaxed state. The interpretation of the visuals is primarily related to fluctuations in the Alpha wave. As the Alpha wave increases, the shapes become more symmetrical and prominent, and the red associated with Gamma decreases to a minimum. However, the green (Beta wave) can still be consistently observed due to my experience with Insomnia (Figure 40).

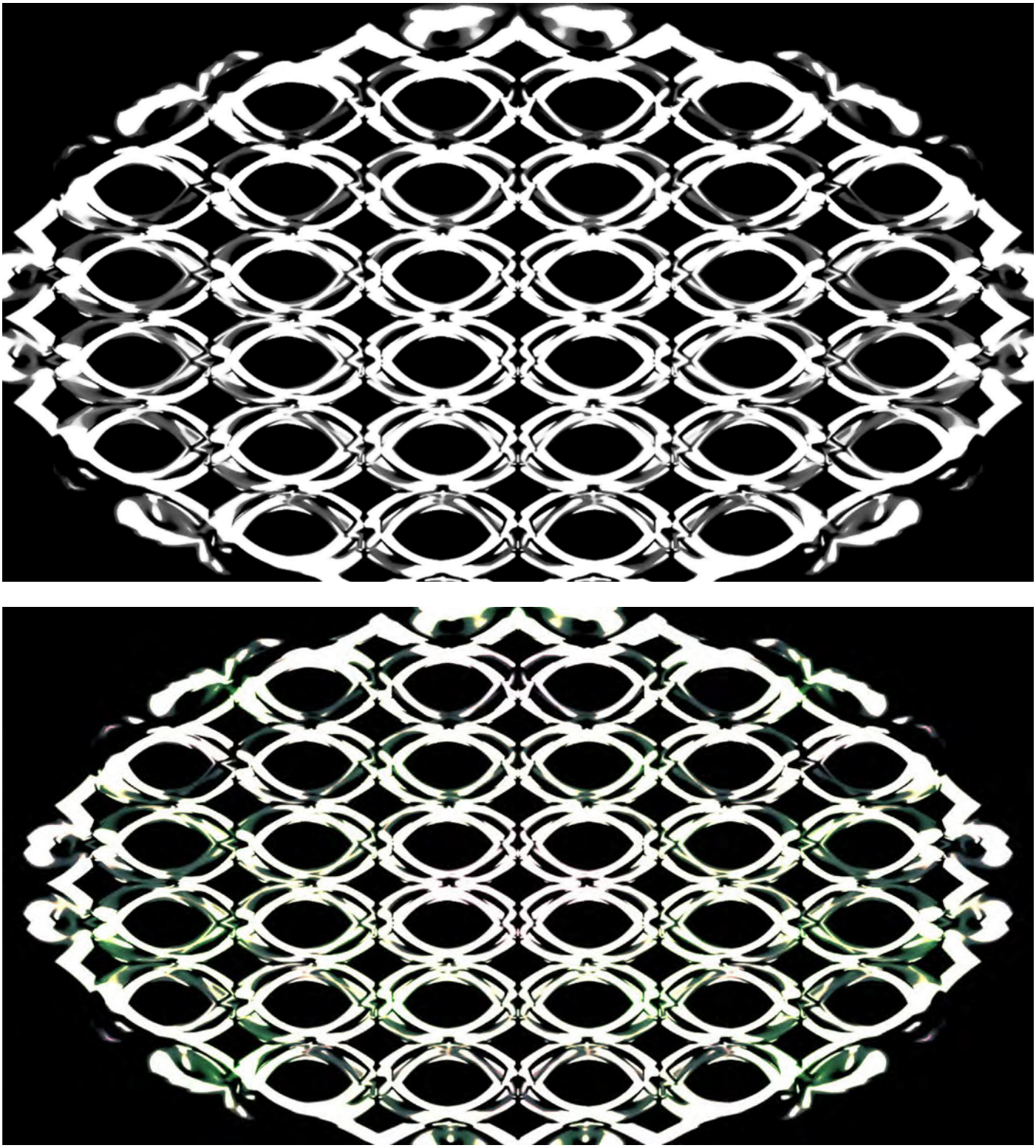
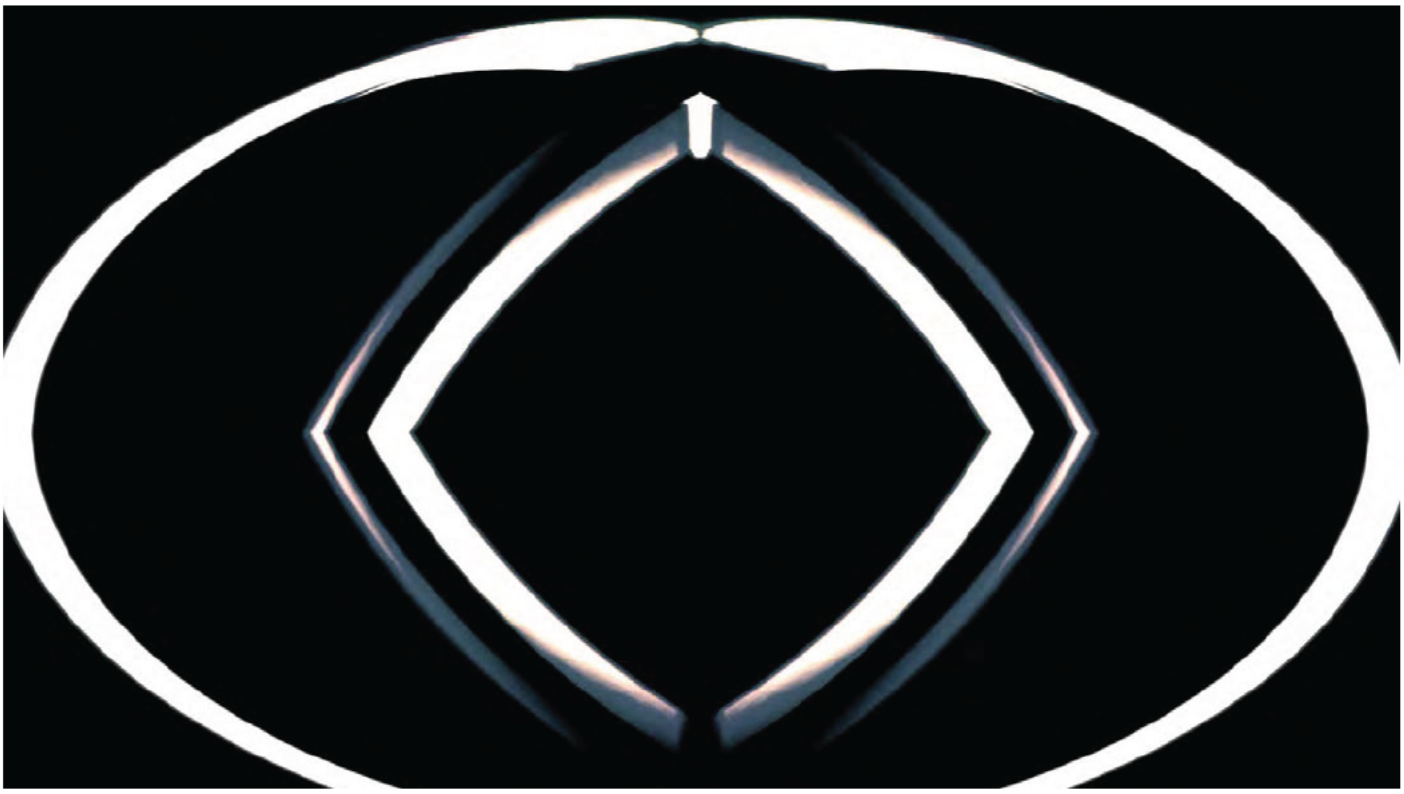


Figure 39- [Screengrabs] The top image is a product of the initial iteration of this study. As can be seen, the monochromatic colour scheme makes the image difficult to interpret. In contrast, the bottom image is generated through the final iteration of the study, which employs the saturation effect of green and red hues to emphasize the presence of Gamma and Beta waves. This enhanced coloration allows for easier interpretation and better visualization of the data.



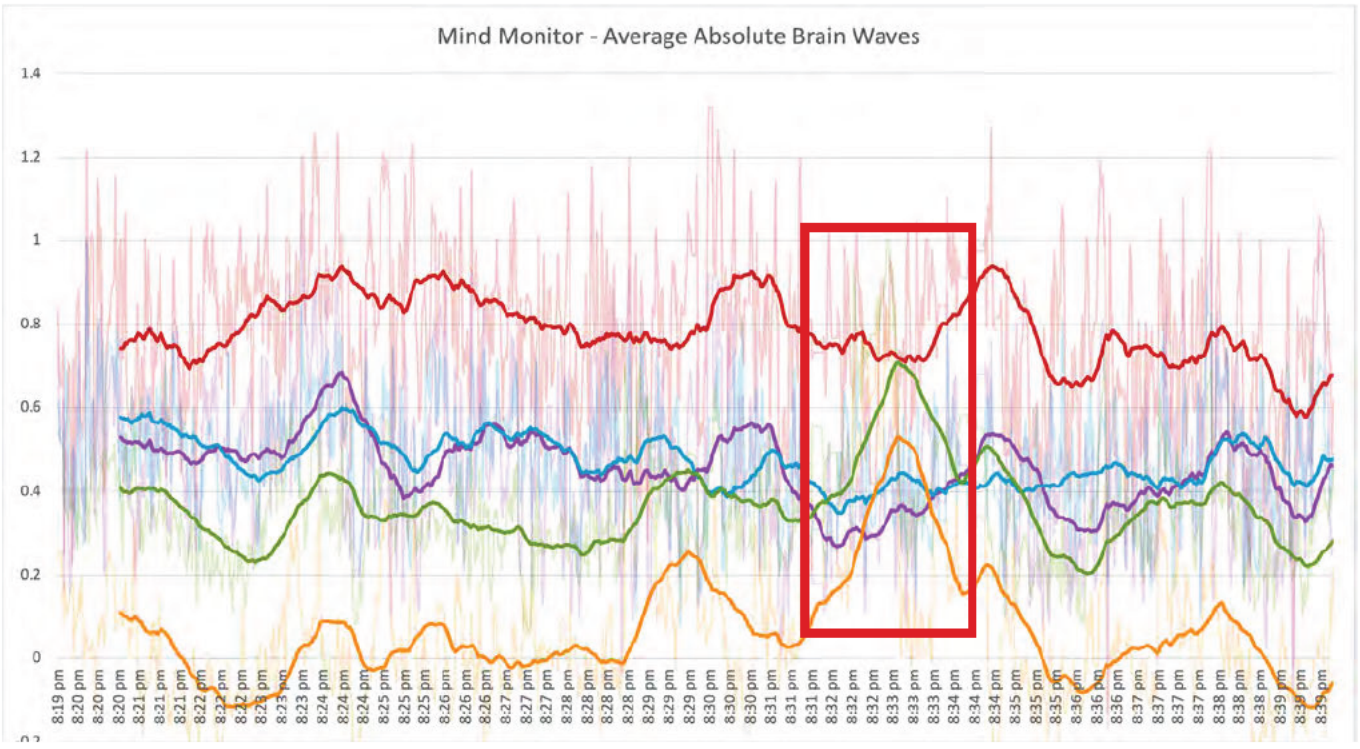
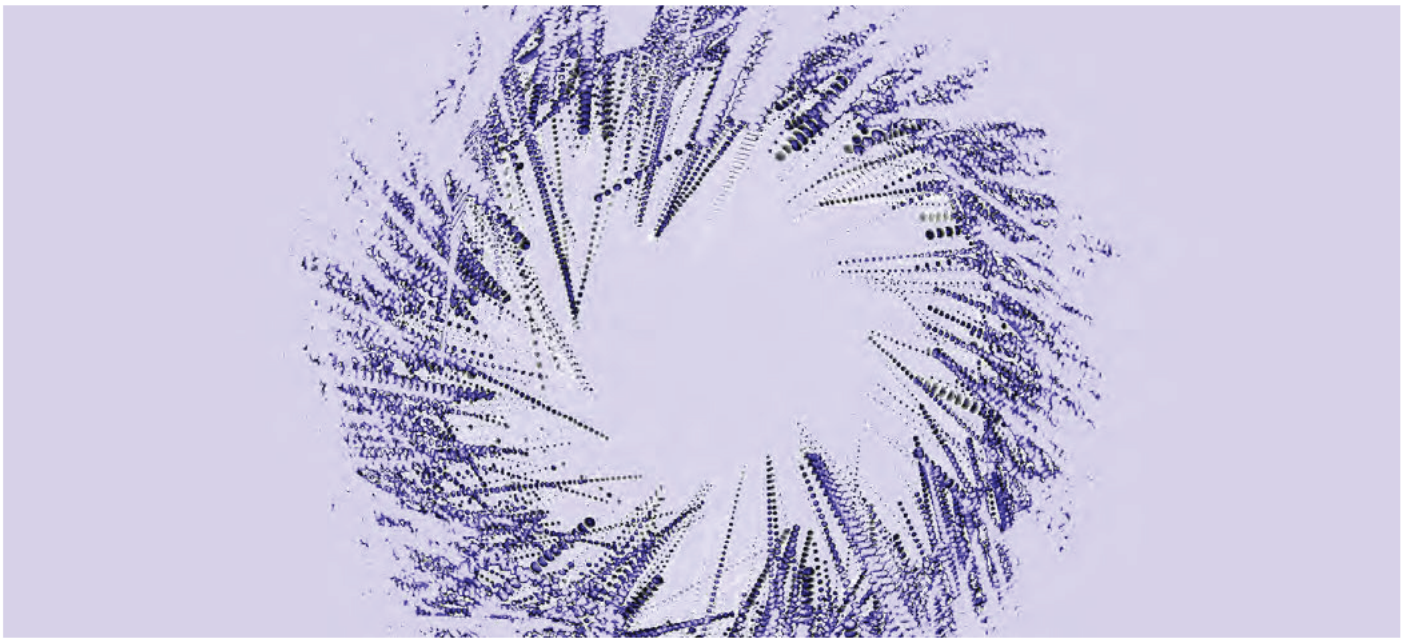


Figure 40- [Screengrabs] The top two images depict the outcomes of an experiment recorded on November 25, 2022, when I was attempting to resolve a software issue on my personal computer. Comparing these two images from Figure 35 reveals a dissolution of the symmetrical peaks or cantered images resulting from a low Alpha frequency. This alteration in Alpha frequency influences the positioning of the Ramp Node within TouchDesigner, leading to the formation of a flat surface. This phenomenon can be attributed to the heightened presence of Gamma and Beta signals (also presented as red and green shades), which suggest heightened alertness and cognitive processing, as indicated in the accompanying graph chart.

In contrast, the alternative aesthetic (radar) visualisation can only be comprehended within the realm of imaginary media (Parikka, 2012, pp. 41-60). This form of design draws inspiration from early radar systems and is a speculative form of digital representation. The final projection (Figure 41), generated entirely through TouchDesigner and brainwaves, presents difficulties correlating events with related data. The underlying reason for this difficulty may be the feedback loop that results in layering images and obscuring visual identifiers. Although, upon analysing various visualizations generated by this model, it can be hypothesized that the positioning and dispersion of the visualizations are significantly influenced by Gamma and Beta waves, given their role as position variables within the Geo operator. However, it is important to note that a definitive confirmation cannot be made at this point, as the Alpha waves in the system have been amplified using a noise function. Further investigation is required to validate the accuracy of this hypothesis in the context of the model's behaviour (Figure 42). In essence, this process is heavily influenced by Manovich's (2013) concept of media hybridization, where hybrid media integrates and transforms various artifactual media forms. As demonstrated in Radar modulation, this hybridization unfolds across all aspects of media materials and artistic expressions, including scale, colour, and position. This process ultimately fosters fluidity within the hybrid network, allowing for seamless integration and interaction among diverse media elements (pp. 161-184).

There are notable glitches in the outputs, which were caused by movements of the head that disrupted the connection between my body and Muse's sensors. The auditory aspect of this research primarily serves as an acoustic expression via the data. Audio does not offer a direct link between distinct stages of sleep patterns as it is influenced by all signals received through the BCI. Additionally, it is limited by my knowledge of Python scripting in terms of filtering sounds specific to a higher signal frequency. However, the mixer component design still represents a valuable feature for use in live performances to create various soundscapes. In conclusion, this experiment is intended for research purposes and aims to visualize my sleep patterns through generative art in an abstract manner. While it is not an empirical

or scientifically accurate representation of the data, it serves as a steppingstone in advancing our understanding of the role of hybrid media in the likes of science communication, engaging with large sets of data, or temporally challenging data. It is crucial to emphasise that this study does not have a medical foundation and should not be used as a reference for any biomedical research. The primary objective of this experiment is to gain a deeper understanding of my personal experience with insomnia and explore its impact through a creative audio-visual collection of work that engages with the affordance of hybrid media and media theory (sometimes quite literally, like recording my brain waves while reading media theory articles) (Figure 43).



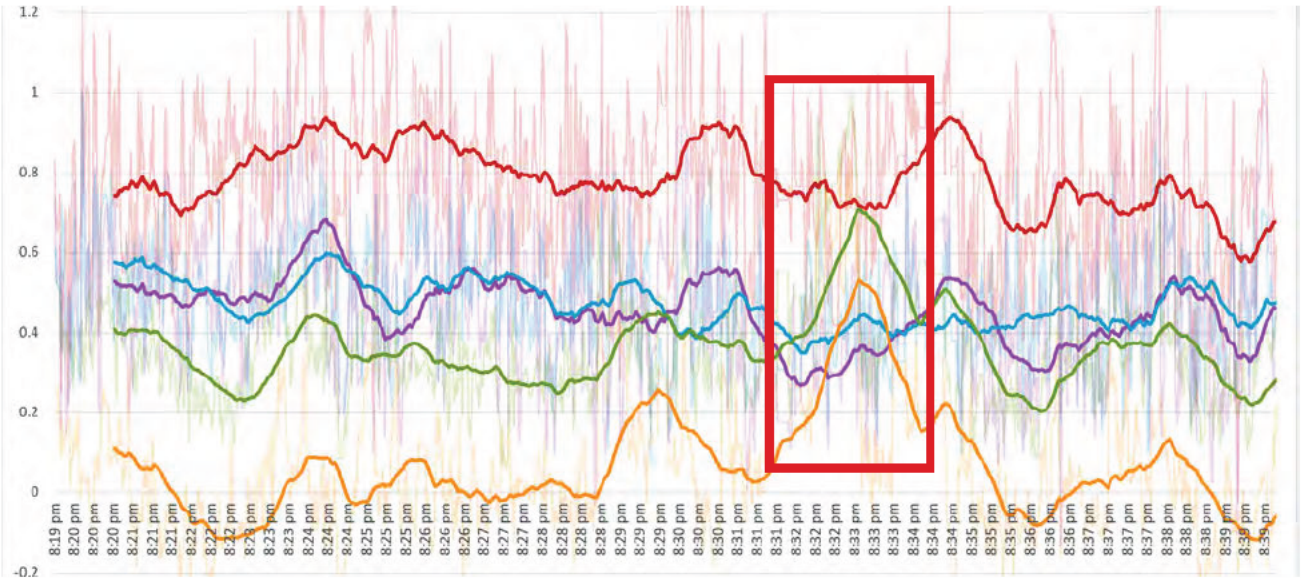
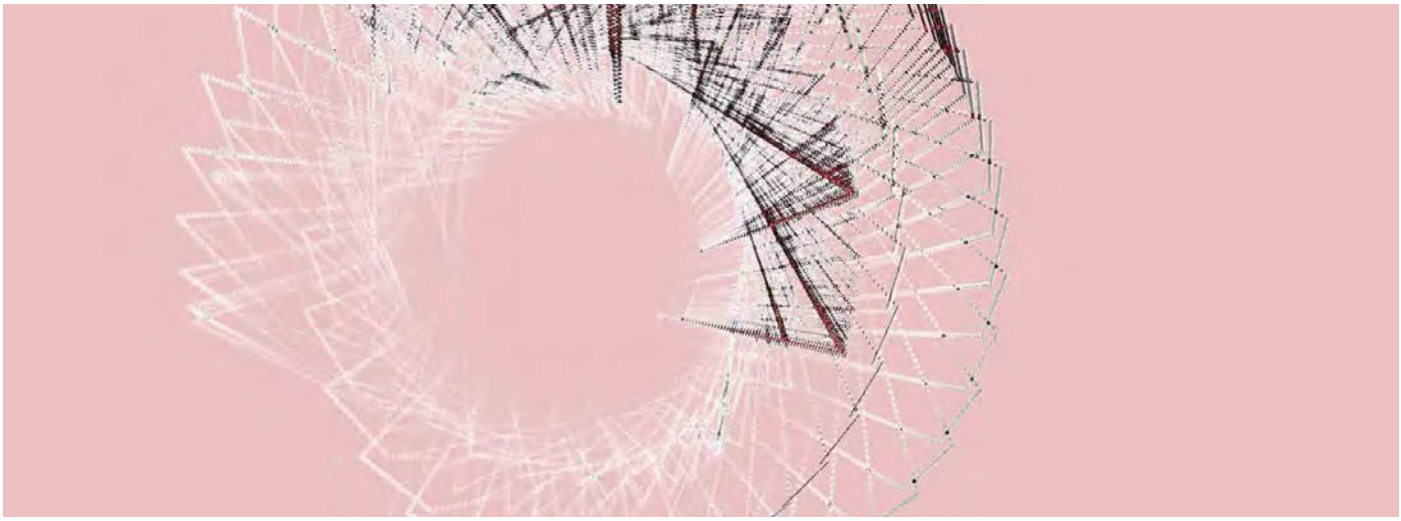
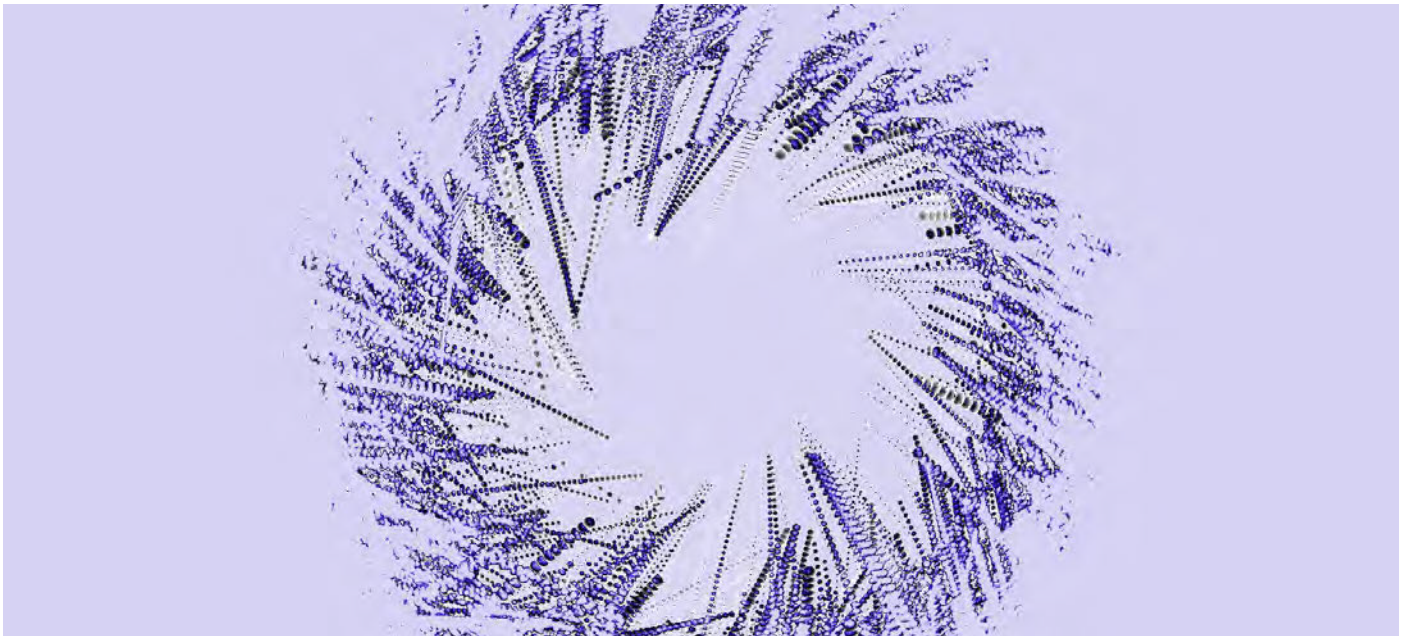


Figure 41- [Screengrabs] The top image represents the radar visualisation output generated using the same data as the previous one (dated November 25, 2022). Although the aesthetic is based on the same signals, it is challenging to interpret the sleep quality compared to the prior representation accurately.





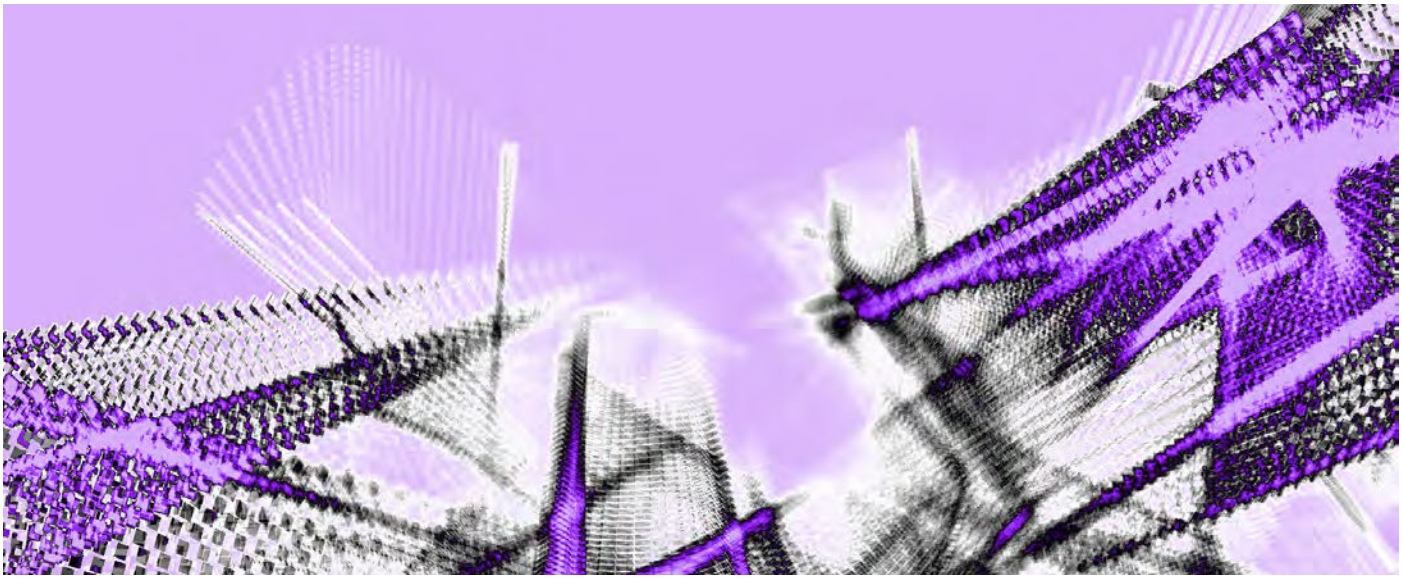


Figure 42 - [Screengrabs] The top image was generated during the initial stages of my sleep, with the graphic's formation and central gravity (centre point) originating from the top left corner. The middle image illustrates a visualization created during a relaxed mental state, where the central gravity is located at the centre of the canvas and semi-symmetrical patterns begin to emerge. In contrast, the third image was captured towards the end of my sleep, offering a different perspective on the visualization progression throughout the sleep cycle.

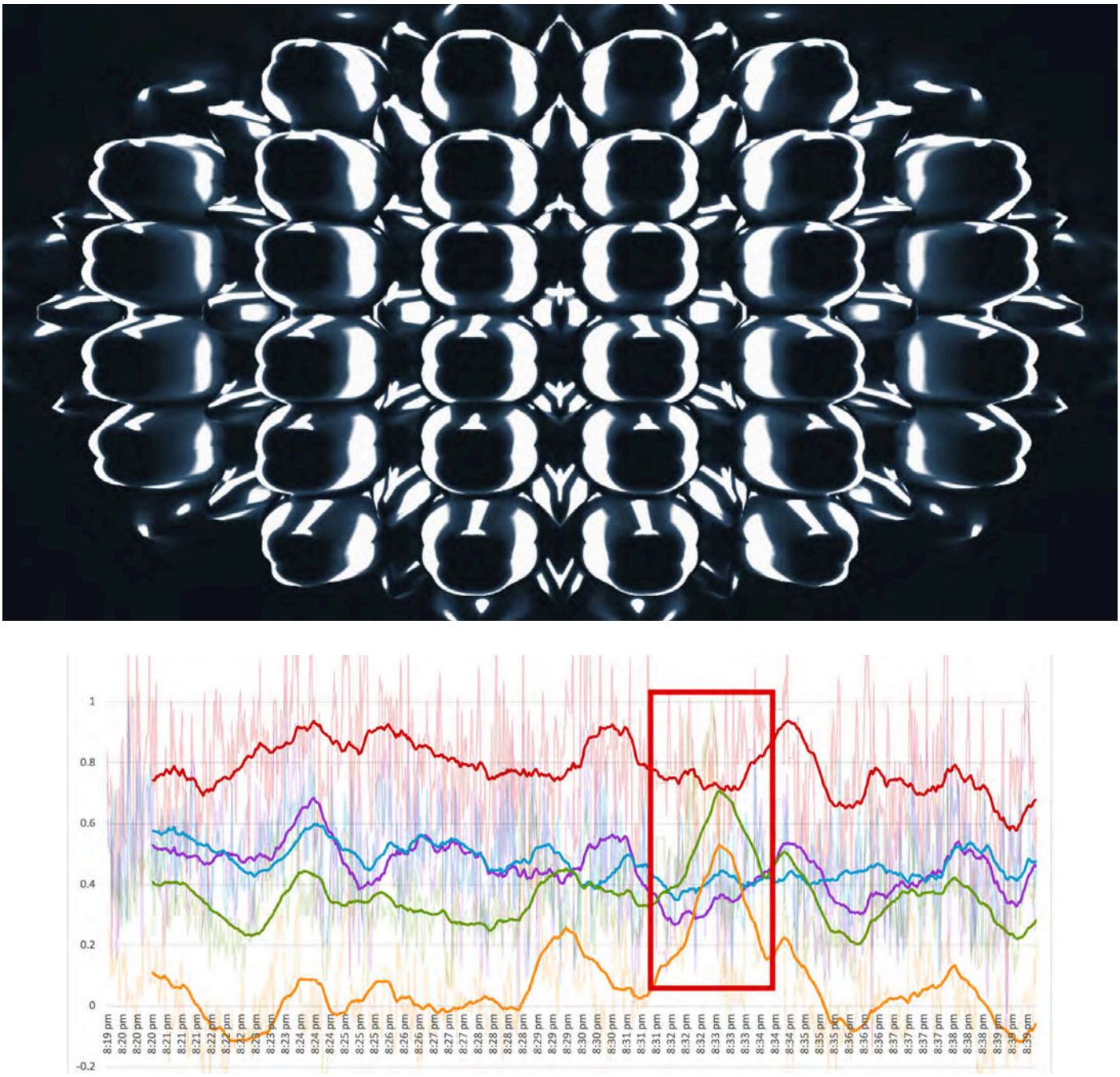


Figure 43- [Screengrabs] The top image represents the results of an experiment recorded on November 25, 2022, while I was reading an article in bed. The symmetry in the patterns observed in this image indicates a heightened amplitude of the Alpha signal (as depicted in the bottom chart). The green hues seen in the image indicate the presence of Beta signals. Based on this analysis, it can be concluded that during this experiment, my brain activity was in a calm state, characterised by a slower processing rate.

7. Obstacles and Future Developments

The development of the *Insomnia* project presented significant technical challenges in both software and hardware platforms. The initial phase involved a steep learning curve with the TouchDesigner software, which required a substantial time investment of six months to master. Moreover, compatibility issues with operating systems such as Mac OS presented challenges, which were eventually resolved through extensive online research and engagement with online communities. The selection and operation of Brain-Computer Interfaces (BCIs) was another challenge, as the majority of options were not readily available in Australia and required extensive online research and trial-and-error testing. In the future, the aim is to enhance the audio-visual representation of the data further and provide a more apparent real-time observation for the audience, which will require advanced skills in Python programming and sound design.

If the factual or empirical study potential of the project is to be pursued further in parallel with the speculative or expressive, the journal-keeping process needs improvement to establish a systematic approach to recording the experimentation process, which will aid in developing and refining the inquiry aspect of the research. Currently, the *Insomnia* project is emergent, based on the hypothesis of exploring the affordances provided by hybrid media for visual and data communication. Prospects of the study include aims to delve deeper into complex speculative hybrid media connections and channel crosstalk to expand the established platform and media understandings.

Without defining an additional methodology, it is important to note that the present study is inherently auto-ethnographical research, and future iterations of the project will move to testing with larger and more diverse sample sets to determine its generalisability.

8. Conclusion

The present study sought to explore the affordance of hybrid media in fostering innovative methods of communication within the fields of creative practice and associated research. The prime benefit of hybrid media lies in its ability to create fluid and dynamic communication channels through the convergence of various media forms (Manovich, 2021; McMullan, 2020). The *Insomnia* project aligns with principles of media studies by synthesising multiple media and cultural techniques through algorithmic logic to embody the concept of insomnia as a "mutable" object, as derived from Latour (2011, pp. 66-71). While this object's mutability depends on the immutability of data and cultural techniques collected through BCIs and the project's production methods, the process of bridging complex, intangible concepts through sensory outputs (Christianson, 2020) presents as the most prominent affordance of hybrid media. By conserving the agility of data as an immutable mobile and creating versatile sensory channels, complex topics such as scientific, social, and global issues can be shared and discussed in an accessible and engaging format (Paterson et al., 2020). *Insomnia* highlights the capacity of hybrid media to enhance human senses, our means of archiving and relaying data, and to expand our ways of knowing.

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