NARRATIVES OF OCULAR EXPERIENCE IN INTERACTIVE 360° ENVIRONMENTS

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Abstract

The purpose of this research project was to examine how immersive digital virtual technologies have the potential to expand the genre of interactive film into new forms of audience engagement and narrative production. Aside from addressing the limitations of interactive film, I have explored how interactive digital narratives can be reconfigured in the wake of immersive media. My contribution to knowledge stems from using a transdisciplinary synthesis of the interactive systems in film and digital media art, which is embodied in the research framework and theoretical focal point that I have titled *Cynematics* (chapter 2).

Using a methodology that promotes iterative experimentation I developed a series of works that allowed me to practically explore the limitations of interactive film systems that involve non-haptic user interaction. This is evidenced in the following series of works: *Virtual Embodiment*, *Narrative Maze, Eye Artefact Interactions* and *Routine Error* – all of which are discussed in chapter 4 of this thesis. Each of these lab experiments collectively build towards the development of novel interactive 360° film practices. Funneling my research towards these underexplored processes I focused on *virtual gaze interaction* (chapters 4-6), aiming to define and historically contextualise this system of interaction, whilst critically engaging with it through my practice. It is here that gaze interaction is cemented as the key focus of this thesis.

The potential of interactive 360° film is explored through the creation of three core pieces of practice, which are titled as follows: *Systems of Seeing* (chapter 5), *Mimesis* (chapter 6), *Vanishing Point* (chapter 7). Alongside the close readings in these chapters and the theoretical developments explored in each are the interaction designs included in the appendix of the thesis. These provide useful context for readers unable to experience these site-specific installations as virtual reality applications. After creating these systems, I established terms to theoretically unpack some of the processes occurring within them. These include *Datascape Mediation* (chapter 2), which frames agency as a complex entanglement built on the constantly evolving relationships between human and machine – and *Live-Editing Practice* (chapter 7), which aims to elucidate how

the interactive 360° film practice designed for this research leads to new way of thinking about how we design, shoot and interact with 360° film.

Reflecting on feedback from exhibiting *Mimesis* I decided to define and evaluate the key modes of virtual gaze interaction, which led to the development of a chapter and concept referred to as *The Reticle Effect* (chapter 6). This refers to how a visual overlay that is used to represent a user's line of sight not only shapes their experience of the work, but also dictates their perception of genre. To navigate this, I combined qualitative and quantitative analysis to explore user responses to four different types of gaze interaction. In preparing to collect this data I had to articulate these different types of interaction, which served to demarcate the difference between each of these types of gaze interaction. Stemming from this I used questionnaires, thematic analysis and data visualisation to explore the use and response to these systems. The results of this not only supports the idea of the reticle effect, but also gives insight into how these different types of virtual gaze interaction shape whether these works are viewed as games or as types of interactive film. The output of this allowed me to further expand on interactive 360° film as a genre of immersive media and move beyond the realm of interactive film into new technological discourses, which serves to validate the nascent, yet expansive reach of interactive 360° film as a form of practice.

The thesis is concluded by framing this research within the wider discourse of posthuman theory as given that the technologies of immersive media perpetuate a state of extended human experience – how we interact and consider the theories that surround these mediums needs to be considered in the same way. The practice and theory developed throughout this thesis contribute to this discourse and allow for new ways of considering filmic language in the wake of interactive 360° film practice.

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Author's Declaration

I declare that the research contained in this thesis, unless otherwise formally indicated within the text, is the original work of the author. The thesis has not been previously submitted to this or any other university for a degree, and does not incorporate any material already submitted for a degree.

Signed

Jeremiah Ambrose

17 January 2019

Chapter 1. Introduction

To begin this thesis, I would like to establish the territories from which my research derives. Initially my research interest pivoted around the field of interactive film, which is already a divisive mode of categorisation. Ranging from offline interactive films such as *Kinoautomat* (Činčera, Roháč and Svitáček, 1967), *Tender Loving Care* (Wheeler, 1998) and *Late Fragment* (Cloran, Doron, Guez, Lee and Serrano, 2007) I started to consider some of the issues with this format. This ranges from: branching tree narratives where the user decides at certain points which pathway to take (*Kinoautomat*), non-linear/linear systems that put the user in places where they have to explore and interact with items in order to trigger scene changes (*Tender Loving Care*) and loop-based interactive narratives that allow users to choose a particular character to follow in a scene (*Late Fragment*). In all of these contexts when I refer to interactive narratives I am alluding to the process in which a user navigates a connected series of events.

Starting with *Kinoautomat* I will provide a brief contextual overview of these interactive films. Often considered as the first interactive film, *Kinoautomat* was presented on a projector-based system that allowed viewers to collaboratively vote at certain points throughout the film, which in turn dictated which projector reel was displayed to them. *Kinoautomat* can be perceived as the first example of an interactive branching narrative structure being actively deployed in a cinema environment, but the interaction also depended on the film being suspended and user interaction being moderated by a performer. “STOP! yells the moderator. As he appears on stage, the film comes to a halt” (Činčerová, 2010) Such an approach was used to moderate the lack of real-time interaction in their system, but is also indicative of the shortcomings of adding user interaction to a film format that is typically pre-determined and linear. This is not a problem specific to interactive film and also persists into games that employ full-motion video (FMV). Most of these formats use symbolic interaction for users to make decisions that affect the outcomes of the narrative that they are engaging with. This typically stops video playback, whilst the system waits for a user response that decides the next scene.

Tender Loving Care is an example of what I'd call a film/game transmedia narrative hybrid as it existed as both a PC game and as an interactive film. This interactive film moves between non-linear game environments and film sequences that in comparison to the branching narrative of *Kinoautomat* appear to have a much more complex narrative structure. Instead of the single decision points used in *Kinoautomat* the interactive space is occupied by three different interactive components. The first of these is a series of questions that the moderator, Dr. Turner, poses to us concerning the narrative episode that has just concluded. After completing these we then move into a 3D navigational space, which allows us to explore the home where the film takes place. Stemming from this navigational space the user can opt when to leave and in doing so initiate a psychological test. This functions as an interactive tool that immerses the user in the patient experience. Although initial perceptions would present this interactive triptych as an expansion of the rudimentary single series of interaction points in *Kinoautomat*, on closer inspection it seems that although *Tender Loving Care* abides to a non-linear/linear narrative model, it suffers from the same immersive shortcomings as *Kinoautomat* due to its filmic elements being suspended.

Offering an alternative method to these approaches in *Late Fragment* the narrative structure is supported by a loop-based interactive narrative system. Instead of suspending interaction in favour of allowing the user to choose their narrative path, the film's narrative continues in a linear fashion until finally entering a loop[1] in one of the hub spaces. These scenes function as the nexus of the film, operating as a catalyst for interactivity, whilst also repeatedly dismantling the linear nature of the narrative generated by non-interaction with the film. Due to this the film is not structured around click versus non-click, but more along the lines of click versus prolonged click. However, although the loop is used as a mechanism for interaction it still depends on the symbolic interaction of the user pressing a button on a remote control, which I will argue in the next chapter does not offer the same level of immersive experience as perceptual interaction. Such experiences lead to the development of reduced engagement that restricts user experience.

[1] A segment of video that is continuously repeated from beginning to end.

In order to explore alternative methods to such approaches I commenced a series of iterative practical experiments developed in chapter 4 using a practice-based research framework that resulted from my initial inquiry. These explored different types of non-haptic interaction such as pulse sensors, galvanic skin response (GSR) and electroencephalogram (EEG). This research trajectory took me away from traditional film theory perspectives on interactive film and into the field of digital media art as a means of considering experimental practices in line with the technologies that are used to make interactive films. These experiments are as follows:

1. ***Virtual Embodiment*** – Creating a new type of outer body experience, whilst exploring the idea of the experience of the virtual-self becoming part of a narrative system.
2. ***Narrative Maze*** – Exploring an emergent narrative system built around unconscious interactions with a moving image database that users curate with hashtags.
3. ***Eye Artefact Interactions*** – Looking for a meaningful application of an electroencephalogram as a user-controlled interaction method.
4. ***Routine Error*** – Establishing an interactive 360° film practice.

Towards interrogating and exploring new types of interactive film my practical experimentation led me to develop an interactive 360° film practice, a workflow and practical output which encapsulates and informs my contribution to knowledge. This practice is essentially built around employing gaze interaction as a method for moving between different 360° film scenes. However, instead of using a visual overlay to represent this interaction my practice focuses on the creation of invisible interaction points that connect user interaction with the visual images of the film, rather than a user interface interrupting or stopping the video to ask the user a question that dictates narrative trajectory. It is here that I should state the unique relationship that exists between theory and practice in this thesis. Rather than being treated as separate research components, they are treated as intertwined elements in a shared system. Through my research a cyclical relationship is established, one where the practice inspires the theoretical research and feeding back into this system the theory inspires the development of my practice.

At this stage I would like to provide a brief definition of some terms referred to in my research questions, each of which will be expounded in detail over the course of this thesis. Firstly, when referring to virtual reality (VR) I am alluding to the creation of an artificial environment through the use of technology that emulates human perception, creating a space where people can be immersed and interact with different environments. Offering a more grandiose description of this in *Dawn of the New Everything: A Journey Through Virtual Reality* Jaron Lanier (2018, p.1) states that:

> VR is one of the scientific, philosophical, and technological frontiers of our era. It is a means for creating comprehensive illusions that you're in a different place, perhaps a fantastical, alien environment, perhaps with a body that is far from human. And yet it's also the farthest-reaching apparatus for researching what a human being is in the terms of cognition and perception.

In the next chapter I will elucidate some of the different ways this can be achieved, towards historically grounding 360° film as a type of virtual reality that is also rooted in art practice. When referring to 360° film I am alluding to any piece of film that can be viewed spherically rather than the flat perspectives offered by traditional film formats. However, there are a variety of ways of perceiving this, each of which I will name and discuss in chapter 2. After exploring a multitude of non-haptic interactions in chapter 4 my final experiment in this chapter combines gaze interaction with 360° film leading to the creation of a novel practice. Each of the practical experiments in chapter 4 explore different ways of perceiving the idea of a narrative system expanding on ideas discussed in chapter 3, but the interactive 360° film practice that forms my primary practical output leads to the creation of interactive narrative structures that alter previous perceptions on filmic interaction. Offering different varieties of spatial, temporal and object interactions I use these approaches to expand and develop my central research questions, which are:

1. In what ways can virtual reality, 360° film and gaze interaction contribute to the production and study of interactive film?

2. How can augmented interactive narrative structures create new experiences and what impact could these have on the future of film narratology, production and reception?

3. Where is authorial control situated in these interactive 360° environments?

4. How do audiences respond to gaze interaction becoming part of the interactive process?

The purpose of this research is to consider the development and use of interactive 360° film and the manner in which it contributes to the discourse of interactive film. Underpinning this research is the creation of a new filmic language that is not fixed to the conventions of film theory and is a process that informs the theoretical underpinning of every chapter in this thesis. The process of unpacking this not only considers new cinematographic possibilities, but also illustrates how such experiments stem from the moving image practices of which our current film conventions are built on. A prime example of what I am referring to here would be *The Big Swallow* (Williamson, 1901), which according to Michael Brooke is “one of the most important early British films in that it was one of the first to deliberately exploit the contrast between the eye of the camera and of the audience watching the final film.” (2014) This is not only considered to be one of the first close-up shots in film, but also uses this technique to transport the viewer, cinematographer and the camera inside the mouth of the protagonist. When referring to moving image practice in this context I am alluding to early experiments in film and photography that led to the development of cinematographic language. With this in mind, my practical experimentations should be viewed as a means of exploring new narrative possibilities in a field more suited to experimentations akin to the origins of cinema, rather than directly applying the established conventions of cinema to these new mediums. Only then can we begin to discover the potential of interactive 360° film as a form of creative practice.

To provide a brief outline of this thesis I start the first chapter by providing a history of virtual reality as it relates to 360° film. Given the complexity of these two interconnected mediums I establish a research framework that promotes

emergent experimentation (meaning to develop concepts where the outcomes are not wholly apparent from the outset), whilst providing a direction to scope my research. This model is inspired by cybernetics, which forms a key part of my interpretation of a medium that depends on the close synthesis of human and machine to achieve the illusionary space referred to as virtual reality. Once the framework is established I migrate into the next chapter where I use this framework to consider where narrative is situated in the wake of such systems. Exploring interaction paradoxes, I address a variety of interconnected fields in an attempt to unpack such issues, but more importantly I use these contestations to pursue alternative interaction methods inspired by Myron Krueger's promotion of perceptual interaction. This is a primary output of his concept of *responsive environments* "which perceives human behaviour and responds with intelligent auditory and visual feedback" (1977, p.423) and connects with his practice-based research using *Glowflow* (1969), *Metaplay* (1970), *Psychic Space* (1971), *Maze* (1973) and the culmination of this work *Videoplace* (1974). In this chapter I also consider user agency in relation to interactive digital narratives and present an alternative collaborative process that doesn't favour the designer, machine or user in the interactive process, instead viewing them as part of a collective system that propagates emergent experiences.

In the next chapter I use the *Cynematic* framework that I establish to begin my practical experimentations, which takes me through a variety of phases that eventually funnel my practice and consequentially my theoretical considerations into interactive 360° environments that use the gaze as the primary method for user interaction. This framework operates as a portmanteau of cybernetics and cinematics, which is a central idea that will be elucidated in the next chapter. For now, it is best to consider the cinematic component as a playful embodiment of or pertaining to or characteristic of cinema.

It is here that I should state that through these methods of iterative experimentation the gaze becomes the key focus of this thesis. Developing my work around this novel and cutting-edge area of research I provide a historical contextualisation of this method of interaction that complements the accompanying practice. The next chapter focuses on the

aesthetics of interaction referring to the overlays that are used to represent a user's gaze as sites that directly influence the experience of these works. Using qualitative and quantitative approaches I not only validate this assumption but use the results to formulate a perspective that runs counter to the idea that interaction is something that inhibits narrative immersion. When I refer to narrative immersion I am alluding to a state of deep mental involvement in the narrative. I also use this data to further develop a parallel history of film that includes the reticle[3] (Figure 57).

The final chapter of this thesis explores the narrative hybrid of linear/non-linear interaction that I developed for *Vanishing Point* (Ambrose, 2018). This type of interactive narrative system not only promotes the 360° loop as a site for fluid interactions, but makes the loop part of the interactive system. Combining this with transitions between linear and non-linear scenes that also fluctuate from flat and 3D perspectives illustrates a variety of additional filmic considerations, such as; the dimensionality of the screen (explored in chapter 2) and the synthesis of different types of narrative systems (introduced in chapter 3). This final piece of practice also coincides with the cyclical methods propagated by the research framework that underpins this thesis. This final chapter also provides a means to position my research framework within the wider concerns of the posthuman condition. It is here that I should state that I don't align with human-centric discourses nor do I view the conversations I'm having as technophilic exchanges promoted by the evolutionary qualities of transhumanism. Instead I favour an approach akin to the following statement from Katherine Hayles:

> I view the present moment as a critical juncture when interventions might be made to keep disembodiment from being rewritten, once again, into prevailing concepts of subjectivity. I see the deconstruction of the liberal humanist subject as an opportunity to put back into the picture the flesh that continues to be erased in contemporary discussions about cybernetic subjects. (1999, p.5)

[3] The reticle is best defined as a visual overlay – used as a sighting mechanism to help users aim their line of sight.

In other words, I align with the idea that information technology does not function as a replacement to the body, but as an extension of it. However, forms of immersive media are being incorporated into everyday life and as part of this significant transition require extensive critical reflection. Considering this, I prefer to position my practice as sites that explore forms of perceptual interaction and as types of immersive media. Such an approach can also be used to reflect and evaluate on how these technologies are changing human experience, a process already initiated in *Experience on Demand: What Virtual Reality Is, How It Works, and What It Can Do* (2018) where Jeremy Bailenson looks at its potential as: a training tool to enhance performance, a recovery method for traumatic experiences, a way to enhance pedagogy and finally as an empathy machine.

When I embarked on this project my primary focus was on developing new forms of practice that augment the potential of interactive film. The majority of my research has pivoted around unpacking and providing a theoretical framework for contextualising the outcomes of my practice. From here we can begin to consider new ways of looking at immersive media and the technologies that surround forms of interactive 360° film practice.

Chapter 2. The Art of Immersion: From Panoramics to 360° Film

In this chapter I explore the evolution of the idea of the all-encompassing image. Using panoramic practice as a site to initiate this conversation, I will then proceed to delineate this history in a manner that navigates a history of virtual reality applied to 360° film. Early examples of circular panoramas align to this via external installations (Figures 2-4), but the arrival of stereoscopic vision and head-mounted displays (HMDs) heralded the development of individual viewing experiences. Alongside these immersive environments was the development of cinematic camera movement practices, which formed the basis of traditional cinematic language. However, cinematography would eventually also become a user-controlled system via the head tracking established in conjunction with HMDs. From here, I discuss the different spatial relationships that derive from internal and external panoramic practice. Building on Oliver Grau's (2003) conversations on screen symbiosis I develop six categories to determine the different screen states that derive from 360° practice. Framing my conversation in the most immersive of these categories (HMD 360° all-encompassing view) I then elucidate how movement is emulated in 360° in comparison to experiences that are typically referred to as virtual reality. To unpack and explore the position of 360° film in relation to the concept of VR I look at Michael Heim's philosophical breakdown of the different ways to perceive the idea of VR (1993). Considering this in relation to 360° film I demonstrate that this is a form of VR due to it operating as a form of cybernetic exchange that synthesises human and machine to create immersive internalised experiences. Throughout this discourse I allude to the conflation of human and machine, but dealing with this directly my final subchapter establishes a framework that functions as a guide for the development of my creative practice, whilst also providing a theoretical underpinning that propagates the systems that underpin a practice first formalised by Robert Barker in 1767. What I am referring to here is the development of a framework that will allow me to extend Barker's idea of the panorama from a concept derived from the world of art into a practice positioned at the cutting edge of contemporary interactive digital media art.

It is first necessary that a history of VR that coincides with 360° film is examined. As the practice developed in this thesis is discussed in the coming

chapters, the relevance of framing it in this manner will become more apparent. Prior to exploring new ways of interacting with moving image it is first useful to establish a contextual overview of 360° film and its interwoven relationship with VR. It should be noted here that I am not trying to present a categorical history of HMDs nor am I trying to define a definitive timeline of VR, rather I am using key points in a timeline of immersive media to illustrate the conflation of cinematic movement and panoramic practice to cement the idea of an expanded framework for interactive film that exists beyond the confines of traditional narrative.

In terms of viewing platforms, I am referring to Google Cardboard/Daydream, Gear VR and Oculus Go as the dominant HMDs that permit a mass use of an entry level VR experience. These arguably promote isolating, but highly immersive visual experiences that transcend Robert Barker's (1796) cylindrical envisioning of the canvas into a spherical rendering of the screen. The idea of the all-encompassing image is now a portable and more accessible reality, but little thought has been given to the ways this has and will continue to transform the landscape of film. In Oliver Grau's (2003, p.3) *Virtual Art: From Illusion to Immersion* he queries the nature of virtual art, when he states that "the suggestive impression is one of immersing oneself in the image space, moving and interacting there in "real time", and intervening creatively". From the outset this interpretation of virtual art suggests that interaction is a key component from both a conceptual and a practical point of view when considering immersion orientated media spaces. To this end I suggest that interactive 360° film is not just an inevitable technological outcome, but is fundamentally intertwined with the nature of how we interpret virtual art practice. There are many points of origin when considering VR, however the benefits of creating a timeline that stretches from the cave paintings of Altamira, Cluvet and Lascaux to the countless number of contemporary practices is not of merit to the primary discourse of this thesis. For this reason, I align with Grau's (Ibid., p.5) viewpoint that virtuality should not be interpreted as an "anthropological constant" and instead adopt a perspective where it is embodied when "the eye is addressed with a totality of images". My approach starts with the idea that VR is an evolution of panoramic paintings and since then has conflated with a plethora of mediums (and mediations), including: science fiction, military simulation,

viewing technologies, Heilig's Sensorama, surveillance research, real-time human-computer interaction, interactive digital media art, cinema and gaming.

Another point of note is that alongside the development of virtual reality is the evolution of spatial audio, which refers to audio practices that are not heard in mono. In particular ambisonics perfectly compliment 360° film as they allow for a full 360-degree soundscape that corresponds with a user's head movements. Like many of the points of historical contextualisation in this chapter spatial audio is not a new process and instead has evolved alongside VR and is now seeing renewed vigour through technological developments in the field of immersive media. Given the scope of this field it will not be addressed in this thesis and instead I will be using stereo audio in my work. However, for some additional context and reading I would recommend *Immersive Audio: The Art and Science of Binaural and Multi-Channel Audio* (Roginska and Geluso, 2017), *New Realities in Audio: A Practical Guide for VR, AR, MR and 360 Video* (Schutze and Irwin-Schütze, 2018) and *Spatial Audio* (Rumsey, 2001). There are many other points intersecting this area such as interactive audio (Collins, Kapralos and Tessler, 2017) and audio narratology (Mildorf, 2016) – all of which give a sense of how expansive these fields are.

Looking towards a definition of what VR is I use Michael Heim's *The Metaphysics of Virtual Reality* (1993) as a way to demonstrate its complicated and inherently vague nature as well as conceptualising 360° film as a type of VR. To outline the journey of my argument I present the conceptual framework which I will be using to develop a practice that addresses the new film topographies made accessible through the experimental convergence of 360° and interactive film. Basing this around ideas of perceptual interaction that will be expounded in the coming chapters I establish a method for exploring the research questions central to this thesis.

I conclude by drawing a comparison between *T_Visionarium II* (Shaw et al., 2006) and other panoramic practices discussed throughout this chapter. Given that my practice eventually conflates interactivity and 360° film into a hybrid genre, I think that it is pertinent to my research that this practice is framed by an approach to VR and 360° film that integrates, rather than alienates such

mediums. The central discussion should be about the impact such forms could have on the future of film narratology, production and reception. Such an approach avoids perpetuating the idea of fixed forms of virtual reality that are counter-intuitive to its potential as a medium. Considering this, could it be considered that the restrictive nature of placing VR into the genres of gaming or film limits the potential for the development of new creative practices? Such a query is unpacked through the emergent outcomes discussed in this thesis.

2.0. Panoramic Perspectives

Figure 1 – Detail from "A Thousand Li of River and Mountains" hand scroll in ink and colour on silk. (Wang, 1096-1119)

If we are to view the scope of VR as a means of creating the illusion of presence, then the earliest attempt at creating this can be perceived in panoramic paintings. However, an exact starting point for this process is difficult to pin point. The idea of capturing perspective in a way that facilitates presence is something that existed long before there was a term to define it. Looking to certain Chinese scrolls (Figure 1) we can see artist's engaging with the idea of a complete perspective, through a flat image. Developing this into a cylindrical format the word "panorama", defined by the Oxford English Dictionary as coming from Greek pan ("all") horama ("view") was coined and patented by the Irish painter Robert Barker in 1767. According to Benosman and Kang (2001, p.5) Barker's "patent described an artistic format of paintings that practically surrounds the viewer". To this end it is historically acknowledged that the concept of the panorama stems from the realm of art, whilst the philosophical idea underpinning Barker's patent has continued to expand via the technologies of immersion and is currently embodied/augmented by the mediums of VR and 360° film. The correlation between contemporary practices and Barker's patent is exemplified by the description of the panorama as a "new medium in which,

from a central raised platform, one could view 360-degree representations of any place in the world on a scale of 1:1." (Oleksijczuk, 2011, p.1) It should be noted here that there are different types of 360° representation and in this early form it is being referred to in a cylindrical context. The scale of this practice illustrates a concern with recreating reality as perceived from the perspective where the painter captured the panoramic from. Rather than framing a window into an alternative reality (such as photography and film practice) the panorama operates as a spatial precursor to the representational concerns of 360° film/photography and the VR technologies that allow these mediums to exist. In Erkki Huhtamo's seminal text *Illusions in Motion* (2013) he refers to how VR's cyclical return via technological development has promoted the research of immersion. This is explicated when he states that "the virtual reality craze that erupted around 1990 also inspired [...] research links between current and earlier forms of artificial immersion." (Ibid., p.xvii) A prime example of this is framed by his excursion to the Swiss Museum of Transport and Communication where he saw Ernst A. Heineger's *Swissorama* (1984), which Lukas Piccolin (2004) describes as "the world's first large format seamless 360° camera and projection system." Such a system represents the evolution of Barker's patent, whilst consolidating the ideas of both the static and the moving panorama that I am about to explicate (Figure 2). It also serves to illustrate the connection that exists between contemporary immersive practices and the previous forms that paved the way for these developments. Drawing on such links I think it is vital to adopt a similar viewpoint when researching contemporary media landscapes. In considering these elements I intend on presenting film as inherently experimental and as a process that runs parallel with the history of immersive media. Building on this in the next chapter I will be looking at expanded conceptions of narrative in the wake of the recent technological convergences that facilitate enhanced relationships with moving images. From here, I can begin to establish a discourse fitting of how these mediums conflate with interactive film and explore how predominant interaction methods influence these spaces. Robert Barker's contemporaries predicted such shifts in narrative perception through their descriptions of the panorama when they stated that:

> No device, to which the art of delineation has given birth, has approached so nearly to the power of placing the scene itself in the presence of the spectator.

> It is not magic; but magic cannot more effectually delude the eye, or induce a belief of the actual existence of the objects seen, There is a kind of infinitude in the form of a circle, which excludes beginning and ending; there is a kind of reality which arises from the spectator's ability to inspect every part in turn; and revert to this incident, or the other, after having contemplated the bearings and effects of different parts of the circle. (Taylor, 1810, p.448)

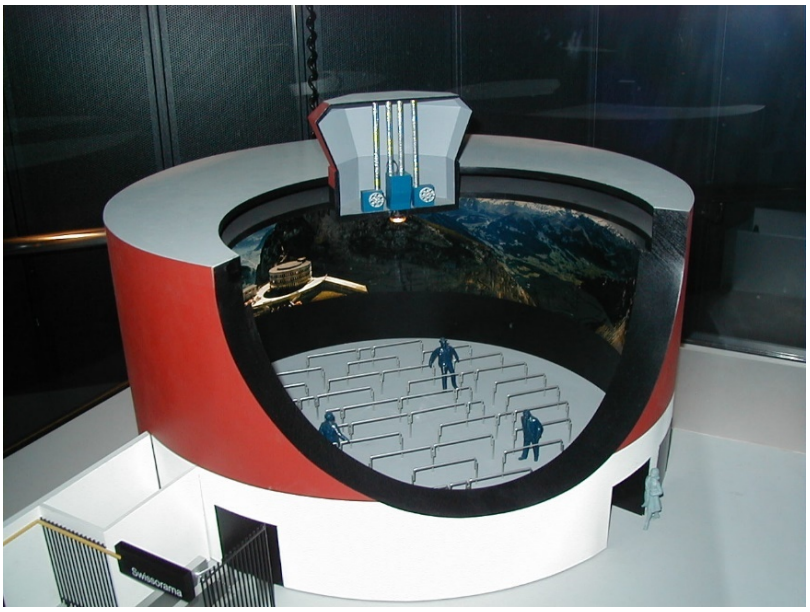

Figure 2 – Swissorama (Heiniger, 1984)

Here Barker's peers demarcate his thoughts on the circular panorama, which cements the notion of a visual experience that has no set beginning or ending point. Such postulations explore the emergent potential of a non-fixed all-encompassing viewing experience. However, as a form of artificial immersion the circular panorama is a fixed medium. To display these circular panoramas Barker had to create buildings designed for viewing these works, best realised in the Rotunda built in Leicester Square in 1801 (Huhtamo, 2013). As can be seen in the sectioned image below (Figure 3) the space was separated into two viewing platforms so as to allow, "at all times a picture to exhibit whilst the other is painting" (Wright, 1803, p.100). This setup allowed Barker to install new paintings, whilst being able to still have a viewing space in the Rotunda available.

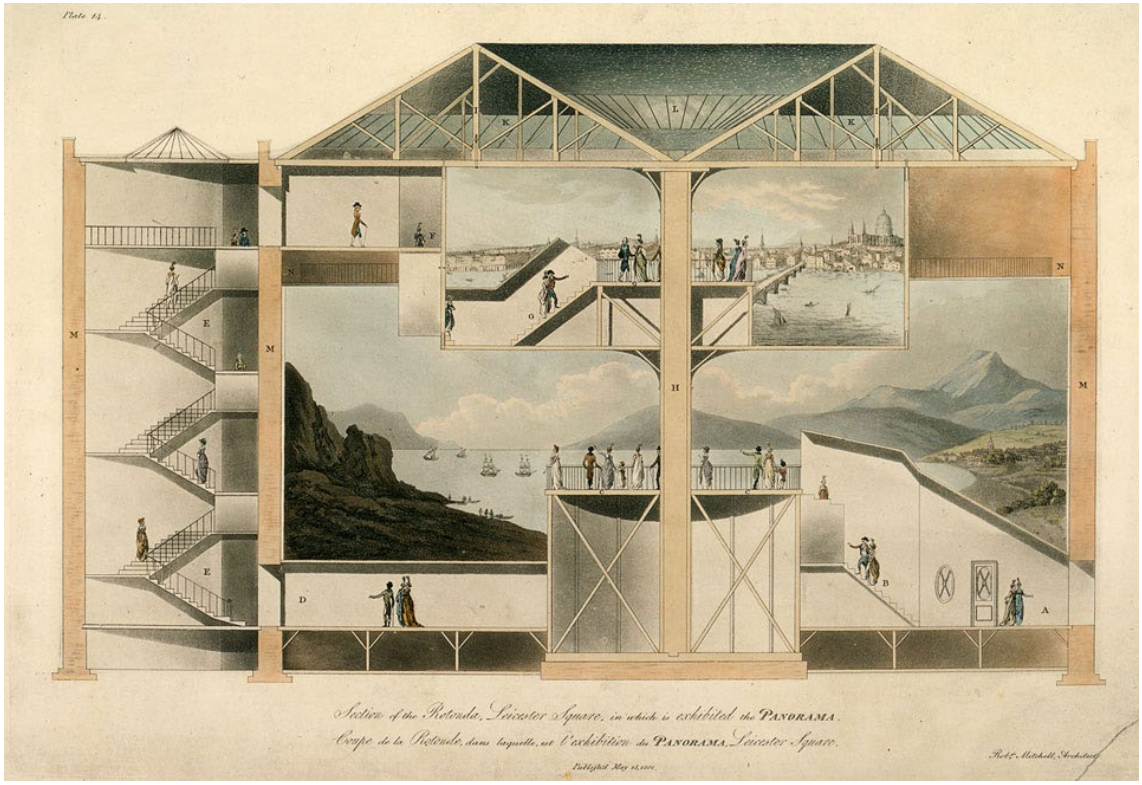

Figure 3 – Section of the Rotunda (Mitchell, 1801)

Such designs offered clear inspiration for Raoul Grimoin-Sanson's 1897 invention of the Cinéorama (Figure 4) almost a hundred years later, which was referred to in the Scientific American Supplement (1900, p.20631) as being a "cinematographic panorama". Such an apparatus is important as it is the first film-panorama hybrid system. Expanding the idea behind panoramic paintings Oliver Grau defines this system when he states that, "ten 70mm films were projected simultaneously to form a connected 360° image. In fact, the walls of older panorama rotundas were often whitewashed and used as presentation spaces for the new cinematic version." (2003, p.147) The Cinéorama represents the first pursuit towards mechanically augmenting the idea of the panorama through the use of film technology. Such a system introduced movement into panoramic practice via a custom-built filming apparatus and an environment suitable for viewing Sanson's cinematographic panorama. With regards to its running at the 1900 Paris Exposition according to Richard Abel (1998, p.17) "the authorities closed down after only four performances, but which recently discovered financial documents disclose posed so many technical difficulties that it never opened." Whatever the outcome of the exhibition, the practice that surrounds this work demarcates the conflation of the panorama and cinema into

a shared external space. However, this wasn't the first occurrence of movement in a panoramic context.

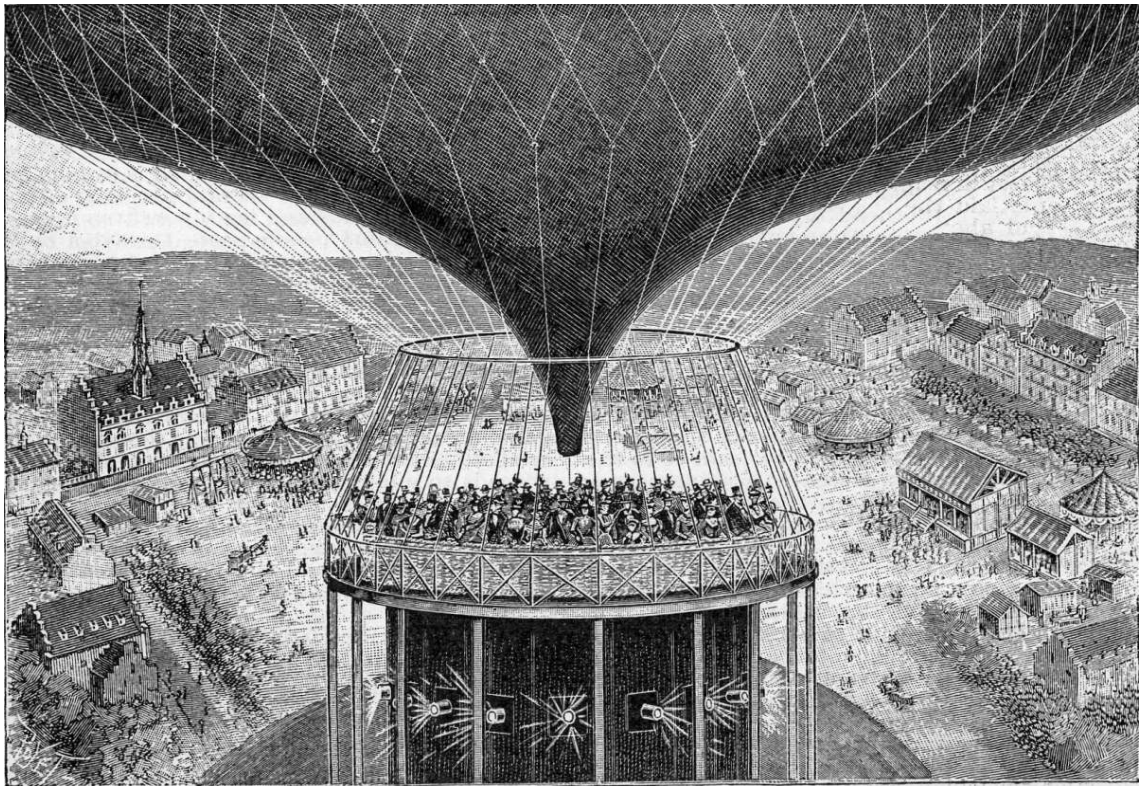

Figure 4 – Cinéorama balloon simulation at the Paris Exposition (American, 1900)

Alongside contextualising the circular panorama Huhtamo aims to establish the moving panorama as a seminal fixture of panoramic history. This he defines as follows:

> Instead of being surrounded by a stationary wrap-around painting, the spectators sat in an auditorium. A long roll painting was moved across a "window" (often with drawable curtains) by means of a mechanical cranking system. (2013, p.6)

Presenting it as an *itinerant medium* (Ibid., p.8) its mobility negates the location specific requirements of the circular panorama, a process whose opposition promotes further conflation of surrounding medias. It operated externally, on the peripheral and amongst other media but also functioned as a system of dissemination (Figure 5). The portable nature of the moving panorama gave it flexibility to be combined with other performance practices, whilst becoming a more widely understood form of immersive entertainment.

Figure 5 – The mechanism of John Banvard's moving panorama (American, 1848)

In Huhtamo's (2013, p.5) considerations on the conception of the panorama he states that "the panorama may have been introduced as a new art form but it was conceived to create a market for mediated realities and (seemingly) emancipated gazes". Both of these factors remain pertinent in contemporary imaginings of the panorama (360° film/photography) and beyond. However, rather than emancipating our gaze my research comes to present it as an inherently immured process. Early incarnations of the panorama allowed people to be temporarily freed of the world they inhabited and visually occupy a landscape that they would most likely never be able to travel to. Contemporary applications offer similar prospects, but the implicit cost of this immersive freedom is that the individual's gaze is no longer a wholly autonomous process. Inside of such systems every type of gaze is quantifiable, whilst also becoming a mediatable process. The nuances of this will be explored in more detail later in this thesis.

For now, I would like to look at the idea of a market for mediated realities offering contemporary comparisons to both the circular and the moving panoramas as a way to connect these processes with the specific systems explored in my research. Starting with the circular panorama obvious

comparisons exist between it and Cave automatic virtual environments (CAVE), which was developed at the Electronic Visualisation Laboratory at the University of Illinois by Dan Sandin et al. (Figure 6). In its first occurrence at Siggraph it was described as “a new virtual reality interface. In its abstract design, it consists of a room whose walls, ceiling and floor surround a viewer with projected images”. (Cruz-Neira *et al.*, 1992, p.65)

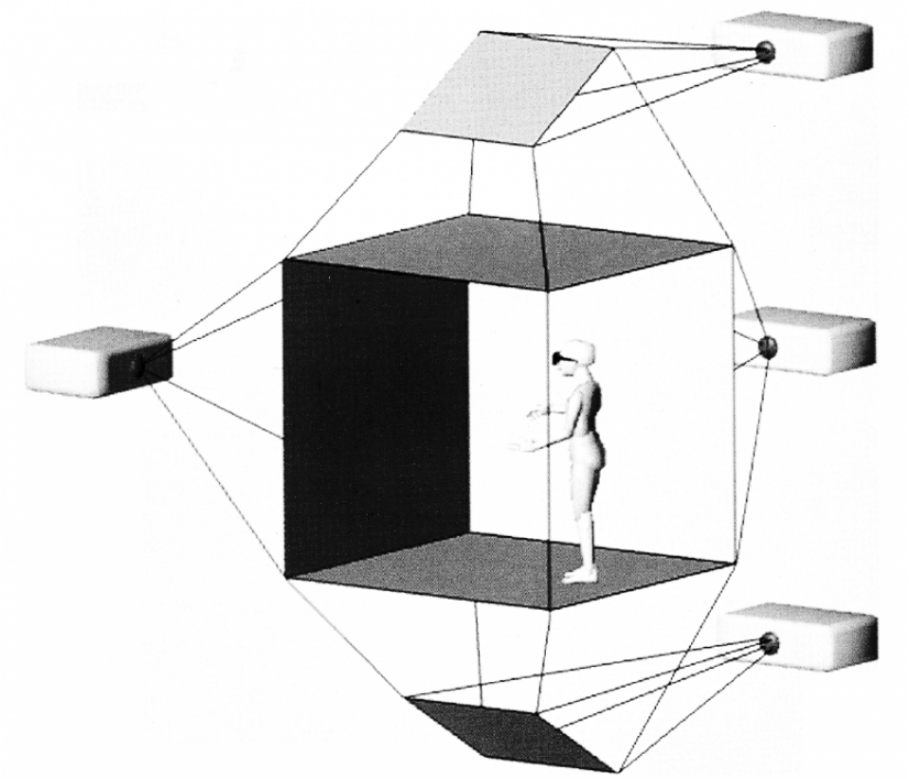

Figure 6 – CAVE Installation (Cruz-Neira *et al.*, 1992)

Although a more complex and cube-based stereoscopic method of projection, this approach shares the same aesthetic/principle of artificial immersion as the panorama. It also offers a form of external immersion that is often missing from many contemporary methods of viewing VR. CAVEs are the most suitable environments for shared immersive virtual experiences, but they are restricted by their site specific and fixed nature that parallels the earlier inadequacies of the circular panorama and that of the Cinéorama. The itinerant nature of the moving panorama complements developments in mobile technology offering the widest range of accessibility at the same time as creating the most isolating forms of experience. This stems from HMDs such as the Gear VR, Daydream and the Oculus Go that although portable only allow one user to interact from

the perspective given in each headset. However, its continual resurgence indicates a persistence that grows in relevance as it conflates with and develops alongside the genres that it propagates. Mobility has been a key catalyst for the rapid development of VR and through the use of mobile phones as a distribution platform it has used the genres of film and gaming to develop new immersive contexts for these, whilst aiding the development of a commercially viable VR market. Considering the moving panorama in a discursive context Huhtamo (2013, p.15) refers to it being "interpreted as a *topos* - a persistent cultural formula that appears, disappears, and reappears, gaining ever-new meanings in the process". As a standardised method this now exists far outside discursive contexts and if anything has shifted from being a *missing medium* to being one of the most visible forms of immersive media in contemporary society. The recent release of *Ready Player One* (Spielberg, 2018) illustrates this point as VR has migrated into popular culture. The context I am viewing this is in relates to the moving panorama being embodied by the mediums of mobile 360° film/photography, which offers artificial immersion and the potential of image movement at the same time. It also serves as an extreme actualisation of the mobility offered by its predecessor.

A recent site of consideration stems from *The Art of Immersion* exhibition that was held at the Center for Art and Media Karlsruhe in 2017. Writing the foreword to the event Peter Weibel (ZKM, 2017) asks the following series of questions:

> What are the effects of the carrier media of our state-of-the-art imagery today and what metaphors are there to conceptualise these images? Are we still intrigued by the view through a window frame or are we stepping through the doorway of a multi-sensory virtual environment?

Throughout this thesis I explore such lines of enquiry via the theory and practice of interactive film, towards outlining a method and establishing a new genre that arises through experimental conflations with VR and 360° film. As a proponent for the majority of Weibel's framing of the event I would like to challenge his statement that "cinema was the first visual medium that could imitate motion". The panorama forms part of a shared history of visual mediums concerned with

capturing motion and therefore it is somewhat reductionist to present a fixed timeline of cinema, especially given recent evolutions of the form. The contemporary evolutions of panoramic practice that I present in this section differ from their progenitors in many ways, but both add another layer of dimensionality to Barker's original patent via the deployment of stereoscopic vision, which forms another part of the evolution of the spatial discourse that stems from these panoramic perspectives.

2.1. Stereoscopic Vision

> A painting, though conducted with the greatest Art, and finished to the last perfection, both with regard to its *Contour*, its Lights, its Shadows, and its Colours, will never show a *Relievo*, equal to that of the Natural Objects, unless these be viewed at a Distance, and with a single Eye. (Wade, 2010, p.9)

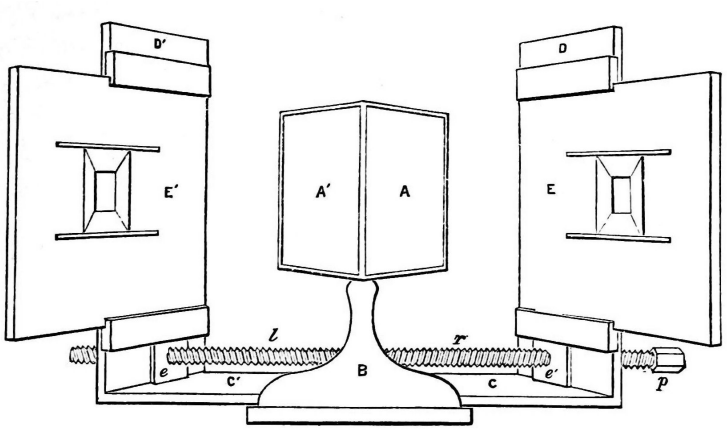

Figure 7 – Mirror stereoscope (Wheatstone, 1838)

The above quote is taken from Leonardo da Vinci's *Treatise of Painting* and is used by Nicholas Wade in *Perception and Illusion: Historical Perspectives* (2010) to discuss the relationship between science and philosophy through art practice. Another way of perceiving this quote is the lack of dimensionality in the images that we look at as they cannot capture the same human experience of the third dimension rendered through a pair of eyes. This quote was also used by Charles Wheatstone (1838) to illustrate the earliest example of an artist and a philosopher considering the inability of images to be perceived as solid objects. The panorama embodies the philosophical thinking and initial practice of adding a geometry of perspective via a cylindrical dimensionality. However,

although broadening the frame of user perspective it still lacks the spatial reality of the third dimension. Considering this dilemma Wheatstone (Ibid.) asked the question, “what would be the visual effect of simultaneously presenting to each eye, instead of the object itself, its projection on a plane surface as it appears to that eye?” This query led to Wheatstone developing the first stereoscopic device. Wheatstone’s mirror stereoscope (Figure 7) was a system where each of the user’s eyes would look to an angled mirror where they could see the reflection of an image individual to each eye. The brain would then fuse together each of these images and create the illusion of depth.

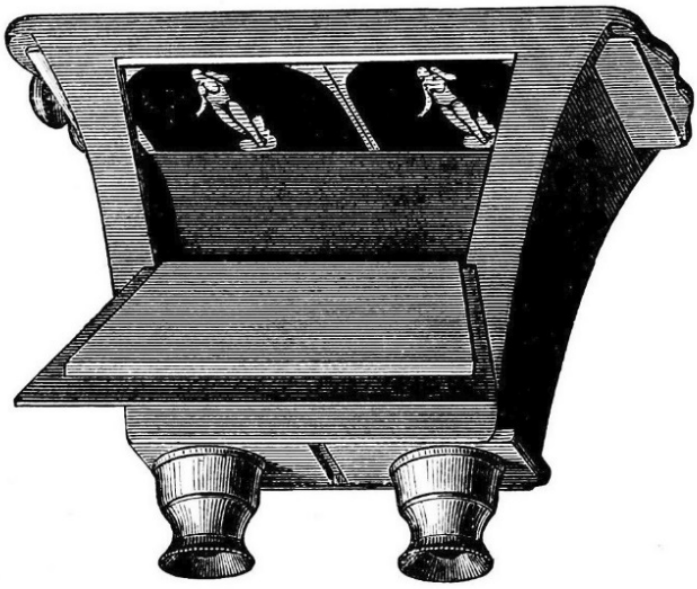

Figure 8 – The Brewster stereoscope (The Popular Science Monthly, 1882)

Such a concept was then evolved into a portable product by David Brewster in the 1850s via the development of a lenticular stereoscope (Figure 8) that enacted the process of stereo via the use of lenses. It is here that we can see an early analogue representation that clearly inspired the design of the head-mounted display technology that we now use. Stereo immersion is an element that I plan on exploring later in my practice, but for now I would like to acknowledge it as another key point in relation to our constantly evolving relationship with the screen. The introduction of stereo stands as a seminal point where depth augments the dimensionality of the screen. Sarah Atkinson (2011, p.141) provides a technical description of this process when she states that, “the principle behind stereography is relatively simple: it replicates human

vision. With 20-20 vision each of the human eyes sees a different image. Our eyes then converge at a certain point – which provides us with our sense of depth and three-dimensionality."

2.2. Image Panning and Head Tracking

Figure 9 – The Photographic Gun (Marey, 1882)

To connect user perspectives into the history of cinema I look to Marey's Fusil Photographique (photographic rifle, Figure 9) as a site of transition from user-directed movement in relation to painting and photography in a physical environment to a directed representation of space and time where movement is predetermined. According to Paul Burns (2010):

> The rifle's portability allowed a new form of perspective to be captured while keeping the subject within frame. This was soon to be known as 'panning', which quickly caught on and in the early twentieth century became a staple of filmmaking.

Panning is the term given to a cinematic movement that means to move the camera across a scene and stems from the panorama. The Oxford English Dictionary defines it as to “swing (a video or film camera) in a horizontal or vertical plane, typically to give a panoramic effect or follow a subject.” The introduction of this method via the technologies of early film demarcates a spatial shift in the agency of the viewer. Previously the all-encompassing and emergent qualities of the static image were established by the immersive physicality that demanded its viewers to be present in a tailor-made viewing space. With the advent of panning this became a recorded sequence of images unequivocally transformed by point of view becoming something totally controlled by the camera and the director’s perspective. The technique of panning diverged and formed a fundamental part of how we express cinematic language starting with what are arguably the first pan shots in film in *The Great Train Robbery* (Porter, 1903). However, alongside such histories of cinematographic movement is head-tracking, which would eventually come to operate as a conflation point between the idea of Barker’s panorama and the movement offered by the camera pan. An origin point for this can be seen in Bryan and Comeau’s creation of *Headsight* (1961) (Figure 10). According to Kiyoshi Kiyokawa the *Headsight*:

> Was more like a today’s telepresence system. Using a magnetic tracking system and a single CRT mounted on a helmet, Headsight shows a remote video image according to the measured head direction. (2007, p.44)

Frank Steinicke refers to the *Headsight* as a key component in the evolution of HMDs, but one that also “lacked integration of computer and image generation”. (2016, p.27) However, its synthesis of human and machine into a shared all-encompassing viewing space functions as a conflation site for the pan and the panorama. Turning head movement into data via the Headsight’s magnetic tracking system allowed the user to move between different CCTV displays, but more importantly function as a precursor to the tracking methods employed in contemporary VR HMD design, such as using a: gyroscope, accelerometer and a magnetometer to track user head movements. This is an important site of discussion as it demarcates another new filmic perspective, one where user-directed movement takes on new relevance. It could be argued that this

represents a key moment in film history – lost due to its abstract associations with the medium and due to the fact that its relevance only becomes apparent later in the life cycle of immersive media. It also serves to demarcate a human-machine interaction that serves to translate organic muscle movement into digital signals that in turn operate forms of moving image. Later in this chapter I will expound such processes by navigating the idea of cybernetic cinema, but more specifically applying such ideas to develop a framework where such ideas can be applied to develop new forms of interactive film.

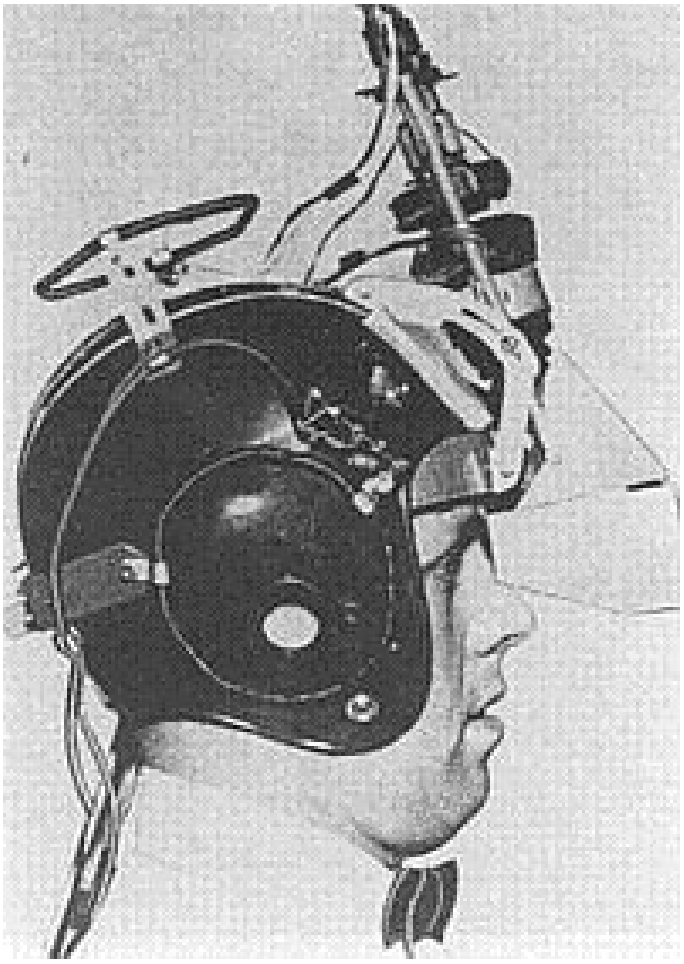

Figure 10 – Philco Headsight (Steinicke, 2016)

For now, I would like to consider the HMD in more detail as a composite for movement and immersive visual experience. In such locations cinematographic movement has been returned to the user, albeit still fixed to predetermined spaces. Here we have the synthesis of the fixed and itinerant (Huhtamo, 2013) panoramas offering 360° immersive media experiences that exist via a perceptual augmentation that also changes our relationship with the screen.

2.3. Screen Symbioses

> A movie that gives one sight and sound. Suppose now I add taste, smell, even touch, if your interest is taken by the story. Suppose I make it so that you are in the story, you speak to the shadows, and the shadows reply, and instead of being on a screen, the story is all about you, and you are in it. Would that be to make real a dream? (Weinbaum, 1935)

The above quote is taken from Stanley Weinbaum in *Pygmalion's Spectacles* (1935), which is considered by Jeremy Norman as "probably the first comprehensive and specific fictional models for virtual reality" (2018). Weinbaum's quote addresses two key components in relation to film: the idea of a movie as a multi-sensory experience and the manner in which such sensory augmentations will lead to a changed positioning between the viewer and the screen. Morton Heilig actualised some of this speculative fiction via the development of his *Sensorama* in the 1950s. Alan Craig, William Sherman and Jeffrey Will describe this as a:

> Scripted multimodal experience in which a participant was seated in front of a display screen equipped with a variety of sensory stimulators. These stimulator displays included sound, wind, smell, and vibration. (2009, p.4)

However, even though this pioneering multi-sensory experience was scripted it should be noted as documented by Richard Blade, Mark Billinghurst, Mary Padgett and Robert Lindeman that the *Sensorama* was "a mechanical virtual display device" (Hale and Stanney, 2014, p.1323). Due to this the experience was fixed inside of an arcade-style cabinet and did not offer its users the ability to move inside of the cinematic experiences presented by Heilig. As discussed in the previous section it wasn't until the development of the *Headsight* that the idea of tracking a user's position in space became possible, but in terms of adapting this into a computer-driven HMD it was the work of Ivan Sutherland that led to this becoming a possibility. In 1965 Sutherland presented a paper called the *Ultimate Display*. Here he expounds the idea of a computer-mediated reality that operates as "a looking glass into a mathematical wonderland" (Sutherland, 1965) Expanding from Weinbaum's writings that viewed a changed

relationship with the screen as a site akin to a dream world – Sutherland in the closing remarks of his seminal essay states that:

> The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked (Ibid.).

Figure 11 – The Sword of Damocles (Richards, 1968)

In an attempt to realise the idea of The Ultimate Display Sutherland developed a HMD called The Sword of Damocles (Figure 11). In his description of Sutherland's system Frank Steinicke states that it "was designed to immerse the viewer in a visually simulated 3D environment, which consisted of wireframe 3D models." (2016, p.27) Although augmenting the way we interact with computer graphics this HMD is better viewed as a form of augmented reality due to the manner in which it overlaid its computer-generated images over the user's external reality, rather than the internalised realities propagated by systems such as the *Headsight*. The binary between externally and internally mediated realities is important to consider especially when framing such considerations in a cinematic context. The arrival of the HMD fundamentally changed our relationship with the screen, which in the same breath changed the way that we interacted with moving images. Such technological developments led to artists and academics addressing the need to reconsider the landscape of

cinema. In response to this the term *Expanded Cinema* was coined by Stan VanDerBeek, which according to Tate (2018) was “used to describe a film, video, multi-media performance or an immersive environment that pushes the boundaries of cinema and rejects the traditional one-way relationship between the audience and the screen.” In the 1960s Stan VanDerBeek wrote a manifesto that stems from the idea of Expanded Cinema. Here he stated that, “the technological explosion of this last half century, and the implied future, are overwhelming; man is running the machines of his own invention… while the machine that is man runs the risk of running wild.” (1966, p.14) Negating such a bleak assertion of the future forms part of the ideological backbone of my research. To achieve this, my work radiates from an applied critical framework that allows me to closely interrogate and elucidate the forms of interaction used in my practice. Embodying his idea of Expanded Cinema and the politics surrounding this new cinematic form VanDerBeek developed a prototype theatre for viewing such experiences. Known as the *Movie-Drome* (Figure 12) he describes it as a spherical dome where the audience lies on the ground and their field of view is surrounded by a plethora of curated multi-screen projections. Placing this in a narrative context VanDerBeek states that:

> The audience takes what it can or wants from the presentation and makes its own conclusions… each member of the audience will build his own reference from the image-flow. The visual material is to be presented and each individual makes his own conclusions… or realisations. (Ibid., pp.17-18)

The manner in which technology has augmented traditional approaches to narrative in film forms the basis of chapter 3, but for now I would like to draw attention to the manner in which *Movie-Drome* (Figure 12) can be interpreted as an evolution of Barker’s Rotunda presented in the first section in this chapter (Figure 3). However, rather than being surrounded by a single all-encompassing image in VanDerBeek’s spherical dome the audience’s viewing space is composed of multiple frames. In such a space the viewer composes their experience based on where, what and when they choose to look at a particular screen. This offers a different spatial relationship to the screen symbiosis present with the HMD. Functioning as a form of external immersion or “image-

flow” as VanDerBeek phrases it this space allows its audience to engage with film projection as a more fluid form (1966, p.16).

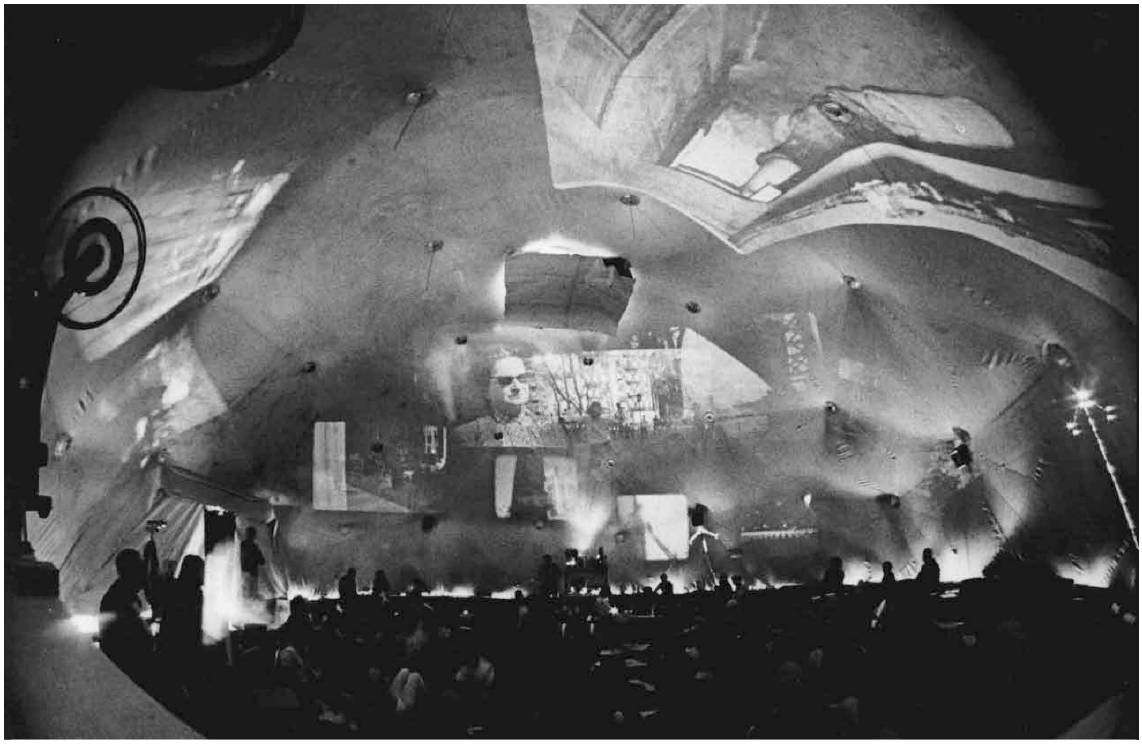

Figure 12 – Movie-Drome (Stan VanDerBeek, 1963-1965)

Such a practice can be interpreted as a precursor to the Fulldome technology that started to appear in 1990s, the i-DAT Open Research Lab defines this as:

> Fulldome is the term used to describe domed projection environment, traditionally found in planetariums. Fulldomes are not panoramas, CAVEs or Oculus Rifts (although many of the underlying technologies are the same), they provide a unique and highly immersive shared audience experience using single fisheye or multi projector systems. (i-DAT, 2018)

The Immersive Vision Theatre (IVT) at Plymouth University facilitates a Fulldome that allows for external 360° viewing experiences (Figure 13). Referred to as a “transdisciplinary instrument for the manifestation of material and imaginary worlds.” (Ibid.) It’s in such projects that we see the ideas of the static and the moving panorama being synthesised into new forms of creative practice. However, interactivity in such spaces functions differently as it must be used to form part of a communal process, rather than allowing individual user control in the same ways that are permitted by HMDs.

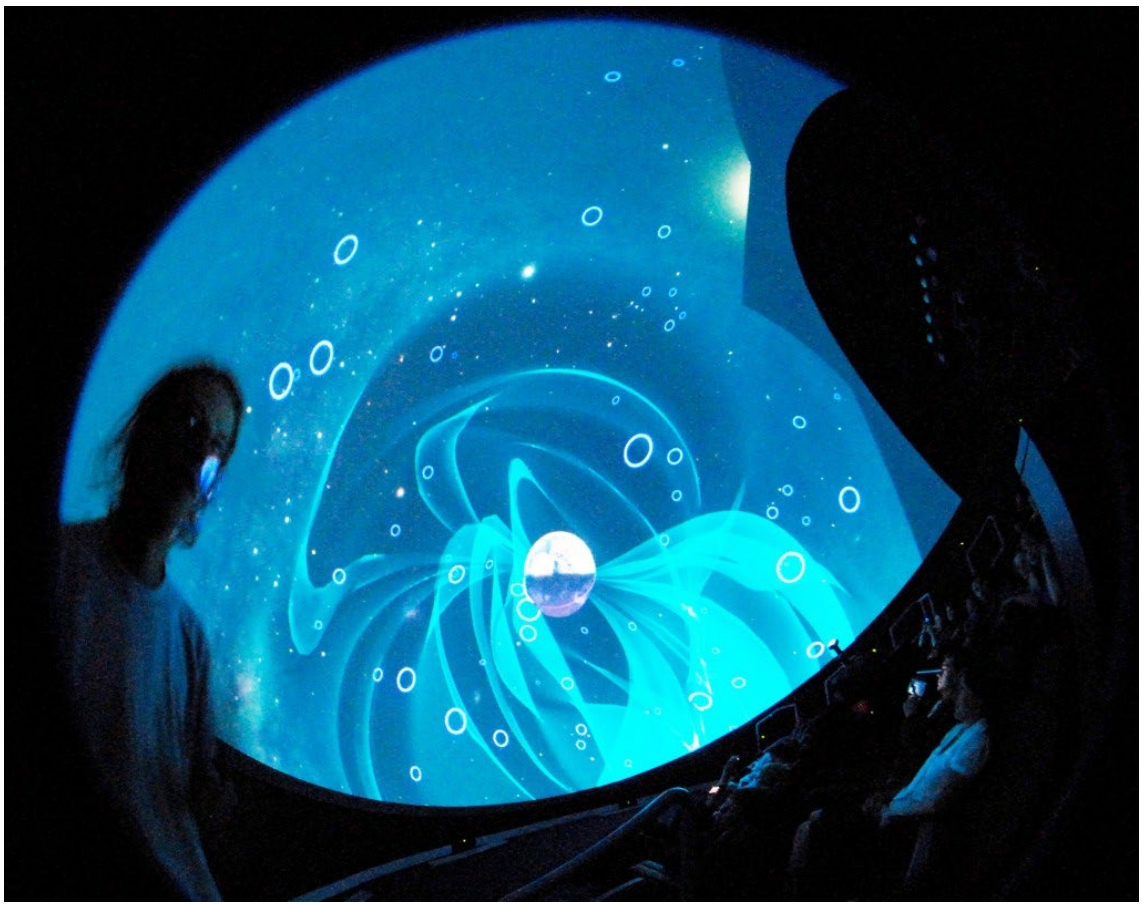

Figure 13 – Immersive Vision Theatre (i-DAT, 2018)

Offering more strands to the perception of Expanded Cinema Gene Youngblood presented this model as a means, “to explore the new messages that exist within cinema, and to examine some of the image-making technologies that promise to extend man’s communicative capacities beyond his most extravagant visions” (1970, p.41) Randall Packer (2017) presents these seminal contributions when he states that:

> Youngblood is widely known as a pioneering voice in the media democracy movement, and has been teaching, writing, curating and lecturing on media democracy since the 1970s. Although Expanded Cinema was published just one year after the birth of the Internet in 1969, he foresaw media and communications as a new medium igniting social, cultural and political transformation.

Inside such explorations are promises of new cinematic languages that stem from such technological expansions. However, in the context of HMDs there exists an inherent identity crisis. As a conduit for internalised immersive media,

confusion is formed by contemporary HMDs offering passive and active: gaming, viewing and mixed media experiences. However, such sites demarcate the extent of the expansion heralded and discussed directly by artists and academics such as VanDerBeek and Youngblood. Throughout this thesis I would like to encapsulate the idea of interactive 360° film as a genre of expanded cinema, rather than framing it as something with ludic qualities. According to Oliver Grau, “Youngblood showed that the cinema’s two-dimensional screen had entered into a whole range of symbioses with other imaging elements and techniques”. (2003, p.164) The vast extent of screen symbiosis and the rapid rate in which its various conflations are constantly changing our perception of media has led to the development of many new genres, each of which lack a coherent discourse. 360° film confuses attempts at specific categorisation as it exists between six different screen states. These I categorise as follows:

- **Traditional screen perspective** – The 360° scene is being rendered, but the viewer is not interacting with the screen and therefore they are only seeing it from a single framed perspective.
- **Equirectangular viewing format** – The scene is being watched flat and therefore not being rendered in 360°. The viewer sees an elongated stitched video.
- **Symbolic 360° screen interaction** – The viewer controls their perspective of the 360° space using a mouse, keyboard or other hardware device. This is still a framed experience.
- **Haptic 360° screen interaction** – The viewer uses their fingers to control their view of the 360° space. The screen operates simultaneously as the viewing surface and controller/interface.
- **Gyroscopic 360° screen interaction** – Movement of the device controls the spatial positioning of the 360° space. Again, the screen functions as both a viewing surface and as a controller/interface.
- **HMD 360° all-encompassing view** – A head-mounted display tracks the user’s head movement in a 360° space. This combined with the lenses in the device creates a highly immersive viewing experience.

The final screen state mentioned here (HMD 360° all-encompassing view) is further obfuscated by the degrees of freedom offered in the virtual space. What is being referred to here is the degree of spatial movement available to the user inside of the virtual reality they are occupying or “the degrees of freedom of an object represent its ability to move around in a space”. (Snyder, 2016) 360° film uses three degrees of freedom (3DoF, Figure 14) which means that the following three rotational movements are being tracked (yaw, pitch and roll). What this means is that the viewer of a 360° film occupies a static position and cannot move from this point.

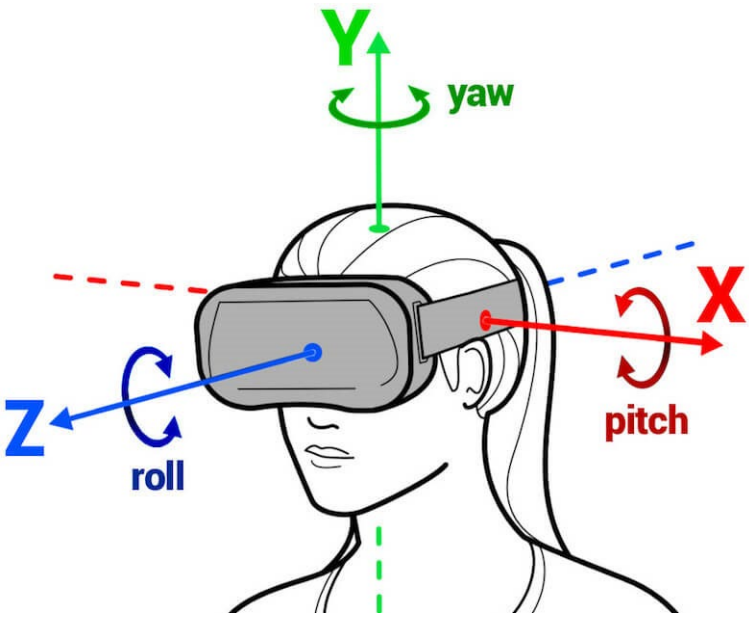

Figure 14 – Three degrees of freedom (Balouet, 2016)

Other types of VR film avail of six degrees of freedom (6DoF, Figure 15), which gives the user the ability to translationally move along the X Y Z axis in addition to the rotational movement offered by the previous approach. Both of these forms (3DoF/6DoF) of spatial movement are often used to demarcate the difference between 360° and VR film. However, as per the practice I develop in this dissertation interactive 360° film is not confined to rotational movement in a video space. With this in mind, I would argue that 360° film functions as a type of virtual reality, but to frame its position in this context a comprehensible framework for virtual reality as a philosophical concept needs to be explored and applied as a method for understanding the role of 360° film in relation to virtual reality.

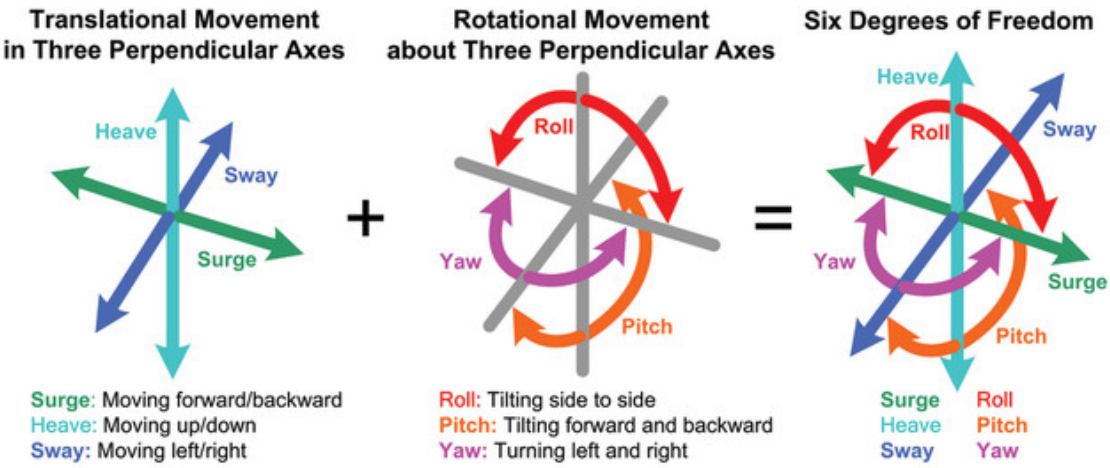

Figure 15 – Six degrees of freedom (Snyder, 2016)

2.4. The Metaphysics of 360° Film

"Virtual reality is an event or entity that is real in effect but not in fact." Here Michael Heim (1993, p.109) provides a definition of virtual reality that illustrates the unenlightening nature of the term. To expound and develop a philosophy around this concept he offers ways to interpret it built from early pioneers' approaches to it. Rather than just reiterating the categories he created in relation to the idea of virtual reality I would also like to use these approaches as a way to consider 360° film as a type of virtual reality and as a philosophical area through this association. From here we can begin to establish a discourse that will consolidate the historical contextualisation explored in this chapter as well as prepare for the inclusion of 360° film practice that involves interaction.

Simulation – Heim (1993, pp. 110-111) refers to simulation as a product of high-fidelity imaging systems and in this manner simulation reflects an imitation of real-world processes or systems occurring over time. If we are to interpret a simulation as a platform using or following reality to form a virtual environment, rather than it being an exact copy it allows for non and altered realities to be considered under the simulation paradigm. Stemming from Walter Benjamin's (1936) argument that, "that which withers in the age of mechanical reproduction is the aura of the work of art", I'd argue that another by-product of this mechanisation and eventual digitisation is a degree of infomania (debilitating

state of information overload) that has left us more susceptible to existential dilemmas such as the simulation hypothesis (Bostrom, 2003), which posits that if we believe in the possibility of conscious simulations being run in the future then we cannot ignore the fact that we might already be living in a computer simulation. More overtly aligned with the ideas explored in this thesis Ransom Stephens (2016) presents the idea of *the reality interface*, which approaches the inherent limitations of subjective human experience. In defining this he posits, “the funny thing about reality is that you can only get so close to it. Our senses compose an interface between our brains and the universe, a reality interface.” (Ibid.) Later in this thesis I will be exploring the interface between our sight and the moving image worlds we can inhabit and interact with in VR, but for now I would like to consider the idea that reality is a feedback loop (Stephens, 2014).

In this lecture Stephen’s presents reality as being composed of inputs that are then processed into outputs that then feedback into inputs. In this infinite loop different effects get augmented leading to the creation of either a positive or a negative feedback loop. Stephen’s illustrates the issues of positive feedback loops by demonstrating how a microphone that can hear itself will lead to the creation of audio feedback. Whilst, negative feedback loops are described as self-correcting systems, such as eating or Earth’s day/night cycle. A key part of Ransom Stephens’ discussions is that different interfaces bring about different realities. This is an interesting assertion to consider in the context of VR as given it has the capacity to augment our senses, then it is fair to consider such processes leading to expanded subjective realities as well. Also, how much autonomy do we have when these realities become part of a computer-mediated experience? When considering simulation we must also consider time, in particular I would argue that real-time is something that needs to be unpacked as it is not the tangible construct that its name implies. This is something that will be addressed throughout this thesis starting with the framework presented at the end of this chapter. Considering simulation in the context of 360° film, it is clear that its attempts to mimic reality embody Heim’s definition of simulation. Contemporary 360° film and photographic practice directly concerns the reproduction of reality via the use of high-fidelity image capturing techniques. However, the imitation of real-world processes or systems

occurring over time equates to a perspective of simulation as the depiction of objective realities being translated into virtual experiences. Considering this the experience of movement inside of a 360° film is permitted by translating human head movement into a rotational data system (Figure 14) that in turn simulates camera movement. When viewing 360° film there is a sequence of machinic processes that allow the act of looking to be simulated inside of a spherical moving image. Such considerations frame 360° film as a type of virtual reality where sensory perception is simulated using body data as a catalyst for immersion.

Interaction - This approach is introduced using an example of the recycle bin as a virtual site that exists through our interactions (Heim, 1993, pp.111-112). What Heim is referring to here is that

> The desk is not a real desk, but we treat it as though it were, virtually, a desk. The trash can is an icon for a deletion program, but we use it as a virtual trash can. And the files of bits and bytes we dump are not real (paper) files, but function virtually as files. These are virtual realities. (Heim, 1993, p.111)

I would support the idea that virtual environments can only exist through our interactions, but I think a more rigorous breakdown of the types of interaction being referred to is needed as each type has a different effect on the virtual environments that they create. For example, earlier in this chapter I referred to the six different screen states that exist for 360° film. Each of these offers a different perception of interaction, which serves to illustrate the degree to which our use of 360° film is not a fixed system. As discussed in the previous category human-computer interaction forms part of how 360° is experienced, but the type of interaction being referred to in this context changes the control the user has over the work. The two most dominant varieties of interaction being used in this context are interactions involving the user's gaze and their hand movements in a virtual environment, which are determined from physical controller movements. As these types of interaction are augmented the relationship between the user, designer and machine transforms into a complex entanglement where exact positions become increasingly harder to define. Such a concept will become more apparent in the second chapter of this

research, but for now I would like to continue considering 360° film in the context of Heim's metaphysics of virtual reality.

Artificiality - When referring to virtual reality Heim discusses the implications of considering everything that is artificial as a form of virtual reality. The core issue of doing this is made evident when he states that, "when a word means everything, it means nothing. Even the term *real* needs an opposite" (Heim, 1993 p.112). I agree with this perspective and think that it addresses a fundamental issue with virtual reality. In this context the question is not whether 360° film is virtual reality or not, but what media that presents a window into another reality is not? Such a definition provides too expansive an understanding of the medium, which is more than just a representation of reality. I would argue that the manner in which technologies are conflated to create states of sensorial immersion (a process that blurs the line between human and machine) is the point where virtual reality starts to become more than a reductionist term for everything that is digital.

Immersion – Heim presents the idea that immersion is an illusionary component of virtual reality, which is a misleading choice in adjective given its pertinence to virtual reality as a form (Ibid., pp.112-113). I favour a description of immersion that presents it as an absorbing involvement, but concur with Heim's view of it as an illusionary practice. As a central component of virtual reality experience immersion represents the level of engagement the work creates, but more specifically the degree to which the user is embodied in virtual environments. In 360° film this creates a unique cinematographic occurrence as the body becomes a camera in this space. Aligning with the mechanics of the HMD 360° all-encompassing view rotational camera movement becomes synonymous with human head movement, meaning that immersion also represents the fluidity of a cybernetic exchange. What I mean here is that the rate in which our own movements are simulated inside of a HMD and relayed back to our eyes becomes the point in which we accept virtual reality as achieving an idea first actualised in Barker's envisioning of the panorama.

Telepresence - “To be present somewhere yet present there remotely is to be there virtually” (Ibid., p.114). Heim discusses the negative implications of this idea by means of referring to a psycho-technological gap that distances the interacting participant from the reality that they are engaging with. On the more positive side of this we can interpret telepresence as a realised transhumanist ideal that has the potential to change how we engage with the world. The idea of presence in 360° film is unique given that the viewer becomes a static version of themselves inside of this viewing space. Software is controlled by either a remote, buttons on the HMD or through a combined or contained use of a type of gaze interaction. However, telepresence is complicated by the technology of 360° film. Without post-production or an aptitude for using the stitch-line[4] the monopod/tripod is always present below the camera (especially when live-streaming). When such scenes are viewed through a HMD the bottom half of a user’s body will appear as the monopod/tripod further cementing the newfound relationship between the camera and the user in this space. To avoid such experiences visual artefacts can be removed from the footage, but already we have reached a dilemma where establishing a state of presence in the scene means that the footage has to be doctored. It’s almost as if to sustain the illusion of this cybernetic exchange the reality of the physical presence of the camera in the shot needs to be destroyed. Even if we are to consider this camera-less state of presence as more immersive it still paradoxically positions a state of embodiment where the viewer exists as a disembodied perspective inside of the film space. I wouldn’t go as far as placing this as an example of a psycho-technological gap, but do consider it as a site that exemplifies the framework I will be discussing in the next subchapter. Although limited, can it be suggested that telepresence occurs the exact moment a user enters a HMD? Although they are close, a remoteness is established through their loss of body or the transformation of their legs into a stand for a camera, leaving them present, but no longer wholly human. Even though 360° film perpetuates the sensation of elsewhere, when the user considers what or who they are in this space there is an immediate identity conflict. Although the telepresent view of the self as the ‘other’ is a disembodied view, meaning there is no body or avatar representing the body, the immersive experience induced by the HMD leads to

[4] Referring to the point(s) where multiple cameras are merged together to become a single equirectangular image.

the creation of a state of embodied-disembodiment placing the user in a liminal state of existence. In summary, the user embodies a 360° film space at the same time as having either no body or literally becoming the camera, which is an incredibly unique phenomenon associated with 360° film.

Full-Body Immersion - Heim discusses Myron Krueger's creation of virtual environments in which the user moves without encumbering gear/wearable hardware. Krueger is considered a pioneer of early virtual reality and augmented reality research. Unique to his field his work attempted "to raise interactivity to the level of an art form as opposed to making art work that happened to be interactive." (Siggraph, 1999) In particular Heim references *Videoplace* (1989) to discuss how video-tracking of the body can be used to control computer interfaces and in turn transform the output of this is into a form of virtual reality. Symbolic interaction is perfect for the operation of machines such as using a keyboard to type this sentence or using a mouse to move a cursor around a desktop space. However, when considering the idea of immersive experience perceptual interaction is key to this. Although all of the different 360° screen states that I defined in the previous subchapter offer different degrees of immersion only the HMD offers the all-encompassing perspective contextualised throughout this chapter. The core reason for this is the manner in which it represents ocular perception by using body movement as a means to control our viewpoint inside of a 360° environment. Meaning our perception of the virtual space is dictated less by the movement of our eyes and more by a perspective attained by tracking the movement of our heads. The relevance of full-body immersion is captured in Heilig's Sensorama, but translates back to the viewing platforms in Barker's Rotunda. Essentially, sensory input has always played a key role in the creation of immersive experiences, but the more this evolves the more virtual reality can be augmented both as a philosophical construct and as a technological output. These extensions that I speak of revolve around bodily senses beyond sound and vision (such as haptics[5] and olfaction[6]) being integrated into virtual experiences allowing for a greater sense of body immersion to be achieved.

[5] Referring to the simulation of touch in virtual reality.
[6] Reproducing smells using artificial means.

Networked Communications - Jaron Lanier's name is synonymous with virtual reality as "he either coined or popularised the term 'Virtual Reality' and in the early 1980s founded VPL Research, the first company to sell VR products." (2018) Lanier also saw networks as equally important as immersion when considering virtual reality. In this context networked communications are the places where shared experiences are created as opposed to the individual ones commonly experienced within a HMD. In relation to 360° film this becomes more complex, but certainly not an unattainable practice. If dealing with pre-recorded 360° film then these shared experiences would have to operate in a space where users can navigate to these scenes. They will also require avatars to be able to identify other users. Such a process would be ideal for something such as communal commentary on 360° film, but much of the potential for this practice aligns with a different avenue of research (especially in relation to live 360° film). Given the range of research avenues involving the application of 360° film as a form of interactive film the topic of networked practice is something best taken forwards as an area for future study outside the scope of this thesis. Another point of consideration are recent developments such as *Sansar* (2018) , which is currently branding itself as "the world's leading social VR platform". As a predecessor created by the same company (Linden Research) that made *Second Life* (2018) this is a prime location for further research into how 360° film can be integrated into different types of networked communication.

Throughout this section I have interrogated what Heim refers to as the "essence of VR" (1993, p.109). In addition to considering these categorical approaches to the philosophy of VR from the perspective of contemporary practice, I also use these categories as a means to consider how 360° film functions as part of a virtual reality practice. Throughout my discussions on these categories I refer to a cybernetic exchange, which represents a thought process that places human-machine interaction as central to immersive cinematic experience. Immersion as an art form depends on sensory input, but how this is depicted has transitioned over time from a human-centred approach to the creation of systems where the synthesis of human and machine perception has become the site where these immersive experiences operate. Given the multitude of ways this augments our conception of and relationship to moving images I think

it is pertinent to establish a model, which will assist with reconsidering our vision of what 360° film is, both as an immersive viewing experience, but as my practice develops also in relation to the ideas of perceptual interaction that surround this form.

2.5. Cynematic Framework

To initiate this discussion, I want to refer back to the first time that I had a virtual reality experience in a HMD. In the Summer of 2014 I procured the use of an Oculus Rift Developers Kit 2 (DK2) during its beta-phase. Although still essentially a prototype model for the consumer version (CV1) that they would eventually go on to release in early 2016, this HMD gave me my first experience of both 3DoF and 6DoF (Figures 14-15). Central to this was the overt realisation of how easy this conflation of technologies came together and tricked my brain to believe I was occupying another space. At the same time as having my first immersive experience in VR I became aware that my sensory experience was more than an organic system, it also exists as data streams that can communicate through programming directly to the machine, creating inputs and outputs that synthesise new relationships with technology. Such a concept was heralded by Joseph Carl Robnett Licklider's *Man-Machine Symbiosis* where he elucidated such a process as involving "very close coupling between the human and the electronic members of the partnership." (1960, p.4) This pairing of human and machine into a shared entity is one that can also be specifically applied to both the theory and practice that surrounds this course of study. Throughout my research I will refer to the term *Cynematics*, which is a portmanteau of cybernetics and cinematics. I have developed this term to explicate an approach to cinematic practice/theory that is conducive to new creative potential for interactive film. In order to establish a heterogeneous avenue that is not bound to the common debates explored throughout my research, I am keen to frame my work as a type of expanded cinema. More specifically as a departure from Youngblood's (1970, pp.179-256) concept of cybernetic cinema, that emphasises real-time human-computer interaction and the narratives produced from engagements with these structures. At the time Youngblood designed this chapter (Ibid.) around three different types of computer output hardware, which were: "the mechanical analogue plotter, the

“passive” microfilm plotter and the “active” cathode-ray tube (CRT) display console.” (Ibid., p.194) After describing these processes Youngblood moves into case studies that explore the computer films of artists such as the Whitney family, John Stehura, Stan VanDerBeek, Peter Kamnitzer. However, at the end of his “Cybernetic Cinema” section he does speculate that “there’ll be no need for “movies” to be made on location since any conceivable scene will be generated in totally convincing reality within the information processing system” (1970, p.206) Considering this it seems that the outcome of machine synthesis with cinema will lead to the dissipation and eventual removal of its “real” elements, but contemporary advancements in 360° and VR film indicate that if anything 360° film is going to migrate into 6DoF through the use of volumetric cameras. For example, light detection and ranging (LiDAR) is used to create a 360° point cloud of a space and then the high-fidelity images captured on the cameras are mapped onto this model. The best current example of this process can be seen in HypeVR and Intel’s work on volumetric video (Figure 16). Futurist Ted Schilowitz promotes the potential of this technology when he states that “the idea of just static normal 2D video is the past. The idea of dynamic volumetric video that you can move around in, is the future.” (HypeVR Technology, 2018)

Figure 16 – HypeVR Rig (HypeVR Technology, 2018)

The division between 3DoF and 6DoF from a cinematic perspective is due to completely converge, which will eventually blur the lines between cinema and games into a new hybrid genre. I referred to the dimensionality of the screen in the *Stereoscopic Vision* section of this chapter discussing how depth augments this relationship. Expanding on this, movement represents a further dimensional

transition for 360° film, whilst embodying the next phase of biological and machine synthesis. Youngblood presents a fascinating and vital history of cinema, but the alignment of cybernetics with cinema is not unpacked explicitly in his work. If we are to consider cybernetics as a metaphor for film, the synthesis of human and machine forms as well as the interactions between these systems form a useful framework for considering both the history and contemporary landscape of immersive media.

Norbert Wiener was a prolific child prodigy and professor of mathematics at MIT who during World War II researched ballistics. Such work assisted with him inventing the term cybernetics, which Peter Galison accurately encapsulates when he states:

> In the course of characterising the enemy pilot's actions and designing a machine to forecast his future moves, Wiener's ambitions rose beyond the pilot, even beyond the World War. Step by step, Wiener came to see the predictor as a prototype not only of the mind of an inaccessible Axis opponent but of the Allied antiaircraft gunner as well, and then even more widely to include the vast array of human proprioceptive and electrophysiological feedback systems. The model then expanded to become a new science known after the war as "cybernetics," a science that would embrace intentionality, learning, and much else within the human mind. (Galison, 1994, p.229)

Wiener’s cybernetics functioned as an interdisciplinary science that inspired a diverse range of individuals to consider it in relation to their respective fields. A key corroborator of this is Ross Ashby an English psychiatrist who started exploring cybernetics in relation to the biological sciences. Ashby popularised cybernetics as a term used to refer to self-regulating systems, such as homeostasis in the human body. However, he also advocated that cybernetics could, “provide the common language by which discoveries in one branch can readily be made use of in the others.” (2015, p.4) Such a statement illustrates the open and interdisciplinary nature of cybernetics, whilst demonstrating its potential as both a science and as a philosophy for exploring human-machine interactions. Rather than being attached to the mathematical specificities of cyberneticists such as Wiener and Ashby, I am interested in how cybernetics can be used to help develop new ways of considering our changed relationship

with moving image practice in the wake of contemporary immersive media practices. Such a process is akin to Roy Ascott's (2002) envisioning of the "Cybernetic Vision in Art", where he refers to:

> The spirit of Cybernetics which may inform art and in turn be enriched by it. […] We say of Cybernetics that, before it is a method or an applied science, it is a field of knowledge which shapes our philosophy, influences our behaviour and extends our thought. (Packer and Jordan, 2001, p.100)

Applying such considerations to telematic art Ascott states that "the theory of this mode of art will have its technical, philosophical, and communications aspect bound up within a larger cybernetic framework, which Gregory Bateson has called 'ecology of mind'" (p.194) A fundamental aspect of Bateson's (2000) work that translates into Ascott's theories is that the relationship between things is more important than the things themselves. Such a statement is reflected throughout this entire thesis both in how I approach my research questions, but also in how I navigate practice as a process that leads to unexpected outcomes. In Katherine Hayles' *How We Became Posthuman* (1999) she presents cybernetics as a formative part of the idea that we now exist in a state beyond being human. Referring to the Macy Conferences on Cybernetics she presents the three central arguments from these radically interdisciplinary conferences as:

> The first was concerned with the construction of information as a theoretical entity; the second, with the construction of (human) neural structures so that they were seen as flows of information; the third, with the construction of artifacts that translated information flows into observable operations, thereby making the flows 'real'. (Hayles, 1999, p.50)

In developing a framework that applies cybernetics as a metaphor for exploring interactive 360° environments it becomes apparent that the human-machine synthesis required for this to occur not only changes our experience of information, but also promotes sensory interactions that shift our understanding of what it means to be human. To this end, *Cynematics* can be interpreted as a node of the posthuman discourse, meaning that it stands as a practice-based exploration into how interactive immersive media discourses propagate new

kinds of human experience. Such concepts will be expounded throughout this thesis, but now I would like to develop the framework that will guide these explorations. At the beginning of this chapter I referred to the panorama as a spatial precursor to immersive media practices that dissolves the idea of art as a windowed representation of reality. In line with such thoughts Roy Ascott states that:

> The commanding metaphor of art shifts from that of a window onto the world to that of a doorway into negotiable (data) space, a space in which we can create our own shared realities. In that space, all sensory modes can be engaged. Images, texts, sounds, and gestures co-exist in this hypermedia. To enter the media flow is to change it. (Ascott and Shanken, 2003, p.352)

To help explore the new theories and practices permitted by the “media flows” we enter in VR and 360° film I have established the following fundamental tenets:

Cynematics:

- Emphasise real-time interaction systems as sites that overcome interaction paradoxes;
- Incorporate the theory and practice of human-computer interaction as central components of cinematic experience;
- Promote collaborative exchange between the designer/machine/user;
- Navigate the cybernetic principles of circular causality, black boxing, feedback and control in relation to interactive film;
- Focus on perceptual interactions as opposed to symbolic ones;
- Explore new types of narrative systems.

These points collectively encapsulate the direction of my research, whilst assisting with the development of a virtual creative practice that helps synthesise appropriate theoretical discourses.

2.6. Conclusion

To finish in a circular manner that mirrors the idea of the panorama and application of *Cynematics* I want to briefly refer to a specific installation called *T_Visionarium II* (Shaw et al., 2006). This interactive installation allows users to live-edit a vast database of moving image in a panoramic stereoscopic projection cinema, but as an external installation this work clearly synthesises the practices of Barker (Figure 3), Grimoin-Sanson (Figure 4) and VanDerBeek (Figure 12) adding a new layer via human-computer interaction. This work presents the need to reconsider narrative in the wake of new technologies merging with forms of interactive film. This builds into ideas for reconsidering the role of narrative and its relationship to authorial control which will be addressed in the next chapter, but for now I would like to acknowledge the human-machine symbiosis that allows 360° film to exist as a type of virtual reality.

Figure 17 – T_Visionarium II (Shaw *et al.*, 2006)

From panoramic paintings to 360° film, the idea of the all-encompassing image has continued to persist and evolve becoming something that changes our concept of cinematic perspective. Never have we been closer to the apparatus of cinema, but this process also augments our linear and passive approaches to

engaging with moving images. No longer are we a viewer looking at a window into another reality, we now embody this space becoming part of the cinematic landscape. However, in the 360° format the viewer exists as an ethereal spectre. Factoring interaction into this moment it becomes apparent that the viewer not only becomes a user, but their interactions play a part in the experience of new levels of immersion.

Chapter 3. Narrative Systems: The Rise of Datascape Mediation

I initiate this chapter by considering the blurred lines between humans and machines. This is explored by presenting how narrative was envisioned by those attempting to create artificial intelligence systems that engage with story generation. The purpose of briefly delving into this area is to highlight how the design of AI narratives requires a perspective of human narratives as designable systems. Such ideations illustrate the systematic commonalities between the human and the machine, which is an essential part of *Cynematics*. Moving the discussion into the realm of cinema, I address the non-linear outcomes of designer/software-driven approaches. These attempts to conflate databases and interactive narratives are undermined by the omission of user interaction, instead favouring subjective interpretations of such systems.

Expanding towards designer/machine/user-driven content makes the application of traditional approaches to narrative construction problematic, although such concerns have been present long before the first computer was developed. Stemming from pre-digital narratives I start to navigate the concept of authorial control, using hypertext, which is commonly perceived as a midpoint between narrative and database (Ryan, 2015). From here I introduce digital narratives, which moves towards a conversation on the role of interactivity in this process. The presence of which leads to the interaction paradoxes common to many forms of interactive media, causing a degradation of immersion. Using examples of this interactivity versus narrative immersion debate, I explain how real-time approaches to interaction are key to resolving such issues. I then explore how modular and algorithmic approaches to narrative construction can help augment our perception of what defines an interactive digital narrative. Delving further into the discussion on interaction, I discuss how non-haptic and perceptual approaches to interaction can allow for new types of real-time interaction. The idea being that this will help aid the experience of narrative systems built using these methods of approach. Key to this chapter is the mapping of the designer/machine/user in a manner that promotes them as communicative systems, while also providing a fluid definition of interactive digital narrative that functions in parallel with my visual experiments. To this end, I frame my practice in the realm of expanded cinema, not for its

relationship to art, but more explicitly due to its relationship with cybernetics, which offers me a platform to incorporate human-computer interaction into my practice, towards establishing the immersive-emergent potential of real-time interactive narrative systems.

3.0. Narrative Intelligence

“We continue to surround ourselves with stories, furnishing our worlds not just with data but with meaning”. (Mateas and Sengers, 1998, p.1)

The idea of “narrative intelligence” (Blair and Meyer, 1997) was adopted by the Association for the Advancement for Artificial Intelligence (AAAI) as a way to engage with research involving AI and narrative. Throughout the 1970’s and 80’s many experimental systems were built that focused on how we understand and interpret narratives. Mateas and Sengers (1998) provide an extensive list of these systems starting with Cullingford’s (1978) system called SAM, which he described as a “computer story understander which applies knowledge of the world to comprehend what it reads”. Other systems include story-generation, TAIL-SPIN (Meehan, 1980) and thematic approaches to narrative construction (Dyer, 1982). Although all of these systems focused on the development of narrative within the context of artificial intelligence, their approaches were built upon the view of narrative as an experiential process of sense-making associated with the human pursuit for meaning. In other words, in order to program a machine to generate a narrative, we must first recognise that the process in which we make meaning is a complex system of links, from which subject specific meaning is interpreted. In a time where we curate our existences with tags, while our data fuels the economics of global technology superpowers, our intrinsic involvement in these systems is a pertinent discourse[8]. To justify this inclusion, it must be noted that even though Cullingford, Meehan and Dyer’s work was grounded in artificial intelligence research, their views on human narrative construction as designable systems complements my conception of narrative. Storytelling is central to human

[8] Referring in this instance to the digital infrastructures that facilitate the pursuit of meaning via making, sharing and curating varying forms of narrative intelligence.

existence, but it is no longer entirely ours to control. To equate humans as systems aligns with a human-machine symbiosis that cybernetics pioneer Licklider first wrote about in 1960. However, rather than expanding this into a conversation on what it means to be human, for now I prefer to focus on the mediative qualities of *Cynematics* and the narratives produced when human and machine systems engage in real-time pictorial interactions.

3.1. Software Cinema

Central to my practice-based research is delineating the kinds of systems I produce amidst previous approaches, in an attempt to quantify what makes my practice different and to navigate the issues that exist in these systems. *Soft Cinema* was a project created by Lev Manovich and Andreas Kratky. Commissioned by the Centre for Art and Media Karlsruhe for *Future Cinema: Cinematic Imaginary after Film* (2005), it explores the use of real-time software-driven editing of visual material, using algorithms to construct database films. In *Media Art Perspectives* Manovich (Klotz, 1996) presents the idea of the *cinema machine*, which is a concept that is presented in *Software Cinema: Navigating the Database* (Manovich, Kratky and M.I.T. Press., 2005, p.3) as being developed from the two main technologies involved in the formation of cinema; electricity and the engine. Expanding on this concept Manovich equates the cinema machine to being akin to an industrial factory and its mechanisms being a form of assembly process not too dissimilar to Ford's assembly line processes, that simplified such processes into sequential and repetitive systems. Taken as a criticism on the homogeneity of traditional film narrative Manovich posits, "given that the logic of the cinema machine was closely linked to the logic of the industrial age, what kind of cinema can we expect in the information age?" (Ibid.) The *Soft Cinema* project is built around this question as it attempts to expand the discourse of contemporary cinema by explicating and creating a series of database films, that challenge our perception of cinematic language (Figures 18-19). A key feature of the three films presented in the *Soft Cinema* project (Texas, Absences, Mission to Earth) is that they feature what I would define as designer/software-driven content.

The idea of conflating narrative and database into a shared space pervades each of these films, the more coherent of which have algorithmic approaches layered with voice-over. However, beyond subjective interpretation they all lack the user-interaction that is integral to how databases are navigated. Replacing this with designer-interaction via the programming and design of narrative database systems presents a generative black box approach that does little to entice its users to become part of the narrative process. Wiener (2013, p.xi) defines the black box as a cybernetic apparatus, “which performs a definite operation on the present and past of the input potential, but for which we do not necessarily have any information of the structure by which this operation is performed”. Although curious visual experiences, Manovich’s user-less interactions quickly become alienating. To promote inclusive interaction, content must be driven by designer/machine/user interaction, which is a system of approach that originated in interactive film. That said, interactive film is not devoid of database qualities and to that end it is difficult to binarise these processes. Manovich's (1999, p.85) conception of database film is orientated towards algorithmic and machine-driven film content that promotes the idea that “database and narrative are natural enemies. Competing for the same territory of human culture, each claims an exclusive right to make meaning out of the world”. I don't believe the database is an "enemy" of narrative, in fact in the context of interactive film it forms an embedded quality of the narrative system that is not mutually exclusive. To this end it is not the database that is the site of contention, but the manner in which it is accessed and used. This observation highlights how *Cynematics* conflates such ideations, whilst positioning user-interaction as the potentially combative space.

Given that the end of the previous section builds towards interactive cinema as a genre that includes user-interaction in its model, I thought that it would be useful to start the next section by mapping out its different phases, as this fragmentation of classification and type is indicative of its malleable nature. In *Interactive Cinema in the Digital Age* Chris Hales (Koenitz *et al.*, 2015, p.37) breaks interactive film down into a series of technological phases, which include; “a film-based phase centred on fictional entertainment, a period in which Human-Computer Interaction (HCI) and nonlinear narrative were the central issues, and an online phase founded more on participation, collaboration

and personalisation." Expanding on this structure he not only provides a historical context for interactive film, but also elucidates the difficulties around providing a fixed definition of this type of cinema. Instead of mulling over the subdivisions of this particular genre, I favour an approach that uses interaction design to explore the systems implicit to this type of cinema. As confluents of narrative intelligence and incorporating aspects of database logic, these systems seek alternative ways to access and create connections between user interactions and visual content. This only serves to highlight the illusion of narrative as a fixed system and promotes it as a liminal construct, reshaped in the age of information. A structural conflation for the designer/machine/user model that I employ will be outlined and unpacked later in this chapter as it forms part of a new conceptual genre derived from my practical research. Prior to this it would be of benefit to explore the relationship between interactivity and narrative, both historically, conceptually and technically.

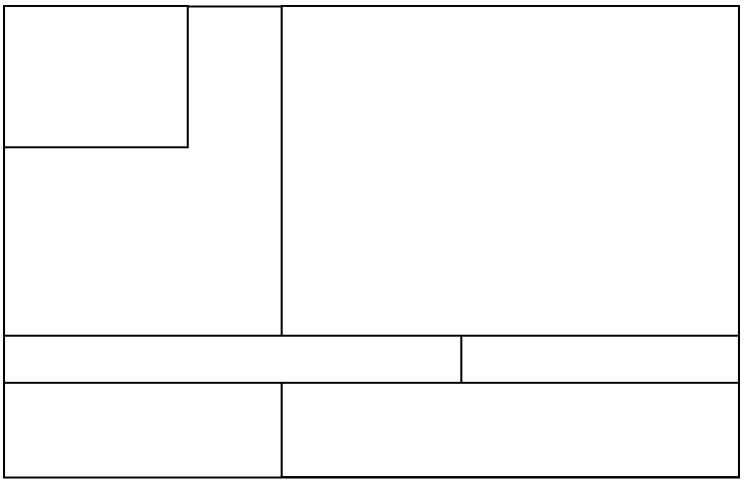

Figure 18 – Screen layout example (Manovich, Kratky and M.I.T. Press., 2005)

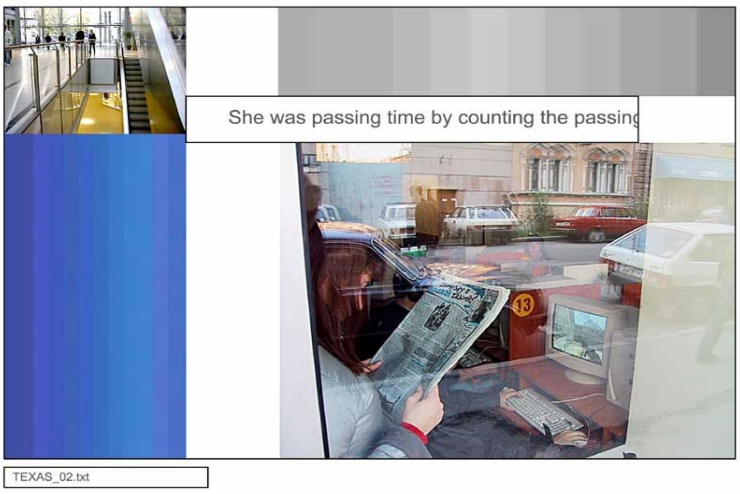

Figure 19 – Still from *Texas* (Manovich, Kratky and M.I.T. Press., 2005)

3.2. Hypertext as Narrative Bridge

In *Pause & Effect: The Art of Interactive Narrative* (2003) Meadows approaches the changing forms of narrative, stemming from the Aristotelian definition of beginning, middle and end (Aristotle and Kenny, 2013) and Freytag's Pyramid, which provides a structural model for plot (Freytag, 2008). In the context of an interactive digital narrative all of these models start to become problematic as they are dependent on the author's design signified in the text, but what happens when this becomes a collaborative process? Janet Murray (2017) explored such a line of interrogation via her conception of the "cyberbard", which is interpreted in *Interactive Digital Narrative: History, Theory and Practice* (Koenitz *et al.*, 2015, p.3) as a term that refers to those, "who feel more confident with the notion of relinquishing some of their authorial control to users, players and interactors, and see themselves not as the creators of singular visions, but as designers of expressive potential." This paradigm is not contained to interactive film and has existed in writing long before the discourse of interactive digital narratives came to the fore. An early example of this can be perceived in Gérard Genette's conception of the metalepsis[9] (1980). This paradoxical destruction of the story world destabilises both the author's role in the creation of meaning and the reader's immersion in their construct. Moving from conceptual branching to a more actualised form, many researchers consider Jorge Luis Borges' 1941 *The Garden of Forking Paths* (2018) as the birthplace of the concept of the hypertext, which was later coined alongside hypermedia[10] by Theodor Nelson (1965, p.96) as a "body of written or pictorial material interconnected in such a complex way that it could not conveniently be presented or represented on paper." These nodal approaches allow interactions to conflate with subjective interpretations of open texts and offer methods to escape what Nelson (Bullard, 2013) refers to as "[...] the prison of paper". Marie-Laure Ryan (2015, p.193) envisions the positioning of the hypertext as a bridge between databases and classical narrative when she states that the, "hypertext lies therefore halfway between the spatiality of databases, out of

[9] Genette ([1972] 1980, pp.234-35) defined metalepsis as "any intrusion by the extradiegetic narrator or narratee into the diegetic universe (or by diegetic characters into a metadiegetic universe, etc.), or the inverse […]".
[10] Extension of hypertext's nonlinear textual movements to include connections between graphics, audio, images, video, text and hyperlinks.

which elements are pulled individually, and the temporality of classical narrative, where meaning arises from a sequential organisation." Essentially once hypertext is added to the equation we enter a space between traditional narratives and database systems, which when applied to interactive film forms also adds the voice of the machine to the dialogue. What's interesting here is that on an interactive film timeline the concept of the hyperlink came two years before the world's first pre-digital interactive film, which is illustrative of an infantile application of hypermedia. Martin Rieser and Andrea Zapp (Rieser *et al.*, 2002, pp.25-26) navigate the implications of machine inclusion when they state that, "traditional narrative has been augmented by the advent of new media, not just through the revolutionary distributive aspects of the technology, but principally through the changed relationship between audience and author". Interaction, which comes as a result of hypertextual machine dialogues is the catalyser for the change they speak of. Rieser (1996, p.1) presents the impact interactivity has on authorial control when he states that, "it is my contention that so-called interactive media contain the potential to liberate writers and artists from the illusion of authorial control in much the same way as photography broke the natural illusion of art". Roland Barthes' *Death of the Author* (1967) is often considered as an inception point for such patterns of thought. The overarching concept behind this was to highlight the importance of subjective interpretation and how this supersedes that of the author, who in the history of literature was placed in a position of highest regard. When considering the creation of meaning it is vital to consider that each individual will create their own version of the text. In the context of interactive digital narratives this seems like an obvious consideration, but Barthes' work still holds reverence in the debate over agency, which also bleeds into more fundamental conceptions of authorship. Within his seminal essay he states that "the true locus of writing is reading" (1967), considering this can it be posited that the true locus of interacting is watching or is it the interpretation of what is produced in response to this interaction? Either way interaction plays a huge role in how narrative is experienced by the user and should be treated as an inseparable part of narrative design.

3.3. Interaction Paradoxes

In order to create interactive digital narratives it is vital that the various paradoxes of interactivity are explored. Nitzan Ben-Shaul (2004, p.152) presents the problems involved with, what he refers to as, 'split-attention' causing issues with sustained engagement with interactive media. This is experienced through the differentiation of narrative film as a deep sustained interaction of the viewer and interactive digital narratives being associated with frustration, distraction or shallow-band engagement. When referring to the differences between these two approaches Ben-Shaul (Ibid.) states that, "only once this is understood, may it be possible to advance hypotheses about what are the factors required in order to make interactive cinema deeply engaging". With this in mind, it is vital that we not only explore the processes that have led to the creation of interactive digital narratives, but more importantly how their "failures" can direct us to approaches that overcome this division. Chris Hales (Koenitz *et al.*, 2015, p.36) states that, "there has been a lack of terminology and few interactive films have ever achieved widespread acclaim or public recognition", which is more of a result of than the reason for its issues. I consider the main origin of this line of enquiry to be a physical interaction paradox, which I define as a *narrative break*. This term refers to the inclusion of symbolic interactions that detract from the experience and alienate viewers into a position where they are overtly aware of their machinic role in a narrative process. Yes they have choice, but the very act of being required to make a choice conversely interrupts a sense of immersion and consequently narrative cohesion.

To elucidate such a conflict I look at the following four different disciplines: media art, contemporary narrative theory, interactive film theory and game studies. An early example of this disputation can be seen in Myron Krueger's Videoplace (1974). When interviewed about this interactive artwork he discusses his resentment about computers, referring to his interactions with them as symbolic as opposed to perceptual (Krueger, 2008). The need to adopt perceptual interaction practices pervades the logic behind my practice, as embodied modes of interaction have the potential to allow for the circumvention of the paradoxes that surround these processes. Offering a more contemporary

insight into this conversation, Marie-Laure Ryan (2015) states “that disembodied, external interactivity[11] is hostile to immersion, and that the fullest reconciliation of interactivity, immersion, and narrativity will therefore take the participation of a virtual body.” As the central thesis of her work this quote implies that physical means of interaction are counter-immersive and to overcome this dilemma a virtual body must be added to the discussion. Although applicable, the emphasis on the “virtual body” is somewhat reductionist as often the perspective offered when viewing through a virtual reality headset is first-person, which indicates a lack of a body. In fact if you are to consider the terminology used in most game engines all perspectives offered are in fact cameras, so your perceptible existence in virtual reality is represented by a virtual camera, not by a virtual body. That said, the merits of exploring the user experience of internal perceptual interaction is something I would like to address later in this thesis. For now, I would like to allude to the mediative qualities of *Cynematics*, which are adeptly expressed in this ideation.

The symbiosis of the camera and the eye is a cybernetic concept first explored by Dziga Vertov’s *Kino-Eye* (Vertov, Michelson and O’Brien, 1995) montage method in 1919, a consideration later expanded by Norbert Wiener (2013) to include all types of sensory data (ocular, haptic, olfactory, auditory, gustatory). In this envisioning of cybernetics, Wiener postulated that all human interactions are composed by an unconscious processing of time where feedback loops are formed between the nervous system and the senses reporting the state of interaction. What can be derived from this is that real-time communication is what makes interactivity function. To navigate the idea of the interaction paradox in relation to early interactive cinema, it can be perceived as far back as the first interactive film *Kinoautomat* (Činčera, R; Roháč, J.; Svitáček, 1967), which I examined in the introduction and in chapter 1, through its branching narrative structure based on collaborative voting that had to stop the narrative flow in order to collate user votes and change to a projector that related to the chosen narrative pathway. The interaction paradox is not limited to the realm of interactive film and exists in many forms throughout interactive digital media. Ruth Aylett and Sandy Louchart (2003, p.1) present a similar concept of the

[11] Any form of interaction that happens outside of the user’s point of view.

narrative paradox as the “conflict between pre-authored narrative structures - especially plot - and the freedom a VE offers a user in physical movement and interaction, integral to a feeling of physical presence and immersion”. The consideration of the spatial aspect of this paradox is not bound to the world of gaming. In terms of its relationship to interactive film there have been numerous attempts to conflate their structures into film/game narrative hybrids, for example: *Night Trap* (Riley, 1993), *Tender Loving Care* (Wheeler, 1998) and The *X-Files Game* (Roach, 1998). In *Changing Formats* (Koenitz *et al.*, 2015, pp.42-44) Chris Hale’s explores this phase of interactive film in more depth. Although innovative at the time these existed in a liminal space between film and game rather than having an identity of their own. That said they played a role in the establishment of full motion video (FMV) games, which are currently undergoing a period of resurgence. A prime example of what Aylett and Louchart (2003) refer to can be seen in the *Grand Theft Auto* series. When a player has been tasked with a mission, but has to navigate a generative sandbox to complete said mission. This often results in a break in dialogue when spatial impacts such as car crashes cross into the predefined narrative realm. The designer’s attempt to remedy this by having filler audio, but there is still an immersive shortcoming between narrative and play. In *A Clash between Game and Narrative*, Ludologist Jesper Juul (1998) summates attempts at cinematic interactive fictions as being, “trapped by unmotivated shifts between the narrative mode and the game mode, the story gets destroyed by the interactivity, the interactivity gets destroyed by the story.” The following theorists cover this area more exhaustively (Bizzocchi (2007), Simons (2001), Zimmerman (2010)). This extension from the interactivity versus narrative immersion debate illustrates the interconnected nature of such conversations, but to avoid being derailed from a film-oriented approach into the realm of game theory, I’d now like to migrate the discussion towards an experimental interactive film installation that plays with a new approach to narrative construction.

3.4. Algorithmic and Modular Narratives

Frank Biocca (Green, Strange and Brock, 2013, p.98) discusses how new media alters the state of how we experience narrative when he states that “new

media technologies and narrative share a common goal: the transformation of experience". However, embedded in this transformative symbiosis are approaches to interactive media that inhibit this potential, which Biocca confronts via a discussion on the different viewpoints people have of interactive media. He explores the contentious issue of utopian models of seamless, real-time, immersive and infinite narrative possibilities as opposed to an approach that merely propagates the interactivity versus narrative immersion debate. To approach a utopian conception of interactive narrative we must first find a narrative structure that complements the utopian model above. In *Future Cinema* Jeffrey Shaw (2003) looks at the differences between traditional approaches and contemporary exponents of new media and the impact these are having on cinematic experience. With this in mind, he gives two examples of ways in which emergent possibilities are being explored. These are composed of modular and algorithmic approaches, both of which relate to potential utopian narrative constructs. The difficulty with defining an algorithmic approach to narrative construction stems from the fact that as a procedural approach built on a series of instructions being sent to a computer, is it not implicitly involved to some degree in every human machine interaction? If we consider our unconscious data or even random number generation outputting to a chain of computer processes, everything that is programed into a computer becomes part of an algorithmic process. This perspective is built on the common definition of the algorithm, which currently offers no clear comparison to standard programming practice. Considering this I will approach modular narrative design[12] as an inherently algorithmic process.

Martin Rieser (1996, p.8) asserts the need to experiment and research in the area of modular approaches to narrative construction when he states that, "only through the open minded commitment of artists, writers and programmers who are prepared to explore the full expressive potential of the medium can we begin to see a meaningful art-form emerge". Affirmation of the need to expand the discourse of interactive cinema is certainly positive, but it does little to actualise an approach that is currently nascent and in a state of flux. To get an understanding of what is actually meant by a modular narrative design we need

[12] Referring to narratives that are designed to have interchanging parts.

to look at particular instances where it has been applied. Carlos Sena Caires (2007) composed an interactive installation film called *Transparency* which uses a modular approach. To maintain narrative coherency he divided his film into a series of narrative segments that were written to accommodate modularity, which he supported by attaching themes to each piece.

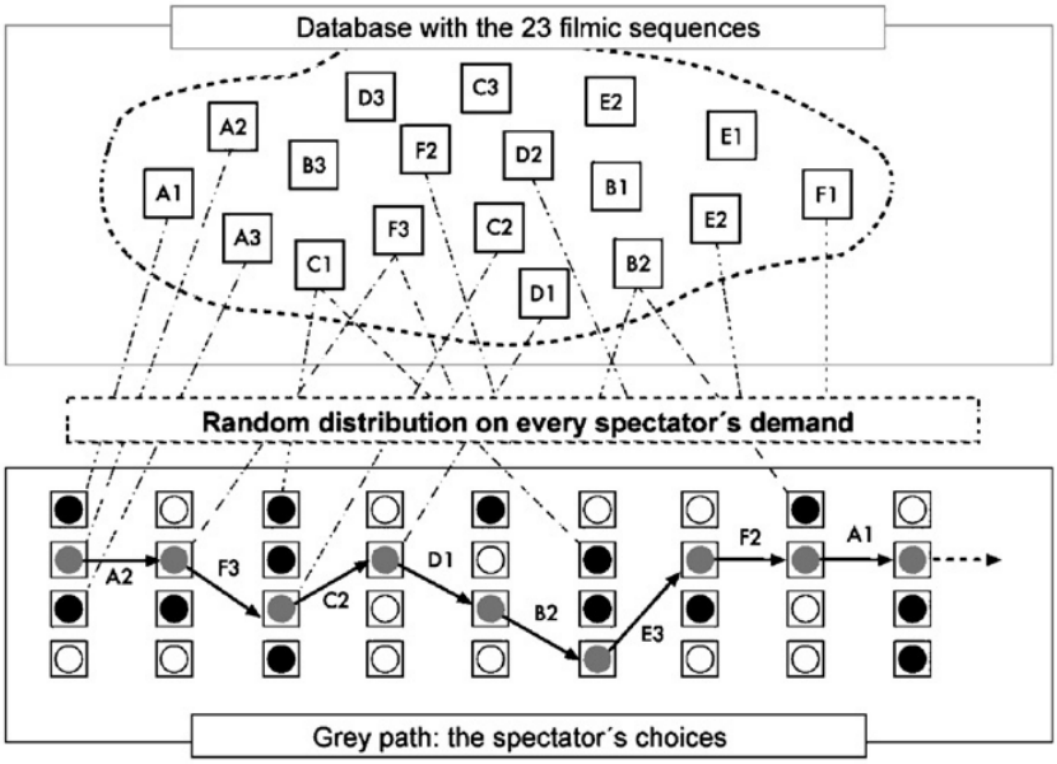

Figure 20 – *Transparency's* modular narrative structure (de Sena Caires, 2007)

Sena Caires also chose to allow random selections of clips within a theme to be made by a computer program, which serves to further fragment the designer/user power relationship as among them is a non-human mediator who is making random choices still connected to a thematic modular structure. His approach suggests that modularity is not a singular process and is achieved via the conflation of a variety of complementing attributes, in this case being supported by themes and machine-driven randomness. It should be noted that modular narratives are not unique to interactive media and exist throughout the surrounding mediascape. In the context of contemporary cinema Cameron (2008, p.1) defines modular narratives as films which, “articulate a sense of time as divisible and subject to manipulation”. This extends to areas such as; transmedia storytelling, interactive media and new media art, but each of these adds further complexity to the perception of time. The reason being that

interaction is central to how these temporalities are experienced. If considering time in a traditionally filmic context Matilda Mroz's *Temporality and Film Analysis* (2012) is a perfect point of consolidation for such ideas.

3.5. Datascape Mediation

In his discussions from *Interface to Cyberspace* (1993, p.75) Michael Heim refers to a feedback loop created when "we feed input into the system which then constantly feeds information back to us". Given that I am using real-time data as an interaction method, how an interactor responds to their data becoming part of the interaction process is a key research area in *Cynematics*. How they respond to their own interactions is a type of feedback loop that will impact both their experience of and the narratives they produce. Heim (Ibid., p.79) queries the location of the user and their role in the creation of meaning when he asks, "where are we when software architects shape the datascape into endless mazes of light attracting us like moths to a flame". The position of the self is something I overtly explore in my practice. For now, I would like to consider my role as the researcher who is also a software architect working inside of the parameters of various pre-authored systems. As a programmer working with a variety of software and programming languages it could be argued that all of these approaches impose specific structures on your work, which when examined further complicates authorial specificity. Given the collaborative realm in which software architects now exist it is more preferable to view them as *datascape mediators*. I present this as an interchangeable term for those who design, those who interact and the machines that process flows of information in virtual environments. This moves away from the authorial dialogue entirely, as promoting a more collaborative role in a system of information exchange is more relative to a *Cynematic* discourse. Such an approach can be perceived akin to Eduardo Navas' "assemblage gaze", which "enables and shapes human engagement with objects, things, concepts, and ideas according to the concept of the machinic" (2018, p.76) However, *datascape mediation* gives equal weighting to all of the components in the system, rather than privileging a human-centric perspective. Considering this I would argue that the more immediate concern is the allure of real-time interaction. Our concept of real-time is built on experiencing seamless and

immediate results to our interactions. This is an impossible process made palpable by an approach akin to how the persistence of vision creates the illusion of movement. Such ideations also enact feedback loops, which allude to the fractured nature of information exchange. Viewing Barthes' (1967) deconstruction of the author as the progenitor for a dialogue where the subjective interpretation and response of the reader is given prominence is a necessary mandate. However, this emphasis on subjectivity is part of an information system that Eco (1989, p.viii) describes as an "interactive process between reader and text." Such ideas are explored in active audience theory, in which proponents such as Stewart Hall (1973) propagate the centrality of the audience in the meaning making process. In the context of interactive digital media such privileging of the audience functions as an oversimplification of a more complex communication system. In *Interacting: Art, Research and the Creative Practitioner* (2011, p.4) Candy and Edmonds refer to how the active audiences "complete the creative process", which is an application more befitting of the collaborative components that allow interaction and consequential meanings to form.

3.6. Narrative Prosthesis

> Today, as more artists are turning to new media, few are willing to undertake systematic, laboratory-like research into its elements and basic compositional, expressive and generative strategies. Yet this is exactly the kind of research undertaken by Russian and German avant-garde artists of the 1920s in places like Vkhutemas and Bauhaus. (Manovich, 2002, p.15)

As expressed by Lev Manovich above, there is a need for new media practitioners to engage in experimental research. Although some of this work might not result in a finished product and other aspects will face execution once audience testing has occurred, this does not equate to failure, instead forming part of the discourse of a medium that is still in its infancy. The practical experiments that complement my research aim to create new narrative experiences that merge machine, designer and user to promote immersion, reduce the visibility of interaction paradoxes and allow interactors to produce unique visual experiences, that are not completely encapsulated by algorithms.

A key benefactor of this is real-time interaction, but without a complementary narrative structure this would be futile. I previously discussed modular approaches to narrative construction that implemented themes, but to explore this idea in more depth I would like to refer to Hargood et al's (2008) article *A Thematic Approach to Emerging Narrative Structure*. Here they are concerned with how folksonomy[13] can be organised thematically in order to identify narratives that exist between the story that can be perceived as the collection itself, and the discourse which refers to how the story is told.

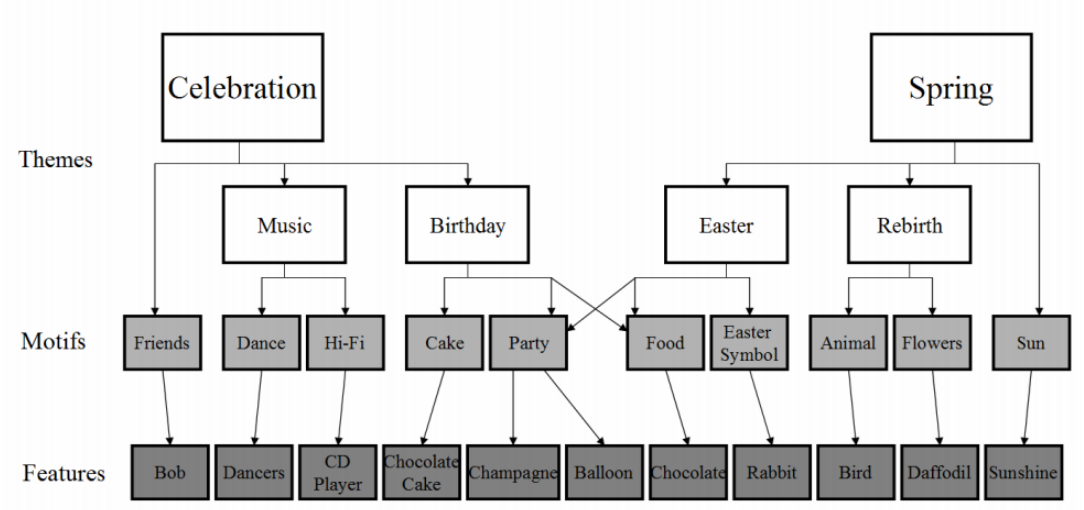

Figure 21 – Hargood et al's example of a thematic narrative structure (2008)

This model takes a structuralist approach to narrative that breaks narrative down into story and discourse. Their vision of this method is one that views thematics as "the discipline of approaching themes within narrative in a structuralist way, deconstructing and analysing the relations between the components that communicate a theme within a narrative" (2008, p.2). Although this method of narrative generation is inherently structuralist the approach that is being applied to the interactor via their method of interaction must also be considered. For example, does randomising their origin point and/or making transitions dependent on non-haptic interaction, create an arena where post-structural interaction is being applied to a structuralist generative narrative structure and what are the implications of this crossover?

[13] A folksonomy is a system of tags that are applied to online items to make them easily identifiable.

In the context of my practice this dualism is superseded by a triptych where cybernetics is operating alongside these two movements. The inclusion of cybernetics stems from the circular causality caused by feedback loops and interconnects with both the design and experiential aspects of my experiments. Primal examples of these relationships can be seen in my early experiments with pulse controlled branching narrative systems[14]. To start the system designer must decide to initiate the experience using a predetermined clip, which could either be randomised or assigned to a particular range of pulse values. Once this clip has finished playing a program will read pulse values in real-time and decide the next clip to play based on a range of values. These can be made more complex, although for the sake of a simple branching system a binary approach works best, but how is the midpoint decided? In the case of beats per minute there is a medical average that works fine for rudimentary experimentation. Once this has been decided the feedback loop must then be considered and factored into the thematic binaries selected. Having the theme invert the status derived from the user's data assists with the flux between positive and negative feedback, whilst also attempting to avoid stasis. However, it also creates a dilemma where the designer is assigning meaning to the user's data. Although these issues of control pervade these systems, interaction is a two-way system where meaning is derived from collaboration not passive consumption. Viewing this as a curatorial process that has the potential to unite database and narrative is a more beneficial prospect albeit not devoid of its own authorial issues. Hargood et al (2008, p.4) promote the curation of metadata when they posit that, "any user generated virtual collection is an account of some human experience and as such should contain a potential narrative; in a sense every blog, photo album, and video has a story to tell". This approach is a step in the right direction, but has two obvious flaws. The first of these is the workload associated with a designer having to screen and assign appropriate metadata to all content in the database, and stemming from this is the degree of subjectivity associated with this practice. Such considerations are present throughout my practice and the manner in which they are resolved offers insight into attempts to add to the field of interactive digital narrative – while building towards an approach that revokes how user-

[14] https://www.youtube.com/watch?v=3CJskdnaLCM

interaction typically distorts the cinematic expectation built around an uninterrupted series of moving images.

3.7. Conclusion

I started this chapter by introducing narrative intelligence, applied to research into AI and narrative. This functions under the premise that human narratives are designable systems, which establishes the human-machine dialogue via a property that is often considered unique to humanity. Such a conception presents humans as systems, which is a fundamental aspect of cybernetics. Aligning with the rise of the posthuman, I position these ideas as components in a dialogue of communication and control that is offered by collaborative interactions between the designer/machine/user.

To ground this approach I offered a case study of Lev Manovich and Andreas Kratky's *Soft Cinema* project (2005), which provides a userless machine-driven approach to cinema. Such work showcases future imaginings of cinema, whilst demonstrating key debates that stem from these kinds of applications. Central to this is Manovich's claim that narrative and database are inherently opposed to one another, which in the context of interactive digital media is something that I refute. Such debates pivot around access and use, which alludes back to interactive films that include user-interaction. With this in mind, I provide a phased outline of interactive film in order to further elucidate such a malleable genre. It's at this point that I promote narrative as a liminal, rather than a fixed system.

In order to approach new narrative conceptions a contextual overview of pre-digital and digital narratives was necessary. This was employed by building on the Aristotlelian (Aristotle and Kenny, 2013) and Freytagian (2008) inceptions for narrative structure, towards points where experiments with narrative form paved the way for the development of digital narrative structures. I framed this with Gérard Genette's (1980) metalepsis and Jorge Luis Borges' (2018) *The Garden of Forking Paths*. Once they are contextualised Nelson's hypertext was introduced as a technological catalyst that builds towards practically actualising and expanding on such experimental cogitations. The addition of the machine

voice is a pivotal point that promotes the augmentation of narrative, whilst further fragmenting the role of the author. To initiate a conversation on authorial analysis I consider how this inclusion relates to Roland Barthes' ideations. Stemming from this the "failures" of interactive film are explored, which brings the interactivity versus narrative immersion debate to the fore. To overcome the *narrative break* that I term as the physical interaction paradox that exists for interactive film, I look towards media art, contemporary narrative theory, interactive film theory and game theory to demonstrate occurrences and explore related problems. To initiate this, I start by aligning with Myron Krueger's (2008) positing that perceptual interaction is a site that opposes typical symbolic interactions. To contemporise this discussion I looked to Marie-Laure Ryan's (2015) thesis, which promotes embodiment as a site of reconciliation for interactivity, immersion and narrativity. However, although I agree with Ryan's promotion of the virtual body, I also view it as a conceptual simplification of a space that is more intrinsically linked to film discourse than is typically discussed. In contemporary virtual reality development the body is typically represented by a virtual camera, which is an ideation that promotes the symbiosis of the camera and the eye. Such a conception is indicative of *Cynematics* and is a pre-cybernetic process established in film theory history through Dziga Vertov's Kino-Eye (Vertov, Michelson and O'Brien, 1995), that was later applied to human perception via Norbert Wiener's conception of feedback in cybernetics (2013). This rebuttal of Ryan's thesis led to the idea that real-time communication is what helps interactivity function. Considering this in relation to the first interactive film I illustrated how narrative flow is stopped in order to allow for interaction, which served as an antithesis and promotional example of *Cynematic's* concern with real-time communication. Expanding on this I presented game/film hybrids as this genre is often considered to be a form of interactive film as well. The immersive shortcomings between narrative and play was briefly mentioned to illustrate another narrative deficiency, but to expand on interactive film's flaws I looked towards new narrative approaches.

After challenging the difference between algorithmic and modular narratives I opted to approach modular narrative design as an algorithmic process. This is elucidated by a diagram of Sena Caires' (2007) experimental interactive

installation film, which conflates modular sequences with a non-linear user-driven narrative pathway. This example aids the refutation of Manovich's theory (1999) that I alluded to earlier, as such a narrative requires the synthesis of database and narrative to function, which builds into *Cynematic's* promotion of collaborative processes.

In order to consolidate my initial ideations on Roland Barthes' (1967) deconstruction of the author I alluded to Michael Heim's (1993, pp.73-82) discussions on feedback loops, which calls into question the role of the user and their involvement in the meaning making process. To promote collaboration between human and machine systems and to condense the designer/machine/user into a single interchangeable term I refer to them as *datascape mediators*. This term moves away from the authorial dialogue completely, instead focusing on the types of control and meaning that can be extrapolated from interactions between these systems.

Cynematics aims to promote *datascape mediation* and hinder the interaction paradoxes attached to interactive film. To achieve this real-time interaction is a necessity, however this needs to be attached to a narrative system that functions in unison with this. Considering this I explored an emerging approach to narrative construction via Hargood et al's (2008) thematic framework built from a structure that starts with oppositional metatags as a base for narratives that can be derived from extensive databases. This formed the theoretical basis for many of the ideas explored in *Narrative Maze* (see chapter 4). Their approach promotes the curation of metadata's narrative potential, which is a merit-worthy endeavour. Running parallel to this are the feedback loops produced from an interactor's body data, which is a cybernetic element that I experiment with in my practice to produce dynamic interactive experiences, whilst looking for an interactive approach that is perceptual without being wholly abstract.

Throughout this chapter I used the tenets of *Cynematics* established in chapter 2 to explore and develop various narrative systems. Starting with pre-digital and then on to digital examples, I considered the application of these structures from a perspective that is looking to promote the synthesis of the components

involved in these interactions. Looking for a means to circumvent previous approaches to interactive film, I extensively explicated why this needs to pivot around real-time interactive approaches. Many of the theoretical refutations that I engage in will resurface in my practice, but all of these stem from ideations formed by the principles of *Cynematics*. This approach provided a framework that assists with the remediation of an interdisciplinary discourse that is otherwise extremely difficult to articulate.

In the next chapter I plan on iteratively experimenting with many of these ideas, towards prototyping a more specific application of *Cynematics*, one that can fulfill my postulations and exemplify the potential of this approach to interactive film.

Chapter 4. Methodology: Towards a Cynematic Practice

4.0. Practice as Process

In the second chapter I defined the tenets of *Cynematics*, which outline the central means required in order to supplant previous versions of interactive film. However, in order to build this into a viable practice a suitable form of interaction is required. This is summated by the tenet which promotes a “focus on perceptual interactions as opposed to symbolic ones”, which I will now explicate in further detail.

Prior to engaging in practice-based research I had referred to this interaction as non-haptic, which is an approach that I initially used to describe the potential of using body data as an interaction method. As I move through each phase of practice I adopt and evolve this approach, which gradually shifts to include a form of perceptual interaction. On a macro level *Cynematics* can be perceived as a research process, as each of its outlined criteria build towards an approach to interactive film that aims to resolve a variety of research questions. However, on a micro level is the more immediate concern of actualising a suitable form of interaction, as without this it would be impossible to delineate a *Cynematic* practice. In this section I implement this by providing an input/output structure, which can be perceived akin to aims/intentions (input) being explored through iterative critical reflection (output), allowing each practical experiment to rotate into the next. Each phase functions as an encapsulated experiment, whilst also forming part of a collective discourse that leads towards the creation of a novel practice and associated theoretical considerations. Linking back to my statement in the introduction on the relationship between theory and practice the methods employed in this chapter give insight into how theory and practice are both used to inform and challenge each other. Rather than viewing them as separate components I prefer to view them as part of a shared system, where feedback from both can be used to implement changes in the next iteration. It is here that I should note that the method of evaluation that best aligns with the practice in his chapter is the lab experiment components, which is outlined in figure 23 in the human-computer interaction model discussed in section 4.4. Prior to taking the practice into the field and doing surveys to explore a

particular aspect of it I need to establish a practical focus that aligns with my research framework.

Prior to engaging in processual reflections on my visual experiments, a more extensive discussion on the mode of approach that I have adopted is warranted. The aim of this is not to justify experimental approaches to practice-based research, but to illustrate how mixed methods can be applied to transdisciplinary research of a more technologically oriented nature. It also serves to elucidate my leaning towards practice as a process, which in this instance produced unexpected convergences on the theme of vision. Each of these experiments allowed me to prototype with a wide variety of technologies, but also iterate ideas derived towards and through these processes. Some theorists refer to this as praxis, which Kolb (2007, p.8) presents as "the transformative dialectic between reflection and action--reflection informed by action and action informed by reflection." I favour the term process over praxis as it semantically aligns better with the machine-driven approaches that I employ in my work. However, the pedagogical research surrounding praxis functions as a starting point for the construction of a mixed methods approach built around cyclical iterations of both theory and practice.

A fundamental concern surrounding this approach is how does practice-based research differ from just being a practitioner? Scrivener (2000, p.12) argues that the intention of the practice-based researcher should be to "generate novel apprehensions (by novel I mean culturally novel, not just novel to the creator or individual observers of an artefact.) by undertaking original creation, and it is this that separates the researcher from the practitioner". The idea of "culturally novel" practice is particularly relevant; as underlying intuition and aesthetics is the practice-based researcher's method of answering their research questions and the impact this generates. In effect this process negates the notion of "art for art's sake" in favour of an approach that generates new knowledge through its positioning within a research context; Sullivan (2005, pp.95-96) alludes to the merits of this when he posits, "if a measure of the value of research is seen to be the capacity to create new knowledge and understanding that is individually and culturally transformative, then criteria needs to move beyond probability and plausibility to possibility." To assemble my own actualisations, I tailored a

mixed methods approach that encompasses the processes involved in this stage of my research.

For additional visual material in support of each section of this chapter please refer to the PhD website via the attached USB appendix. It is accessible through “Towards a Cynematic Practice” on the main page of “PhD_Website”.

4.1. Mixed Methods

Throughout this chapter I employ three different research methods, which each inform a cyclical phased structure. This is formed of reflective practice, action research and human-computer interaction. Each of these methodologies is underpinned by my own theory of *Cynematics*, which is a theoretically grounded approach that aims to provoke new forms of practice and usurp current understandings of how we define film practice. From the outset I should state that it is difficult to consider these methods in isolation of each other as collectively they form the research process that I am alluding to. With this in mind, one should consider each method referred to as part of a more complex system.

4.2. Reflective Practice

To begin, I start with an application of Donald Schön’s (1983) concept of reflection-in-action and reflection-on-action, which Linda Finlay in *Reflecting on ‘Reflective practice’* (2008, p.3) simplifies to “after-the-event-thinking” and “thinking while doing”. This method is used as a mode of processual thinking with an emphasis on the aesthetics of interaction (form & experience). The central idea being that although I have predetermined research questions I don’t want them to hinder my creative output and I also expect unforeseen findings to emerge from my work. Given that I am engaged in experimental practice, I have to remain open to potential deviations as such research not only has unpredictable outcomes, but also has the potential to reorient research questions. In support of the merits of iterative experimentation Henry Roediger, Adam Putnam and Megan Smith (2011, p.4) offer evidence that “testing identifies gaps in knowledge”. Such observations became apparent during each

of my own experiments as I put conceptual ideas into practice, but it took after-the-event-thinking to consolidate aspects that work, towards making considerations for the next experiment to be conducted.

4.3. Action Research

“No action without research; no research without action”. (Marrow, 1977, p.193)

Working in synthesis with my reflective practice is an approach to action research that supports a linear progression in my work (Figure 22). As previously stated, being bound to your research questions can hinder experimental practice, but without their presence your work can become structurally chaotic. The aim of using both of these methods in parallel with one another is to create an approach to practice that allows for experimentation and new outcomes derived from these processes, but also incorporating a method that can help guide these outcomes. In *Is reflective practice synonymous with action research?* Tim McMahon (1999) states that *strategic action* is integral to action research, which is the key difference in two otherwise very similar recursive processes. Rather than dwelling on the specificity of research questions it’s this strategic action that helps articulate my reflective practice in a manner conducive to culturally novel outcomes.

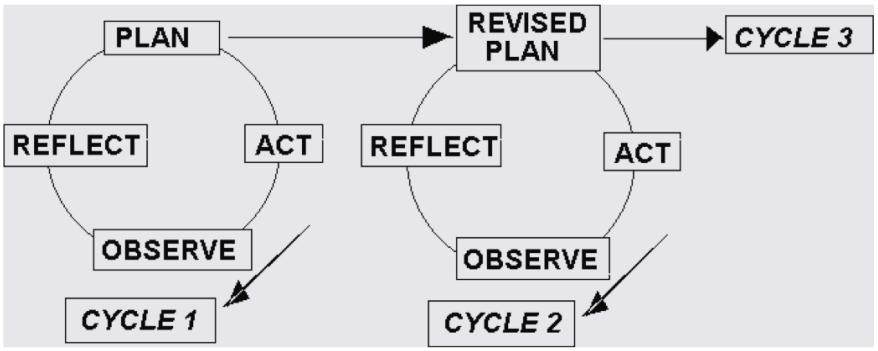

Figure 22 – Action research (Phil Riding, Sue Fowell, 1995)

4.4. Human-Computer Interaction

The final component in the methodological framework employed during this stage of my research is derived from human-computer interaction (HCI). A methodology typically assigned to this area is user-centred design, which

becomes a more prominent discussion area when I focus on the outcomes developed from this part of my research. However, at this stage I am more concerned with heterarchical interactions between humans and machines. In MIT's graduate course on User Interface Design and Implementation they convey the three main types of research methods in HCI (Figure 23). This macro level envisioning of HCI methodologies is applicable to my practice as I start with lab experimentation, move on to field study, and finally will use surveys as part of an analysis on the experiences derived from my practice. A lot of my early stage experiments were contained to a lab setting and as this figure illustrates, although this approach offers precision, interactions can become abstract if contained entirely in this setting. As I discuss each experiment I will allude to how their progressions through different HCI methodological settings brings their flaws to the surface. Combining this with reflective practice and action research allows me to illustrate how the process of experimentation is a form of research in itself, whilst also demonstrating how these experiments introduce an unexpected and entirely novel course of research.

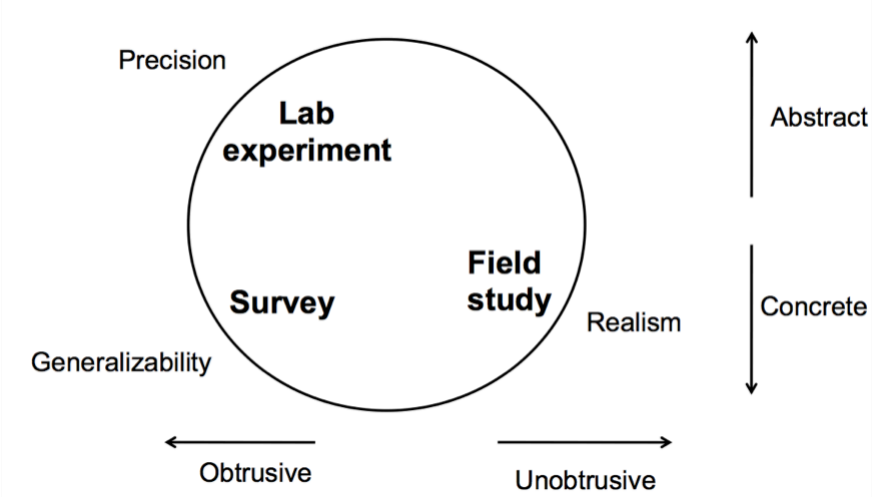

Figure 23 – Human-computer interaction diagram adapted by MIT from McGrath's *Methodology Matters* (1984)

4.5. Phase 1: Virtual Embodiment

To map my practice-based research in a manner that interrogates the idea of tacit knowledge and "arrays of activity" (Schatzki, Knorr-Cetina and Savigny, 2001) developed throughout my iterative visual experiments, I have employed a

phased structure. This method allows me to encapsulate aspects of my practice that can then be unpacked and explored through the mixed methods approach discussed in the previous section of this chapter. I would like to start by engaging with the materials that inspired this work and shaped the lines of enquiry associated with it. Using a chronology of research[15], I will chart the development of my ideas, towards contextualising my practice and establishing the contributions to knowledge that stem from this process.

In this section I refer to three main practitioners, each of whom informed the first phase of my practical experimentation in different ways: Hiro Iwata's work introduced the paradox of embodied disembodiment and the merits of using real-time interaction, Char Davies (1995) used atypical kinds of interaction and Jacolby Satterwhite (2013) narrativised the self using chroma key.
The final output is a series of visual experiments that conflate aspects of these artists' work, into systems that use real-time embodied interactions to address if the user's experience of self can be narrativised. Although the immediate concern is pinpointing a suitable interaction method for *Cynematics*, in order to achieve this such experiments conflate with other parts of this discourse – this allows the interaction methods to be tested in an environment relevant to these requirements, whilst also exploring the emergent potential of cinematic approaches accessible via this practice. Outside of the immediate context of these experiments, I am more generally considering the experiential aspect of these types of real-time interaction systems. The following points elucidate my initial lines of enquiry:

Inputs:

- Create a platform where a user's physiological data changes their perception of "self" and vice versa.
- Can the experience of "self" become part of a narrative system via embodied interactions?
- Exploring other kinds of experiences that can be generated in this environment.

[15] Materials ordered in line with when they appeared in my research.

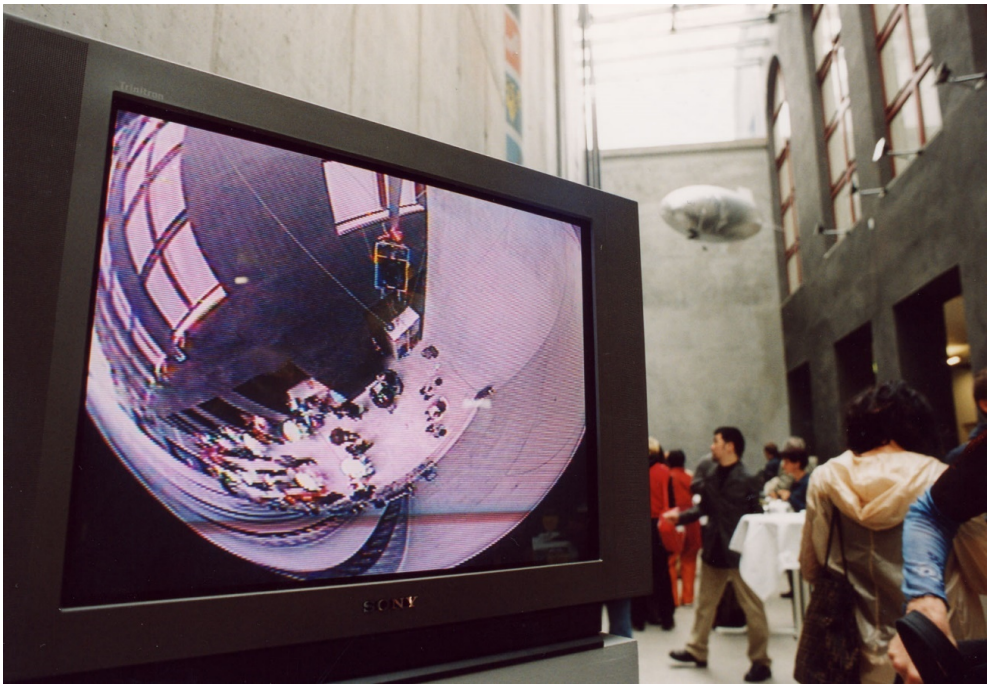

Figure 24 – *The Floating Eye* (Iwata, 2001)

Prix Ars Electronica gave an honorary mention to Hiro Iwata's *Floating Eye* installation (Ars Electronica, 2001), which focused on separating vision from the body. The user places their head inside of a spherical egg-like container, which projects wide-angle live video around the user's entire field of view. Outside of this space they control the camera's movement via a string that is attached to an airship floating above them. This gives the user a real-time third person perspective, creating a degree of omnipotence but even more so challenging their perception of self. Akin to René Descartes' (Descartes, Cottingham and Williams, 2016) interrogations into the reliability of the senses, this installation creates a Cartesian dualism where the user's internal vision becomes externalised as they become both the user and the subject of interpretation at the same time. This new kind of outer body experience made me query, to what degree our experience of the self could become part of a narrative system? Although physical interactions, such as the manipulation of the floating camera create a connection between the user and their environment, the most prominent feature of this interaction is its actualisation of Dziga Vertov's Kino-Eye (Vertov, Michelson and O'Brien, 1995). Amongst the various attempts to define this term, Joseph Christopher Schaub (1998) interprets it as a "cyborg construction that contains multiple positions for the production of film meaning".

The inclusion of the cyborg into this discussion is an inevitable outcome of the human/machine dialog. This is explored through the lense of authorial control in the second chapter and more specifically in relation to *Cynematic* practice in the third phase of practice discussed in this chapter.

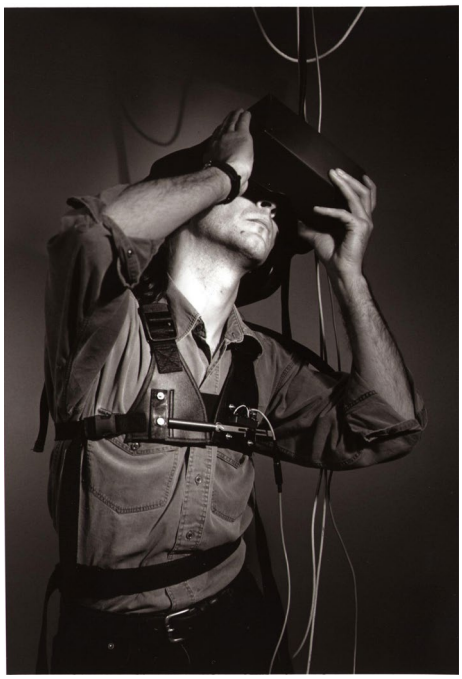

Figure 25 – Breathing and balance interface used in the performance of immersive virtual reality environment *Osmose* (Char Davies, 1995)

Considering embodied interaction[16] in more depth, my research led me to Char Davies' (1995) immersive environment artwork called *Osmose* (Figure 25). Although a virtual environment filled with particles and transparent textures, this precursor to the previous installation deals with similar themes, which Davies defines as a "space for exploring the perceptual interplay between self and the world, i.e., a place for facilitating awareness of one's own self as consciousness embodied in enveloping space." (1995) What's particularly fascinating about this work is her use of breathing and balance as methods of movement in this environment. As a contrast to typical symbolic interactions i.e. controller, mouse and keyboard, this approach embodies the experience, creating a connection between the user and the work that promotes the thematic qualities of movement in virtual spaces. This type of interaction also challenges our

[16] Interaction that stems from body data.

perception of how we interact, as typically it is formed by our hands controlling the digital realm via mechanical movement.

In *MediaArtHistories* Peter Weibel (Grau, 2007, p.24) states that "there are two forms of interactivity between work and viewer: manual and mechanical". This dichotomy is blurred when alternative interaction methods are used leaving behind a posthuman cyborgian entity. This addition can obfuscate our attempts to derive meaning, but it can also heighten immersion leading to more complex narratives being generated. Is it a case that embodied interaction could allow aspects of the self to be externalised, which in turn could be experienced as a type of narrative of the self? And if so how does the design of this frame how it is interpreted. Edmond Couchot (Grau, 2007, p.183) refers to the emergence of a "new perceptive habitus" in which subjectivity is formed by the hybridisation of the self with both the object and the image. Referring this to his interpretation of Levy's vision of subjectivity as a fractal system (Ibid.), it is clear that the boundary between the self and how it is represented digitally forms an expanding symmetry – one where our perception of the self is concurrent with the interactions that allow us to access it. Such a postulation synchronises with *Cynematic's* promotion of human-computer interaction, whilst also promoting the relevance of *datascape mediation* as an alternative to hierarchical divisions of control.

At the Whitechapel Gallery's *Electronic Superhighway* (2016) exhibition I had the opportunity to view Jacolby Satterwhite's *Reifying Desire 6* (2013). This six-part series transports us into phantasmagoric environments where his body virtually interacts with a series of 3D objects. Satterwhite[17] defines his structural approach when he states that "the intersection of the disparate disciplines including dance performance, drawing, and digital media acts as an exquisite corpse strategy for guiding the storyline". The idea of relating his work to a collective assembly process akin to William Burroughs' popularisation of the cut-up technique[18] (Jones, 2018), can be perceived as an emergent narrative experience that illustrates that versions of the self can be narrativised (explored

[17] http://jacolby.com/section/267514_Reifying_Desire.html
[18] Referring to the process of cutting up and rearranging a text to create an entirely new outcome.

more thoroughly in *Narrative Maze*). However, this is bound to a predetermined system that does not include user interaction, beyond interpretation of the surrealist worlds created. Expanding on Satterwhite's use of chroma-key I wanted to add a real-time variant that would allow users to experience virtual representations of themselves and experiment with types of embodied interaction that engage with this experience.

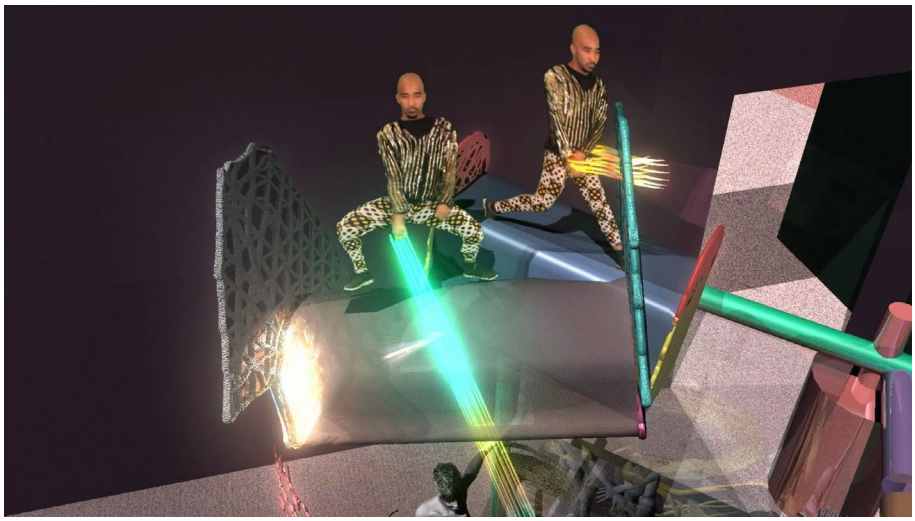

Figure 26 – *Reifying Desire* (Satterwhite, 2013)

Once I developed an approach to generating live chroma key in a VR enabled space I started to experiment with different approaches, towards encapsulating the experience as a narrative system. My first experiment involved walking around and observing myself in VR, which became a kind of virtual mirror (Figure 27). Iwata's outer body experience involved the user perceiving themselves from another perspective in real-time, which creates a disembodied self engagement with a cybernetic practice that conflates organic vision with mechanical vision, a theme that continues to develop as my practice ensues.

Figure 27 – *Virtual Embodiment*: Experiment 1 (Ambrose, 2016)

In the case of my first visual experiment I created another new type of outer body experience, where through the use of VR the user's vision becomes the viewpoint of a virtual camera that navigates a virtual environment. Inside of this space is a real-time chroma keyed visual of them that is being filmed on a physical camera. As an actualisation of whether the self can become part of a narrative system, this experiment has the user confronting the site of data production (their body), which in turn is used to create environmental changes that potentially change their experience of the virtual self. The overarching idea was to create a dynamic environment that responds to changes in user data, using the feedback loop as a method of interaction.

Figure 28 – *Virtual Embodiment*: Experiment 2 (Ambrose, 2016)

To initiate this, I started by adding pulse-controlled dynamic lighting. Using an open-source pulse sensor I programmed the environment to become darker the higher your pulse, which had a more relaxing capacity than the stark white. As the pulse lowered the environment would become brighter, which caused the

pulse to raise, creating a feedback loop where the user's experience of the virtual mirror, the vast empty space and the dynamic lighting all had a real-time impact on the experience and the production of user data (Figure 28). The game called *Nevermind* (Flying Mollusk, 2015) employs a similar method, but instead of your pulse controlling the colour of the environment it controls a filter that distorts your vision of the game (Figure 29).

Figure 29 – *Nevermind* pulse-controlled filter (Flying Mollusk, 2015)

Rather than being a constant inclusion it only activates when your pulse peaks over a certain level. Their use of this feature is interesting although it synchronises with a psychological horror game better than it does with a VR installation space. Although this experiment adds a generative quality to the environment, which in turn shapes the perception of the real-time image being viewed. This is a relational interaction that takes emphasis away from the real-time chroma key. To realign this, while establishing a key component of VR I shifted towards real-time scaling.

To implement real-time scaling I used open-source galvanic skin responses (GSR) to measure the emotional arousal of the user (see p.213 of technical documentation). Connecting this data to an incremental scale the chroma key object was set to scale once data exceeded the user's baseline and the speed of scaling is relative to the percentage amount they are above their baseline. I experimented with the idea of having the object shrink as well, but found that constant scaling was more imposing and allowed me to cap the experience with an ending. These experiments illustrate ways that embodied interactions can be

used to externalise aspects of the self in virtual environments. Which, if framed in the right context can be used to form narratives.

Figure 30 – *Virtual Embodiment*: Experiment 3 (Ambrose, 2016)

Expanding on the outer body experience that operates in the liminal space between human and machine vision, the user's data becomes implicit in a narrative system where their virtual self grows, becoming a monstrous distortion as the angle of view changes (Figure 30). The ever growing virtual self minimises the user's disembodied gaze as they become overpowered by their own presence. Drawing on notions of the Lacanian mirror stage[19] (2001), these experiments use VR to explore the existential crisis of self, which as the source of subjective meaning is the site where narrative intelligence (see chapter 2) is formed and a perfect point of entry for my visual experiments. To cement the existential nature of the piece, the virtual self is eventually destroyed via emotional arousal and in its place is a randomised phrase that plays with the utopian and dystopian qualities of this kind of embodied interaction (Figure 31). As a demarcation of the end of the piece, this inclusion frames the user's interactions in a narrative where their body data becomes synonymous with reinforcing the notion of an existential crisis or subverts this notion in favour of the virtual self being freed from the constraints of this environment.

[19] Referring to the point in which a human becomes aware of their existence and consequently begins creating a perception of self.

Figure 31 – *Virtual Embodiment*: Experiment 4 (Ambrose, 2016)

The inclusion of a database approach to text generation at the conclusion caps the experiments as reflective spaces in which the experience of self and its eventual removal becomes part of a generative narrative. Aligning with a more conceptual take on how we define user-produced real-time narratives, these experiments explore ways in which our bodies' data can be used to catalyse narrative systems, designed to frame our experiences of them.

The final experiment conducted for *Virtual Embodiment* pivoted around the concept of a live first-person view in VR (Figure 32). Coming full circle back to a derivation of the ideas explored in Iwata's work, this work attached a live perspective of self to the controller camera, creating a live over-the-shoulder perspective, which I then used to navigate a basic maze. This mode of approach forms a fluid synthesis between VR and chroma key, but given the emphasis of my research towards film applications, I found this added layer to be quite overwhelming to an already daunting visual experience, and therefore decided to pursue different avenues of visual interaction.

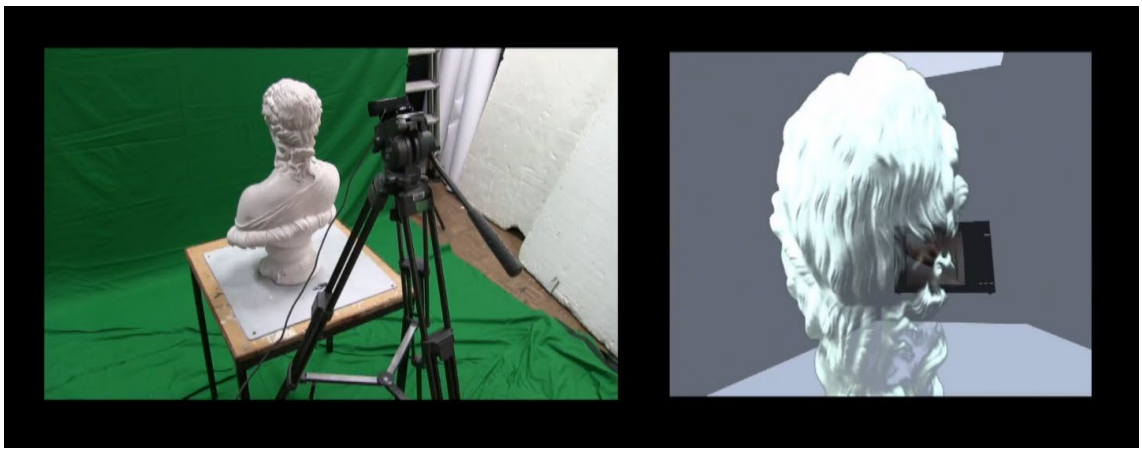

Figure 32 – *Virtual Embodiment*: Experiment 5 (Ambrose, 2016)

Outputs:

- Creation of a new type of outer body experience.
- Made Max-Unity Live Chroma Key scripts open source.
- Physiological interactions employed in this space were too abstract.
- Galvanic skin response data via the sensors I was using was too unstable
- Difficulty navigating the virtual environment while having sensors applied to a user's hands.

4.6. Phase 2: Narrative Maze

At the end of the previous work I created a maze environment, in which the next phase of my experimentation took hold. In opposition to the vast expanse of my earlier experiments and introducing a degree of gamification that alludes to early first-person games, this approach explores an emergent narrative system built around unconscious interactions with a database. Inspired by a conflation of practice and theory in practice, these experiments synthesise: Nam June Paik's *Internet Dream* (1994) both aesthetically and the application of screens in a spatial and narrative context, Jeffrey Shaw and Dirk Groeneveld's work on *Legible City* (1989), in terms of adopting an experimental interaction method that forms a relationship between text and the environment the user traverses, and finally the recursive qualities of these interactions are wrapped in a Foucauldian (1995) panoptic narrative that frames the work under the theme of surveillance.

Inputs:

- Create an environment where a user's pulse data is meaningfully assigned to a word that is visually represented from a curated moment online.
- Establishing an emergent narrative system built around unconscious/conscious voyeurism.

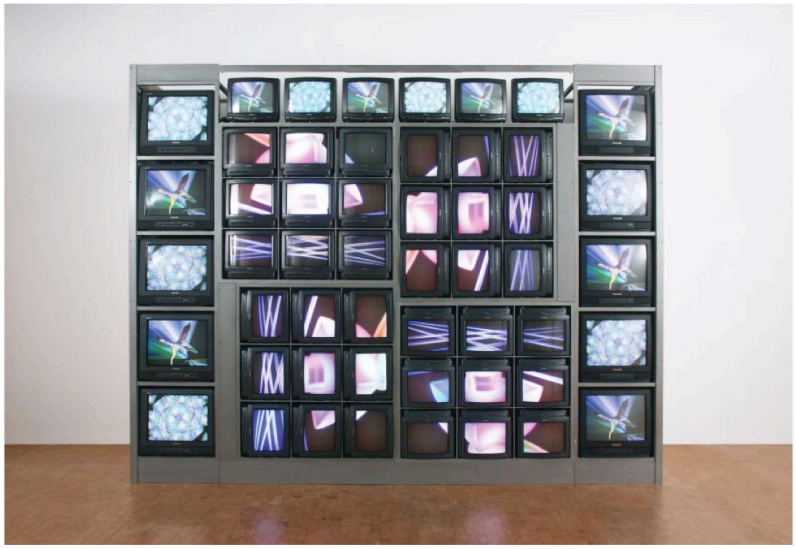

Figure 33 – *Internet Dream* (Paik, 1994)

Rather than making the entire focus of these experiments about the user's attempts to escape the maze, I wanted to present them with visual content at each 'dead-end'. The idea being that their pulse data could relate to a word that would then call the most popular Vine[20] hashtag using this word. In *Media Planning for the Postindustrial Society* Paik (1974) places television as a utopian model, which he stated "will join ranks with many other forms of paperless information transfer, such as audio cassettes, telex, data pooling, continental satellites, micro-fiches, private microwaves and eventually, fiber optics on laser frequencies. All of them together will constitute a new kind of nuclear energy for information and the improvement of society." I opted to display these Vines on three-dimensional television sets as they represent such utopian principles in the same breath as they reflect dystopian ideologies. More specifically I was curious how hashtags (which in this instance are used to

[20] Video service where users could upload six second looping video clips.

curate visual content) can be used to access a database of user-generated video content. Having these Vines displayed on virtual televisions, not only entices the user to watch them, but also symbolically aligns them with the spatial qualities of the screen as a boundary. In *Screen Dynamics: Mapping the borders of* Cinema the relationship between spatiality and narrative is raised when Morsch states that (Koch *et al.*, 2012, p.115) “the *material* boundary of the screen is therefore simultaneously a *narrative* boundary”. This idea of the different boundaries that make film “readable” is of particular interest as *Cynematics* disrupts these and in turn calls into question how we define the “readability” of moving images. Given that the user is confronted by these televisual encounters in an immersive virtual reality environment, initially there is a clear division between these moving images and the virtual environment that everything occupies. However, at the end of the maze they are presented with a screen that displays a recording of all of their movements throughout the maze, which shows how they are implicit in a narrative about their interactions.

In the context of VR the screen becomes an invisible boundary and instead is better envisioned as operating simultaneously as a virtual narrative boundary. That said there is a new physicality offered by first generation commercial VR HMDs. Stemming from the irony that the screen is transcended by the inclusion of a screen for each eye, is the fact that both the weight and the wired tethering of these devices deprecates immersion in ways different to the external surroundings of a screen changing how content is experienced. In those brief moments the user becomes aware of the screen, but typically the experiential aspect overcomes this. In *Narrative Maze* this is promoted by visual encounters produced from user data, but more specifically how words are assigned to this information and built into a generative visual system.

Legible City (1989) is an installation by Jeffrey Shaw and Dirk Groeneveld that allows a user to navigate a simulated representation of a city using a bicycle. The architecture of the city is occupied by textual formations, where each narrative strand is demarcated using a different colour. Shaw (1989) expands on the purpose of the installation when he states that, “travelling through these cities of words is consequently a journey of reading; choosing the path one takes is a choice of texts as well as their spontaneous juxtapositions and

conjunctions of meaning". There is a flavour of the cut-up technique, although in the case of *The Legible City* new meanings are derived from a user's movements in a virtual space. It could be argued that such interactions form generative narratives, but these remain grounded in a textual realm.

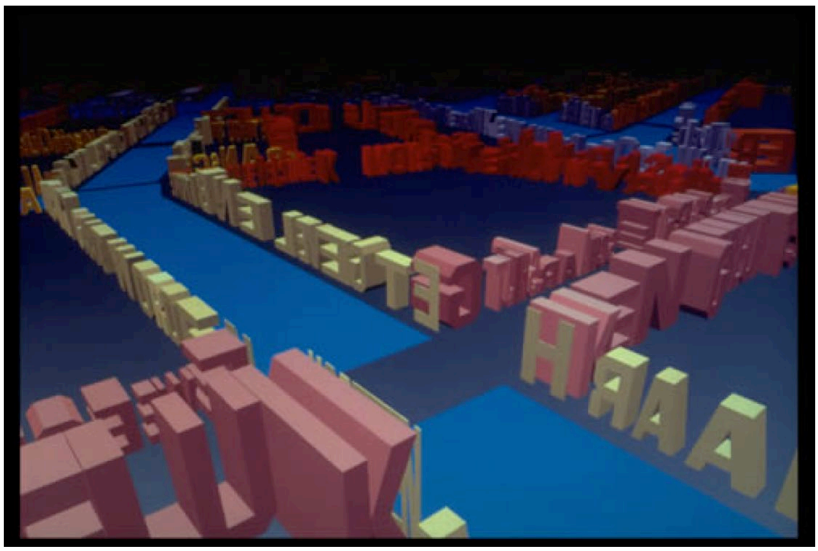

Figure 34 – *Legible City* (Shaw, 1989)

Narrative Maze adopts an approach akin to Tristan Tzara's Dadaist poetics, but

1. **Sentiment analysis** - To obtain a vast list of positive and negative words I looked to Github, where researchers Liu Bing, Hu Minqing, and Cheng Junsheng (2005) published a list of opinion words derived from their research. Sentiment analysis refers to the computational analysis of words, that aims to categorise user opinions in a given text. This approach gave me a massive array of binary words to work with, but beyond the positive and negative binary there was no scale of textual representation to work with. In practice this means that a random scale is applied to each category, creating an erratic disconnect between a user's data and the videos that are being called. Given the chaotic nature of calling videos with incredibly

subjective hashtags, the unpredictable nature of the work did not need to be reinforced. However, relating pulse data to emotions aided in the generation of visceral visual experiences.

2. **Emotional labelling** - In my search for a scale of words relating to particular emotions I discovered a technique used by mental health professionals to help patients that struggle with processing their emotions to understand how to categorise them. The result of this is a series of textual scales assigned to each emotion that provides a textual frequency that the sentiment analysis approach lacked. This is reflected in the intensity of feelings (Figure 35) and a video called by a high pulse value as illustrated below it (Figure 36).

In the third chapter I discuss the feedback loop as a site that challenges the positioning of the human and the machine with reference to Michael Heim's philosophies of cyberspace, but my transdisciplinary approaches are better actuated as cybernetic systems, as the inclusion of the user adds an experiential and unpredictable component to the analysis of digital topographies. To clarify, rather than focusing specifically on user interaction I prefer to see this as part of a larger network, one that involves types of unconscious user interaction that form part of a complex entanglement that collectively informs the user's experience. Such unconscious systems of interaction are actualised in *Virtual Embodiment* when I referred to using feedback loops as components of interaction, which is a recurring trope when dealing with human-computer interaction. Again, in *Narrative Maze* I explore the potential to harness a feedback loop to promote information changes as opposed to perpetuating homogenous user data. To this end, although a user's data is reflected in both the word and the video called, to make this process dynamic the user's data has to be designed to accommodate the production of data variations.

Intensity of Feelings	HAPPY	SAD	ANGRY	AFRAID	ASHAMED
HIGH	Elated Excited Overjoyed Thrilled Exuberant Ecstatic Fired up Passionate	Depressed Agonized Alone Hurt Dejected Hopeless Sorrowful Miserable	Furious Enraged Outraged Boiling Irate Seething Loathsome Betrayed	Terrified Horrified Scared stiff Petrified Fearful Panicky Frantic Shocked	Sorrowful Remorseful Defamed Worthless Disgraced Dishonored Mortified Admonished
MEDIUM	Cheerful Gratified Good Relieved Satisfied Glowing	Heartbroken Somber Lost Distressed Let down Melancholy	Upset Mad Defended Frustrated Agitated Disgusted	Apprehensive Frightened Threatened Insecure Uneasy Intimidated	Apologetic Unworthy Sneaky Guilty Embarrassed Secretive
LOW	Glad Contented Pleasant Tender Pleased Mellow	Unhappy Moody Blue Upset Disappointed Dissatisfied	Perturbed Annoyed Uptight Resistant Irritated Touchy	Cautious Nervous Worried Timid Unsure Anxious	Bashful Ridiculous Regretful Uncomfortable Pitied Silly

The five core emotions run left to right across the top of the table. Manifestations of each emotion based upon the intensity felt are described down each of the columns in the table.

Figure 35 – Emotional labelling adapted by Travis Bradberry and Jean Greaves (2009)

Figure 36 – Word called video in *Narrative Maze* (Ambrose, 2017)

“The Panopticon is a marvelous machine which, whatever use one may wish to put it to, produces homogeneous effects of power”. (Foucault, 1995, p.202)

In the above quote Foucault speaks of the power relations that stem from the Panopticon, but also indicates that it is a process that can be adopted beyond the institutional considerations of discipline and punishment. As a concept, it refers to invisible observation in the guise of a system where the person that is being observed does not know when they are being observed, so they have to assume they are always being watched. The go to point of analysis for contemporary society when considering issues of surveillance is CCTV, which thoroughly embodies panopticism, but a less insidious example and more light hearted interpretation can be perceived in UCL’s *Panopticam* (2016). At the site that contains Jeremy Bentham’s preserved skeleton a streaming webcam was installed, which promotes a metanarrative system akin to the one developed for this phase of my practice. Although it should be noted that this use of the metanarrative is not in a Lyotardian sense, as in representative of a totalising system that promotes universal truth. Instead, it is applied as a kind of thematic umbrella that consolidates narrative fragments, derived from what is essentially a form of visual cut and paste. However, it also explores human-computer interaction both as a catalyst for this process, and as a form of surveillance in the context of this work. The notion of the user as the unseen voyeur is confronted by an assortment of interactive stimuli, ranging from:

- Proximity activated interactive paintings relating to Bentham’s designs that play text to speech audio that reflects on user interactions in the maze.
- Animated 3D surveillance cameras that occupy certain corridors.
- Final screen that plays a screen capture of their interactions back to them.

Designing a space where interaction and vision are highlighted by a metanarrative dealing with surveillance was a means of formalising the abstract nature of both the interactions with and the types of moving images that enter the maze. To this end, this work runs emergent narratives parallel with a panoptic metanarrative. However, as a result of my pre-occupation with wanting

to showcase the potential of VR I alienated users from their own bodies[22] and its associated interactions, creating a space that was too abstract and interdisciplinary to be easily perceived as a cinematic form. However, this work does serve as an actualised contestation of Manovich's ideations on the inherent conflict between database and narrative, indicating that the two can co-exist. In order to fully incorporate users as part of an emergent narrative system they must feel in control of their interactions, otherwise immersion dissipates, but the challenge here is what kind of interaction can be employed to propagate real-time human exchanges with moving images? Such a query is something that I continue to explore throughout each of these experiments towards finding a resolution that coincides with my central research questions.

Outputs:

- Proof of concept that database and narrative can co-exist.
- Designed methods to create visual cut and paste techniques.
- Piece generated motion sickness, which illustrates the tolerance designers develop and the uncertainty that still surrounds this area.
- Interaction methods need to be reconsidered in order to immerse users more.

4.7. Phase 3: Eye Artefact Interactions

Moving away from previous approaches I looked at using electroencephalogram (EEG) as an interaction method. This is the process used to detect real-time electrical activity in the brain, but the software that renders these signals can be integrated into communication workflows, leading to a wide range of applications. In this section, I discuss my attempts to apply the EEG practices of artists to the realm of moving image. As a site that merges the human and the machine brain it certainly fulfils the parameters of *Cynematics*, but beyond random streams of data does it offer a meaningful way to invoke interaction? As I explore the limitations of this query an interesting yet unstable application for

[22] Most evident in the cybersickness that the work induced.

VR comes to the fore, which steers my practice towards perceptual interaction of an ocular nature.

Inputs:

- Explore the potential of EEG as an interaction method for *Cynematics*.
- Create a meaningful correlation between this and the content viewed.
- Test how this approach functions in VR.

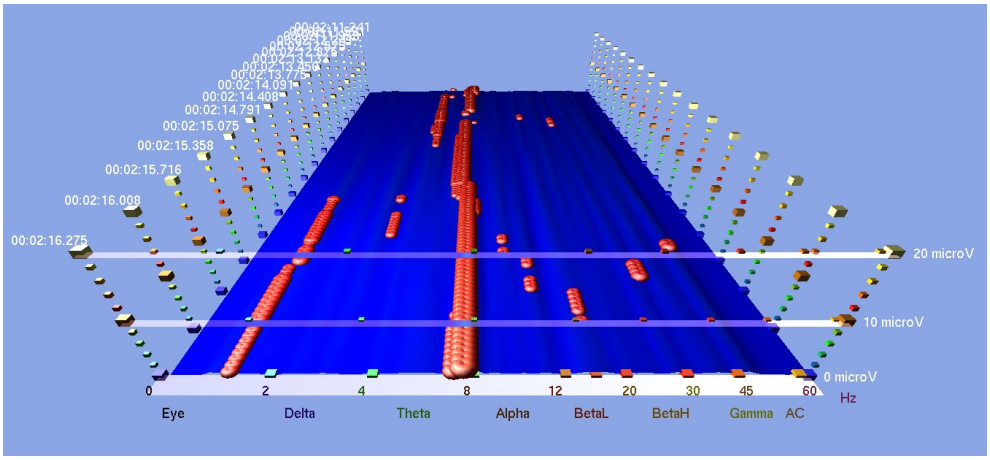

Figure 37 – IBVA software (IBVA, 2018)

In order to gain a better understanding of EEG applied to the realm of interactive art, I decided to attend a workshop hosted by EEG artist Luciana Hail. Throughout this workshop I realised that the sporadic nature of brain signals was better suited to generative audio/visuals, as the data output lacked the specificity for users to feel in control of their interactions. If I was to develop an interactive narrative system that availed of this interaction method, there would be little or no difference between it and the userless approaches developed by Manovich and Kratky (2005) that I referred to in the first chapter. Given that *Cynematics* promotes human-computer interaction I decided to look for a signal that users could consciously control, which ironically came in the form of the artefacts that typically disrupt signals of a cerebral origin. As well as reading electrical signals produced by the brain, EEG also picks up muscular data, which is most prominent during eye movement. To the left of the image above is the tab for “Eye”, which is a frequency range that constantly produces data in response to eye movement. In the first chapter I contested Marie-Laure Ryan’s (2015) thesis, which led to a discussion on the symbiosis of the camera

and the eye. To practically actualise this ideation I adjusted the sensitivity of this frequency range, not to remove the signal but to magnify it. Once established I used these fluctuations to control a video crossfader[23]. However, this first iteration is more indicative of a synthesis between the screen and the eye as it does not occupy a VR space. Once I had a functioning prototype I decided to make another version with content that thematically aligned with eye artefact interactions[24]. To further hearken back to the origins of such cybernetic exchanges the first video I used was a segment from Dziga Vertov's *Man with a Movie Camera* (1929), which includes the following dialogue, "I am an eye. A mechanical eye. I, the machine, show you a world the way only I can see it." This combined with the use of stop motion animates the camera to become a living subject in the scene. This functions as an embodiment of the transformative potential of technology, in particular the camera, but it also preempts cybernetics in the manner in which it presents the camera as an augmentation of the eye.

Figure 38 – *Man with a Movie Camera Eye Artefact Interactions* (Ambrose, 2016)

In juxtaposition to this machine oriented approach the other clip I used was from John Berger's *Ways of Seeing* (1972), which relates to the importance of the human eye in the meaning making process. Here he states that "perspective

[23]https://youtu.be/d-RMD5kARdQ
[24]https://youtu.be/WAMT3YiGqXg

makes the eye the centre of the visible world", which is an ideation that grounds human experience as a perceptually generated process. Allowing the user to move between these two perspectives using eye artefact interaction creates a deeper connection between both of these clips as the method of interaction encapsulates both of their ideologies.

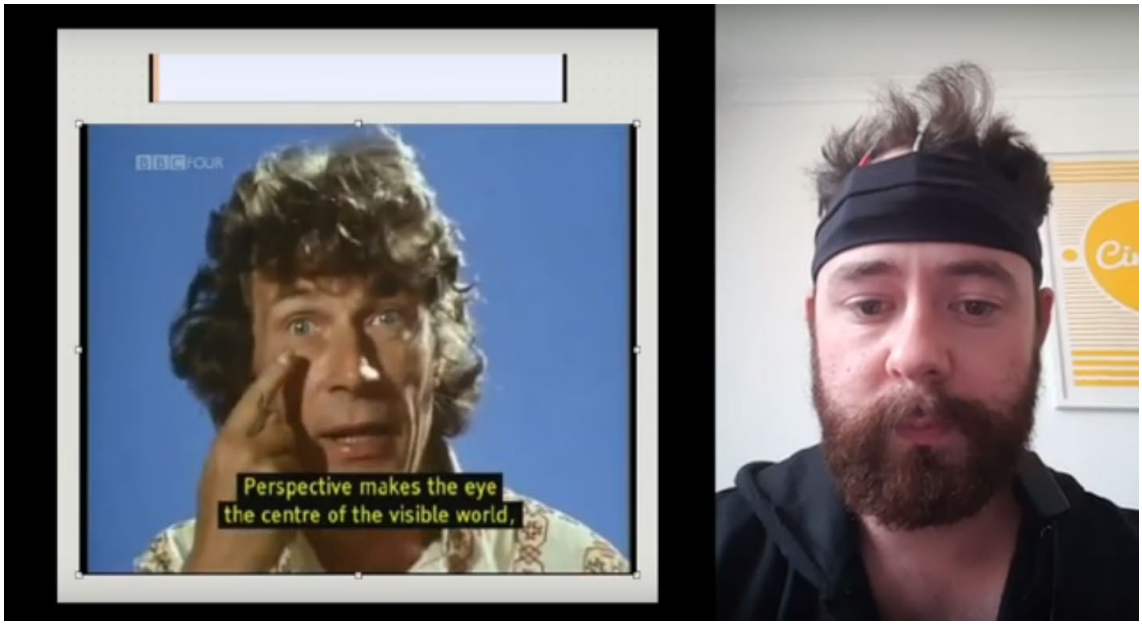

Figure 39 – *Ways of Seeing Eye Artefact Interactions* (Ambrose, 2016)

Although a novel interaction method it is hindered by two key issues. The first of these stems from taking this experiment into VR, which immediately demonstrates the limits of EEG. In a VR space peripheral vision is limited which means that for a user to expand their field of view they must turn their head. When used in conjunction with EEG these movements create artefacts that disrupt those specific to eye movements. Until this is circumvented these two technologies inherently oppose one another. Another issue with eye artefact interaction is that it struggles to differentiate what type of eye movement is occurring, which reduces its interactive application.

Outputs:

- Developed a real-time video crossfader using eye artefact interaction.
- Aligned interaction method with theoretically related video content.
- Elucidated why EEG and VR do not function well together.
- Introduced ocular interactions to the *Cynematic* discourse.

4.8. Phase 4: Initial Experiments with Virtual Gaze Interaction

With ocular interactions still in mind, I started looking for more reliable interaction methods that avail of such practices. Eye tracking is a commonly used approach, but in terms of its application it lacks the universality that I am looking for. What meets this requirement is the current interaction method being applied in most VR environments. In this section I introduce a term for this process and engage in experimentation that tests its *Cynematic* application. This is initiated through a directional structure akin to Mike Leggett's (2009) four-way interactive movie schema that he developed for his PhD (Figure 40). Once built, I contest the simplicity of an approach that reduces interaction into four symbolic pathways – instead offering to expand this into interactive meshes that make what is specifically being looked at an interactive element. This idea is practically demonstrated through the use of real-time perspective switching, which cements this approach as the interactive method that I will use to explicate a *Cynematic* practice.

Inputs:

- Definition of a term to represent ocular interactions in VR.
- Creation of an interactive approach that relates to this interaction.
- Illustrating how this embodies the tenets of *Cynematics*.

There are a variety of ways to interact with elements in VR, but a common feature shared by many of these environments is the use of a new type of ocular interaction. I refer to it as *virtual gaze interaction*, which I define as a simulated line of sight that projects outwards from a virtual camera, detecting when digital objects are being looked at and activating code in response to this. This is often guided by a reticle (referring to a visual overlay that is used as a sighting mechanism for a user's lines of sight), the role of which I will define and challenge in future practice and in the coming chapters. The gaze has been a site of theoretical discussion for many theorists, including; Jean-Paul Sartre (existentialism) (2003), Michel Foucault (panopticism) (1995), Jacques Lacan (mirror stage) (2001), Edward Said (postcolonialism) (2003) and Laura Mulvey (male gaze) (1975) yet the interactive gaze remains relatively under-theorised

and underexplored. In the canon of such gazes, *virtual gaze interaction* is best considered as a sensorial attribute of the posthuman, but it also functions as a proponent of *Cynematics*. Given *virtual gaze interaction's* precision it offers a much more stable and robust form of real-time perceptual interaction, which assists with the mandates of a *Cynematic* practice. However, how this can be used to create new narrative structures is a concern that can only be resolved through extensive experimentation.

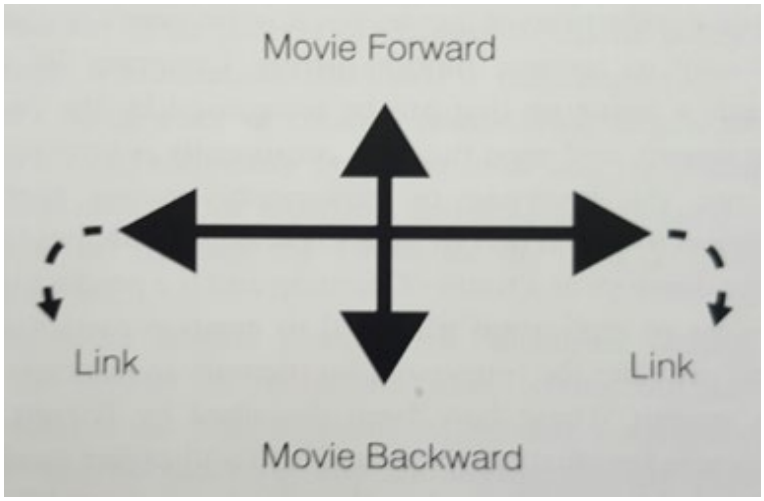

Figure 40 – Legett's four-way interactive movie schema (Candy and Edmonds, 2011)

Figure 41 – Interface of *Aspen Movie Map* (Allen *et al.*, 1978)

The first iteration of *virtual gaze interaction* applied to *Cynematics* was inspired by Mike Legett's *Mnemovie* (2009), which formed the practical component of his PhD research into creative interactive video which he elucidates in *Memory, Schema and Interactive Video* (Candy and Edmonds, 2011, pp.282-294). In

particular his use of a four-way directional system seemed like a good starting point for my experimentations. However, rather than using it as a form of hyperlink controller akin to the *Aspen Movie Map* hypermedia system (Naimark *et al.*, 1978) (Figure 41) I opted to display video that related to the direction being looked at.

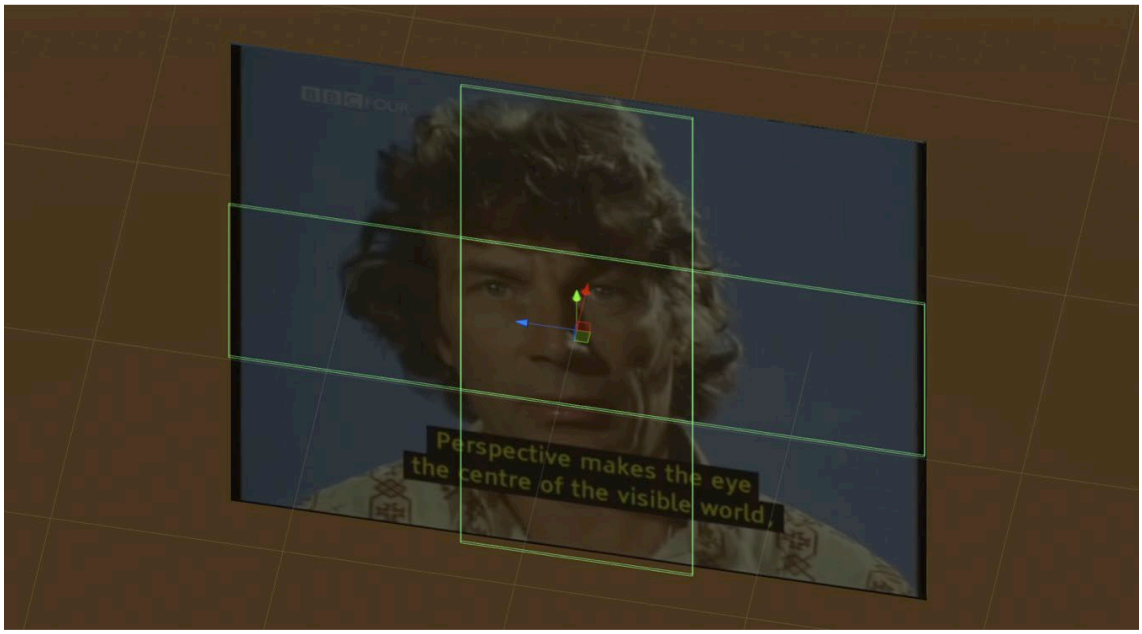

Figure 42 – Directional quadrants layered over screen (Ambrose, 2016)

Carrying the Berger theme over from my testing of eye artefact interactions, I started by applying this clip to a three-dimensional plane and then built five quadrants to layer over this plane (Figure 42). Once established I applied the relevant code to each quadrant so not only did they know when they were being looked at, but once viewed a video relating to each section would be initiated[25]. This worked well as a proof of concept, but the directional approach was quite limiting as beyond being a novel form of interaction there was no real difference between using it and the direction buttons on a keyboard or a remote control. It also did little to create relational communication between *virtual gaze interaction* elements and what was being displayed on screen. In order to overcome this issue I decided that creating interactive meshes indicative of what was on screen was the best way to conflate the eye, *virtual gaze interaction* and screen into a shared space. This approach can be interpreted as an emerging outcome of all the visual experiments that came prior, but more importantly as a type of

[25] https://www.youtube.com/watch?v=z20mYsinHJo

Cynematic practice that offers a perceptual synthesis between human and machine. Once I had tested that this interactive mesh idea was viable (Figure 43), I initiated a basic test of this approach applied to video. This took the form of a real-time perspective switching[26] test, in which I had myself and a participant exchange in conversation with two cameras filming over the shoulder from each of our perspectives. Once filmed, I placed a mesh over the shared subject space and implemented it in a way that the user would perceive the perspective that they chose to look at. Although rudimentary such an experiment demonstrates how *Cynematics* leads to new film practices, whilst offering a user experience that conflates the camera and the eye – promoting a symbiosis that allows for the generation of new narrative systems.

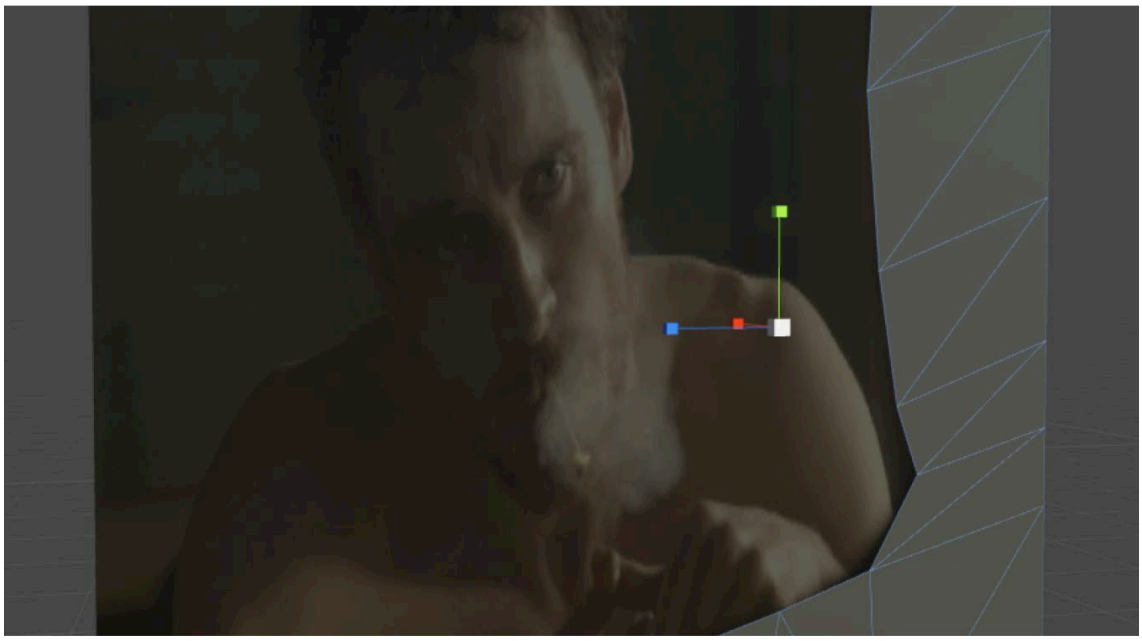

Figure 43 – Illustration of a mesh applied to existing film (McQueen, 2008)

- Found a perceptual interaction that meets the requirements of *Cynematics*.
- Developed an application for *virtual gaze interaction* that promotes new narrative potential.
- Demonstrated how *virtual gaze interaction* applied to *Cynematics* propagates new film practices.

4.9. Phase 5: Routine Error

[26] https://www.youtube.com/edit?o=U&video_id=6cD-CM4k3LA

Once I had established a method for applying *virtual gaze interaction* to flat moving images the next step was to combine this method with 360° film environments. This is a process that involved rigorous experimentation and the creation of an interactive system to achieve fluid transitions between each 360° film space. The goal of this was to assist with shaping my practice, whilst establishing *virtual gaze interaction* in conjunction with immersive media environments to explore new methods for creating applications that augment and expand the interactive film discourse.

Inputs:

- Design a practice that facilitates interactive 360° film.
- Explore how *virtual gaze interaction* can be used to navigate interactive 360° environments.
- Use this method to initiate emergent narrative systems.

The following diagram (Figure 44) illustrates the structure of *Routine Error*, which in this version is fixed to a single residence – offering no linear pathway or expected end to the piece this image focuses on capturing the structural qualities of this approach. To achieve this, I use *virtual gaze interaction* inside of 360° film spheres to interact with invisible links that inhabit each scene. In order to assist users with building a cognitive map of the video space I use aural and spatial expectations to establish a language of interaction for this piece. In the first scene of *Routine Error* the user appears in a sitting room, immediately looking at a man staring at himself on a TV. The sound of canned laughter can be heard across the room, the source of which stems from three screens. When the user looks at these screens this audio raises indicating that these screens are interactive components. These laughter sequences are randomly generated and the only way to quieten them is to look away from these screens. As soon as the user looks at a screen another invisible interaction point is activated on the subject in the scene. The expectation here being that after they tire of listening to these audio loops that they will eventually look back towards the

person in the scene and trigger a perspective/scene change[28]. This next scene offers a sense of embodiment via an over-the-shoulder perspective.

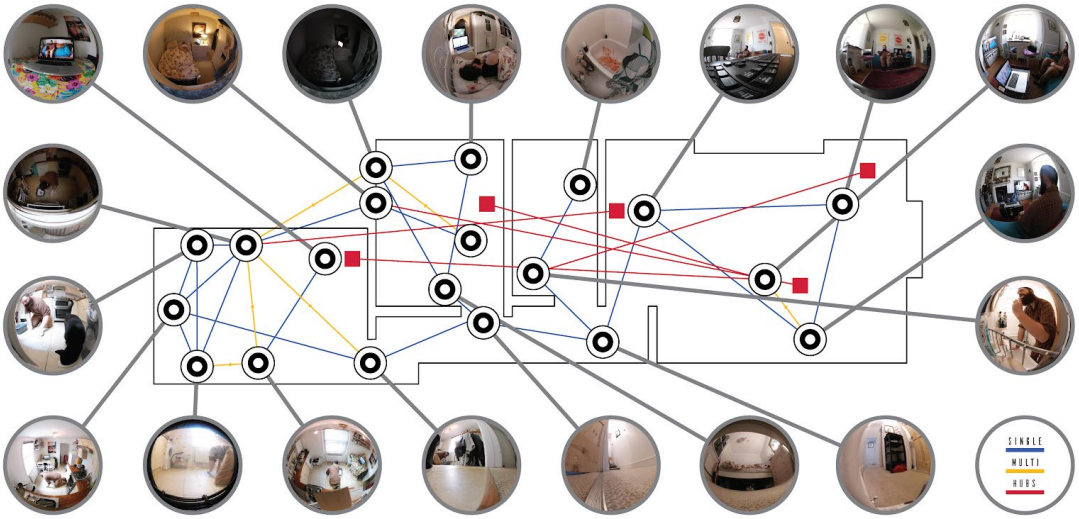

Figure 44 – Network Topology for *Routine Error* (Ambrose, 2017)

In this space all of the screens and audios have changed to different locations throughout the house. If the user looks at these screens the perspective will change yet again and any further ocular interactions with these screens will take them into these environments. However, screen-based interactions are not the only way to leave this room. As the user navigates the space it becomes apparent that in one of the scenes the door is open. This initiates movement aligned with physical boundaries such as doorways and windows and then interactive objects in some of these spaces allow further vantage points to be obtained[29]. In each room a series of mundane everyday activities are looping – adding a sinister undertone to user meanderings is the potential discovery of a violent act, but claustrophobic perspectives also assist in building uncanny experiences of otherwise quite banal activities. Some stand out moments include viewing the subject clean from inside a greasy lit oven and using *virtual gaze interaction* to turn on the lights in the room where he is sleeping[30]. The ability to move in and out of spaces, whilst having a hub (sitting room) in which recursions can pivot – allows users to familiarise themselves with the interaction

[28] https://youtu.be/c00LVNg1YYo
[29] https://youtu.be/KltMu7642NU
[30] https://youtu.be/qgpqYEQ4CzA

points and explore other pathways through the work. As a prototype *Routine Error* demonstrates how *virtual gaze interaction* can be used as a live-editing tool (a concept that is developed in the final chapter), using what is being looked at in the scene to enact a cut, and controlling elements such as audio allows for immersive interactions that conflate the eye, the camera and 360° film into a shared network. It demonstrates how 360° film can be used to allow users to occupy inhuman perspectives, which creates new experiences of scale, but combining this with *virtual gaze interaction* adds to its voyeuristic qualities giving a sense of ocular omnipotence to user navigations.

Outputs:

- Need to develop a more fluid method for fading in and out of different 360° film environments.
- This needs to be made into a more coherent artistic practice that explores *virtual gaze interaction* as a form.
- The work needs to be published on a more accessible VR platform.
- Explore the different types of emergent systems that can be created with this practice.

4.10. Conclusion

At the start of this chapter I referred to the emergent potential of practice-based research, which is a concept that I fervently agree with. Having initially alluded to vision as a thematic commonality that emerges from my practice the iterations between each phase of practice brought me ever closer to an interaction method wholly in line with the principles of *Cynematics*. Stemming from my initial experiments into pulse-controlled branching narrative systems I started to consider the role of the self as a narrative system. This thought process stemmed from ideations of humans as systems that I discussed in the opening of the second chapter. Although this is an assertion that cybernetic theorists robustly support, when presented with an environment that explores this idea it is typical for it to be condemned by abstraction or further supplanted by the allure of immersion. The next phase of practice was situated on the rift between database and narrative where I sought to find a way to create

generative/emergent narratives, but in doing so allowed flawed interaction methods to permeate my work. This made it difficult for users to engage with the types of narrative systems I was experimenting with.

To circumvent this engagement issue I looked into using EEG as an interaction method, which only met the *Cynematic* criteria via eye artefact interaction as this is the only electrical signal that an EEG user can actively control in a real-time setting. However, given that this failed to work in synthesis with VR and had a limited interaction capacity I decided to look for yet another approach. Still considering a form of ocular interaction, I looked to the universally used approach in current generation VR, which having a lack of a relevant term I defined as *virtual gaze interaction*. This approach synthesises with VR allowing it to become a site of immersion and interaction, which aligns perfectly with the guidelines of *Cynematics*. Stemming from this process the coming chapters will each involve iterative reflections on the interactive 360° film practice that I have developed through the following pieces of practice:

- *Systems of Seeing* (chapter 5)
- *Mimesis* (chapter 6)
- *Virtual Gaze Interaction Network* (chapter 6)
- *Vanishing Point* (chapter 7)

Chapter 5. Systems of Seeing: Virtual Gaze Interaction

5.0. Systems of Seeing

Figure 45 – Equirectangular image of *Systems of Seeing* (Ambrose, 2017)

Experience:

As a praxis for virtual gaze interaction this installation uses a digital representation of an art replica as an interface for emergent filmic experience. The act of looking at a virtual version of this replica spatially shifts the user, creating connection between their gaze and the space that surrounds them. For additional context on the design of this application please refer to the poster in section 9.4 of the appendix.

Audio:

I acknowledge the role of audio in relation to this work, but given that the key focus of this thesis is on gaze interaction it is worth noting that in the context of this research audio is not a theoretical focal point – as this is a vast area of research in its own right.

Materials:

Display – Gear VR / Oculus Rift
Video – Monoscopic 360° Film
Sound – Stereo Audio
Camera – Samsung Gear 360
Software – Unity / Premiere Pro / After Effects / Audacity

In September 2017, I created an interactive 360° film installation for the *John Berger Now* Conference at Canterbury Christ Church University. The aim of this work was to critically engage with the state of seeing in the 21st century and provide a pedagogical practice and theoretical discussion on how interactivity has impacted this process. With this I posit that contemporary viewers are no longer bound to the subjective interpretations packaged in Berger's *Ways of Seeing* (1972), in fact the act of seeing is now embroiled in mechanisms of control that have transformed us into restrained users of art. My installation, titled *Systems of Seeing* explores how such processes change our relationship with the art object – towards establishing the idea that through a confluence of creative practice and theoretical discussion these perceptual shifts can still have meaningful application. As VR continues to expand our use and perception of our world(s), John Berger's earlier assertion that, "perspective makes the eye the centre of the visible world" (1972) takes on a new kind of significance. Another focus of this chapter will be to further define, evaluate and historically contextualise *virtual gaze interaction*, as both a conceptual model and as a practical process augmented by VR technologies. The primary mode of evaluation for this chapter will be through a close reading of my own practice, which will be used to demonstrate how this work is used to conceptualise the visibility of virtual gaze interaction. Currently, this type of human-computer interaction – the virtual gaze – is a somewhat overlooked aspect of VR's resurgence. If we are to look to Unity's (2017) online documentation gaze interaction appears under the title of "interaction in VR", which is unhelpfully broad. Unity's specifications introduce the notion of "the gaze", but I contend that this is not *just* a type of gaze, but that it is inherently virtual in nature. This method of interaction exists as a perceptual extension of a process called Ray Casting, which is embedded in the history of philosophy, art and science.

The gaze is an incredibly loaded political, critical and philosophical term attuned by countless academics to address a variety of ontological states. Offering a succinct theoretical frame, we can begin to consider how every strand of these discourses needs to be reconsidered in the wake of the act of looking becoming part of an interactive system. In *Being and Nothingness* (Sartre *et al.*, 2003) Jean-Paul Sartre introduced the concept of the existential gaze, which I perceive as a type of plughole effect – one where the act of looking permits us to create subjective narratives and assign meaning to everything around us. However, the existential gaze derives from the very point when someone you are assigning meaning to turns and looks at you – and you realise they are subjectively creating you in that exact same moment. Such an idea is directly challenged by the viewers' state of embodiment in a 360° film space, but also in the way that their gaze becomes a site of navigation and control for movement between time and space in an interactive 360° film. Paul-Michel Foucault (1995) addressed the notion of control in relation to the gaze via his conceptualisation of panopticism. Here Foucault (1995, p. 214) appropriated Jeremy Bentham's prison design into a model for external surveillance, one where:

> Power had to be given the instrument of permanent, exhaustive, omnipresent surveillance, capable of making all visible, as long as it could itself remain invisible. It had to be like a faceless gaze that transformed the whole social body into a field of perception.

Through the mechanisms of *virtual gaze interaction* the panoptic gaze sustains its position of invisible control. However, the divide between the watcher and the watched has become obscured through interaction. Users have become the faceless voyeur inside of VR, but also offer their field of perception and the data that it represents as a type of uninformed payment. The private curation of these gaze economies forms part of a discourse around the control of the interactive gaze and how this translates to other forms of perceptual data. Forms of invisible control permeate the formation of *virtual gaze interaction*, but beyond objectified vision is a commodified state of perception that promotes, rather than deprecates such discourses. To dismantle such potentialities, the establishment of a lexicon for this new type of gaze is essential.

5.1. (In)visible Interaction

> Everything we see hides another thing, we always want to see what is hidden by what we see. There is an interest in that which is hidden and which the visible does not show us. This interest can take the form of a quite intense feeling, a sort of conflict, one might say, between the visible that is hidden and the visible that is present. (Magritte and Torczyner, 1977, p.172)

This quote is taken from a radio interview where René Magritte reflects on his self-portrait titled *The Son of Man* (1946). To augment this conflict beyond the perception of states of visibility we must ask, what happens when that which is hidden in the image allows us to change the presence of the visible? Within this query the act of seeing shifts from a form of interpretative observation to being a form of communicative transformation that intertwines with the former. In other words, looking at something is no longer just a subjective practice, instead it has become part of a dendritic process propagated by the addition of control. To frame such a line of enquiry in the context of *virtual gaze interaction*, I align this system of seeing with a form of replication that not only assists with explicating this form of interaction, but places it within a wider discourse where the relationship between the user and the "original" object becomes a site of reflection. Therefore the installation is not just about illustrating *virtual gaze interaction* in a filmic context, but is also about attaching invisible interactions to an object whose existence already challenges the act of looking. This serves to promote a new way of centring film around interactions with objects, but also grounds the object itself as a vehicle to explore the interpretation of the "real" and the virtual. Such (object)tifications could be interpreted as augmentations of Laura Mulvey's concept of the 'male gaze', especially if the technologies and genres involved in these exchanges stem from male-dominated fields (Mulvey, 1975). However, the nascent states of VR and 360° film offer the potential to revisit such discourses, usurping such perspectives in favour of diverse and enhanced relationships with such mediums.

In 1935 René Magritte painted *La Clef des songes* (The Key of Dreams), which was one in a series of paintings that explored the relationship between words and images. Sometimes classified as a symbolic painting this surrealist work

causes viewers to question the images they are looking at by misnaming them, whilst also affirming the idea that an image of a thing is not the same as the thing itself. Beyond the narratives formed from the juxtaposition of these words and images this painting cements the act of seeing as a process that existentially grounds us. John Berger navigates this in relation to Magritte's painting when he states that, "it is seeing which establishes our place in the surrounding world; we explain that world with words, but words can never undo the fact that we are surrounded by it" (Berger, 1972, p.7). The decision to reproduce this image and use it for the cover of Berger's *Ways of Seeing* enforces it as a metaphor for the problem of pictorial representation, but as a work of art it lacks a discourse in relation to the auratic arts explored throughout Berger's seminal text. To actualise this, I sought to make the physical component of this installation challenge notions of authenticity and in turn present more than just a digital copy of Magritte's original painting. Contextualising the work in this installation serves to position it in time and space towards establishing an aura unique to this replica.

5.2. The Aura of the Replica

In 2017 an unknown artist from a Chinese art factory painted a replica of *La Clef des songes* (The Key to Dreams), which was a painting commissioned to explore the relationship between words, images and *virtual gaze interaction*. The unknown artist used a high-definition digital image of this painting which was provided by me for reference. They were also sent the original painting's dimensions, which they used to make the painting the exact same size as the original. Once the first draft was completed I was sent a photograph of the painting along with the message, "please check the painting and tell me your ideas about it." Three main observations stemmed from receiving this near perfect replica. The first of which was to do with the dot over the i in 'valise' being too far to the left. Considering this further made for an interesting observation, was the text perceived by the unknown painter as an image that needed to be replicated instead of a word to be read? To this end the act of having such a painting replicated in a Chinese art factory not only challenges the notion of the original, but in this instance potentially nullifies the actual

meaning of the painting, instead becoming an embodiment of the practical process of replication.

The second observation I had towards this draft copy was that the canvas had no border. In fact until I received this image this was something that I had never actually even considered, the reason being that all digital and print forms of the painting that I had looked at omitted this element as it was not part of the two-dimensional image. After much investigation I managed to source an image of the painting hanging in a gallery and used this perspective to acquire a hexadecimal value for the colour of the border that stretches over the edges of the canvas. Once these amendments were confirmed the unknown artist then modified the replica to be more like the original. After this the replica spent a number of weeks trapped in customs before finally being released to me and immediately being stretched onto a canvas frame. The final remark that I chose not to pursue was the absence of Magritte's signature, which was present in the digital version I first provided them. The unknown artist in a single oil-based swoop redacted the painting's author and in turn marked it as an auratic object made unique by its replication.

5.3. Object-Oriented Cinema

To expound René Magritte's *La Clef des songes* (The Key to Dreams) (1935) in a virtual context I created a site-specific installation – *Systems of Seeing*, which as mentioned in the introduction was befittingly demonstrated at the John Berger Now international academic conference at Canterbury Christ Church University 2017 as well as a practice-based PhD exhibition with the TECHNE consortium (Figure 46). To initiate this practice, I created a digital copy of the painting by filming it in 360° at the event locations.

Figure 46 – *Systems of Seeing* at the Chelsea College of Art (Ambrose, 2017)

This allowed me to begin the experience by disembodying users in a 360° film version of the space that they were already in (Figure 45) – and then give them the ability to transport themselves to different locations via *virtual gaze interactions* with the panels in the painting. There were two main intentions with this installation. The first being to use it as a teaching tool for people to understand a basic form of *virtual gaze interaction* that complements many of the intricate components discussed in this chapter. The second is to explore the application of *virtual gaze interaction* combined with a 360° filming technique that makes object interaction the focus of a human-computer filmic exchange. Such an approach stands as a nascent advocation for the speculative idea of an *object-oriented cinema* (OOC). What I am referring to with the idea of OOC is an approach to moving images that uses objects to control movement between linear and/or non-linear narratives. Alongside this practice is the need for a more in depth consideration of how the use of objects and interaction aesthetics can modify our engagement with the images that they overlay. One envisioning of OOC is framed by the overlaying of invisible interaction points over a filmed object that then uses *virtual gaze interactions* with this object to transport the user to a different scene, but one where the object is constant.

This way the object always appears fixed in the same space, but the user's interactions with it change the film space around it. In the case of this installation this is achieved by combining 360° with a fixed motion technique. Using a laser sight, the painting is recorded at the same distance and height away from the camera in every scene. Each scene is then positioned in Unity to occupy the exact same interactive space. The application of this concept will become more apparent as I discuss each of the scenes that I attached to the panels in *Systems of Seeing*.

Developing Magritte's original exploration of the conflict between language and images I position the act of looking in a virtual space as something that changes the surrounding videoscape. To explore the emergent narrative qualities of interacting with this surrealist digitised replica I attempted to draw visual connections with the panels being looked at. In the first instance I used *The Door* written in the first panel to create a portal into my own home (Figure 47). In this version of my sitting room I positioned the canvas in front of a window that shares the same design as portrayed in the painting. In contrast to the symbolic freedom offered by the image of the horse this scene induces a sense of uncanny voyeuristic entrapment – In fact many of the users at the demonstration found their occupation of this private space to be the most unsettling manifestation of their interactions. To the left of the painting is a television playing a clip from Berger's *Ways of Seeing* (1972) that shows the scene where he exclaims that 'perspective makes the eye the centre of the visible world'.

Figure 47 – Equirectangular of panel 1: *The Door* (Ambrose, 2017)

The idea behind adding this to the scene is to position the user's experience in the context of perspective and ask them to reflect on the process that is allowing them to navigate these spaces. In addition to this, I wanted the interactions with each panel to make the user consider the relationship between the panels they look at and the environments that each of these trigger and inhabit. How this scene informs the user's experience is dependent on the order in which they look at the painting, which means that there are twenty-four different combinations for experiencing this piece and that is not taking into account video loops and users choosing to navigate to a space more than once. Framing this in a site-specific installation where the physical reality of the painting in the room forms part of the experience both before and afterwards, leads to the creation of emergent experiences. However, in designing a system so open to interpretation there is the concern of first time users being distracted by the immersive qualities of 360° film and people getting lost in the techno-fetishistic exchanges that permeate such processes. What's lost in such considerations is the aesthetics of the medium and the user's ability to reflect and engage with the mental topographies that their interactions are creating.

The second world that I filmed pivots around the image of the clock in relation to *The Wind*, which generated the idea of the passing of time framed in a natural context. Such a thought process steered my thoughts towards Patrick Kavanagh's (2005, p.224) *Canal Bank Walk*. Transporting users to a serene

space that embodies such a poem allows them to reflect, positioning them somewhere that can be perceived as meditative or as a catalyst for impatience (Figure 48).

Figure 48 – Equirectangular of panel 2 – *The Wind* (Ambrose, 2017)

Figure 49 – Equirectangular of panel 3 – *The Bird* (Ambrose, 2017)

The next scene was a derelict area that housed a couple of correlations to the chosen panel (Figure 49). Given that *The Bird* is present in textual form there are literal birds that fly in the sky above, but this word is also tagged on the wall to the right of the painting. The image of the pitcher loosely correlates with the empty paint bucket, which was intentionally framed to play on this connection. The audio in this scene is a non-diegetic ambient recording of graffiti artists

actively tagging and spraying a wall. This creates a sense of experiencing something after the fact, which bizarrely relates to the art replica that transports the user to this scene.

Figure 50 – Equirectangular of panel 4 – *The Valise* (Ambrose, 2017)

The final panel *The Valise* (Figure 50) was recorded on top of a carpark at Gatwick Airport. Given that this panel textually and visually depicts a suitcase I decided to capture an aeroplane landing in the background. Outside of the obvious connotations of travel was the idea to frame the landing plane in a manner in which it shares the same scale as the rest of the images in the painting. As it flies directly over the painting it draws the viewer to look towards the canvas, which leads to them eventually departing the scene. It also turns the plane into an object akin to the images in the painting creating a sense of distortion between these framed images and those that move freely outside of these confines. In this installation the reticle operates as a liminal medium between different realities of the image, still and moving. It is a boundary object operating between states of interaction, however without it the user has no point of reference. The idea of targeting a painting with a reticle is an aesthetic quality that formulates its own narratives, but as a demonstration of *virtual gaze interaction* this installation represents new ways of engaging with the interactive film discourse.

Aside from the non-diegetic audio referred to in the scene called *The Bird*, the immersion in each scene is amplified by the addition of ambient field recordings taken at each location. These assist with establishing a sense of presence, which helps take the viewer out of the gallery space where they started their experience.

As a pedagogical tool the installation serves to provide a practical means of engaging with the theoretical aspects of this chapter – that otherwise would remain impounded in the specificities of interconnected fields that are often treated as disparate by academics working in localised areas. As a form of practice, it transforms an art object into a visual controller and demonstrates that such systems allow interactive digital narratives from new media theory to be assigned to new environments of interactive film. Before critically engaging with the reticle in more detail I would like to position *virtual gaze interaction* as a resurgence of our original perspective on how we see, rather than sustaining the view that it is an inherent component of virtual reality. I initiate this by using the subjective nature of seeing to build towards early ideations of vision that connects to the perceptual interaction in my practice and assists in establishing it as an interdisciplinary discourse.

5.4. The Radiating Eye

“The way we see things is affected by what we know or what we believe”. (Berger, 2008, p.8)

To illustrate this statement Berger uses the example of fire’s meaning being different in the middle ages when people believed in the physical existence of hell (Ibid.). The idea of this is propagated by the properties of fire, both as a destructive force and a pain inducing element. This example serves to promote the idea that our beliefs affect our experience of what we see, but also that the act of seeing forms part of the experiential process fueling the formation of such belief systems. Fire also holds a unique history in relation to early ideations of vision. In *The Fire That Comes from the Eye* Neuroscientist Charles G. Gross (1999) presents a timeline of emission theories where Plato (427-347 BCE) “argued that visual fire streams out of the eye and combines with daylight to

form a ‘single homogenous body’ which serves as an instrument for detecting and reporting visual objects.” This serves as a refinement of Empedocles’ 5th century envisioning of the eye as a “shining lantern” (Parry, 2016). The idea that our eyes emit rays of light has been scientifically disproven in favour of intromission theory (stemming from the 9th century), where visual perception is achieved by light reflected from objects entering the eyes. However, such theories of emissive vision have returned to the public eye via the aesthetics and structural qualities of VR development. The most prominent of which relates to the forms of reticle applied to a user’s *virtual gaze interactions*.

Figure 51 – *The Radiating Eye* (Zahn, Johann et al., 1685)

5.5. The Role of the Reticle

To consider emergent narratives and emissive vision in the context of *virtual gaze interaction* shifts these discourses, as forms of interaction beyond subjective interpretation have permeated the processes of knowing and seeing. To initiate this line of enquiry I posit that *virtual gaze interaction’s* system of seeing is guided by the reticle (the visual overlay that represents a user’s line of sight), which assists with deconstructing the statement that “to look is an act of

choice” (Berger, 2008, p.8). Embedded in such specificities are new components, which explicitly and implicitly mediate our ways of seeing.

As a user interface, factors such as the colour, size and shape of the reticle alter our perception of virtual environments, as well as the obvious telescopic and weaponised associations with this medium. The reticle operates a visual layer indicative of the center of a human’s field of view, which assists with controlling ocular interactions in VR. However, in opposition to this, *virtual gaze interaction* represents the machinic coercion induced by VR and how it forms an immersive barrier between the user and the material that they are looking at.

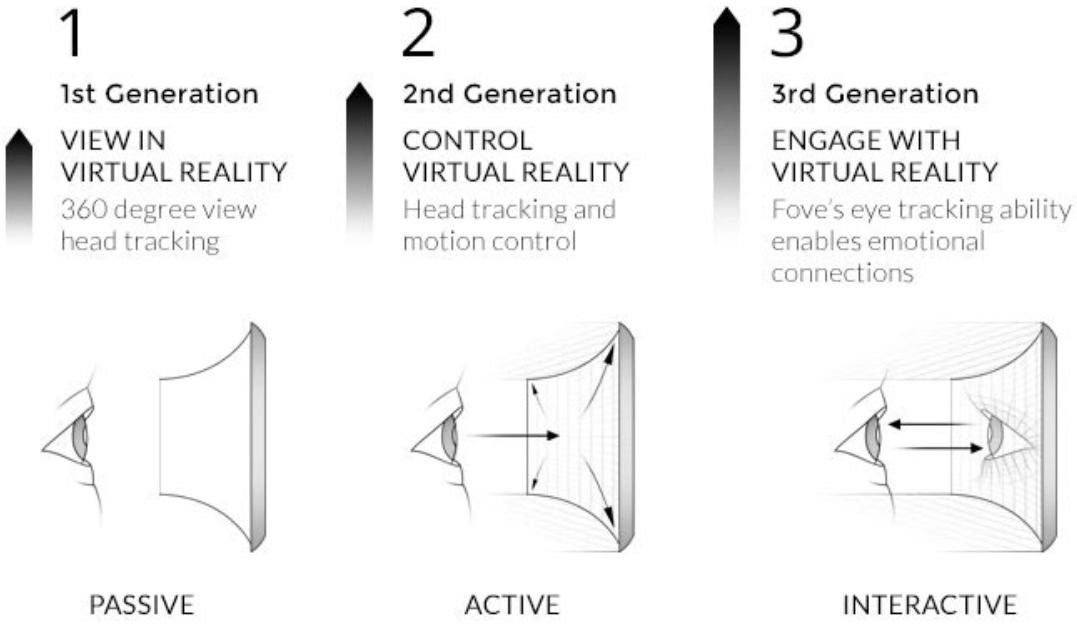

Figure 52 – The World’s First Eye Tracking Virtual Reality Headset (FOVE, 2018)

A resolution to this dilemma is projected in gaze interaction that tracks movement of the eyes, which the developers of FOVE present as a form of interactivity added to a system whose previous generations were merely passive and then active (Figure 52). Such a proclamation elucidates how fragmented understandings of interaction in VR are being forged by companies that are eager to obtain their share of a burgeoning market, but such processes also obfuscate already tentative understandings of these new technologies. In the next chapter I will be offering a means to consider the aesthetics of interaction and its relationship with the reticle. However, before being able to

develop further critical lenses for these interfaces we must first expound and isolate *virtual gaze interaction's* origins in the processes of Ray Casting.

5.6. A History of Ray Casting

In Ray Casting for Modelling Solids (1982, p.109) Scott Roth quantifies the Ray Casting process when he states that "to visualise and analyse the composite solids modelled, virtual light rays are cast as probes". However, this does not mark the first occurrence of Ray Casting in the field of computer graphics. Towards the beginning of this field both "Ray Casting" and "Ray Tracing" were used interchangeably, but methods of differentiation have since been established. Ray Casting's digital origins can be traced back to Arthur Appel's (1968, p.37) seminal paper titled *Some techniques for shading machine renderings of solids* – where he attempts to capture the "vivid illusion of reality" using computer graphics.

Originally developed as a method for pen-plotters, "a simulation technique tested was to shoot random light rays from the light source at the scene and project a symbol from the piercing point on the first surface the light ray pierced" (Ibid., p.39). This is where the first Ray Casting algorithm was presented, which was later augmented to Ray Tracing by Turner Whitted (1980). The key difference between these models is that Ray Tracing is recursive, whilst Ray Casting is non-recursive. Turner simplifies this further when he states that in recursive Ray Tracing, "information is stored in a tree of "rays" extending from the viewer to the first surface encountered and from there to other surfaces and to the light sources" (Ibid, p.343). Whilst in a non-recursive example (Ray Casting) no secondary rays are generated. Unity (2018) describes Ray Casting as a process that "casts a ray against all the colliders in the scene and returns detailed information on what was hit" – which can be applied as a simpler form of information sampling, one synergetic with the requirements of *virtual gaze interaction*.

5.7. The Ray Casting Machine

To practically inform Zahn's (1685) vision of The Radiating Eye (Figure 51) and offer pre-digital context to Ray Casting and its relationship to perspective, Albrecht Dürer's (1525) mechanical creation of this process offers a fitting, yet tedious actualisation that mathematics professor Annalisa Crannell (Mathematical Association of America, 2014) describes as "the original dot matrix printer". This same image is also referred to as Dürer's "Ray Casting Machine" (Figure 53) and is often used by academics to provide a historical context to this technique. Such experiments affirm Berger's statement that "perspective makes the eye the centre of the visible world", but also indicates how a literal line of sight can be used to extrapolate spatial information allowing for the creation of a single-viewpoint perspective (Berger, 2008, p.16). In terms of its application Dürer's work can be perceived as a precursor to *virtual gaze interaction*, but instead of using a physical line of sight to create a two-dimensional version of a three-dimensional object – my practice uses a virtual line of sight to control any element in the film space. To explicate the potential of *virtual gaze interaction* it is beneficial to explore how its synthesis of Ray Casting, head-mounted displays and VR engines creates new ways of perceiving and interacting with cinema.

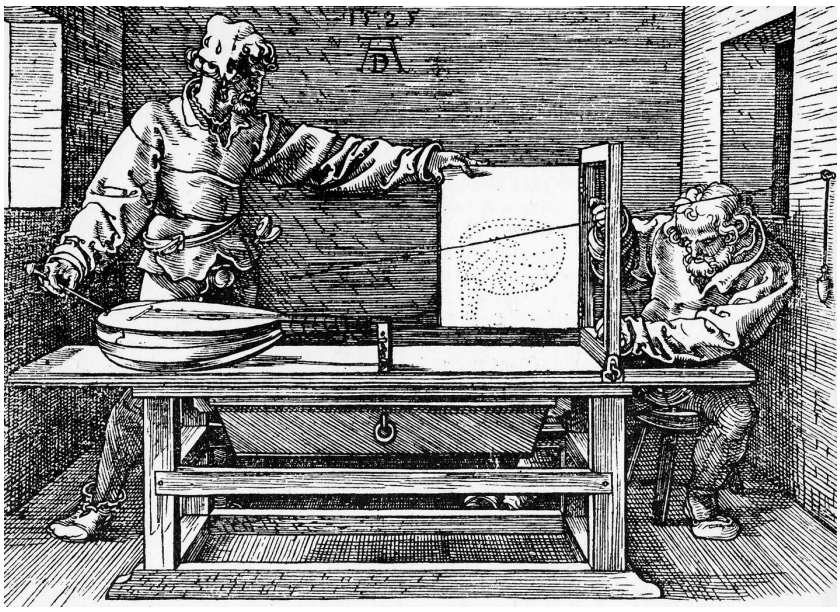

Figure 53 – *Man Drawing a Lute* (Dürer, 1525)

However, as demonstrated so far this process is merely augmented by and not formed from VR, which forms the contextual grounding necessary to delimit and cement a form of interaction liminally positioned by VR evangelists eager to consolidate their own territories. Typical applications of *virtual gaze interaction* find users presented with a series of hotspots, which populate the screen space as user interface elements. These graphical layers further reduce immersion, already hindered somewhat by the presence of the reticle. In a filmic context, these added overlays, take emphasis away from surrounding videoscapes causing users to focus on interaction as opposed to the visual environment. To circumvent this immersive deficiency my interactive 360° film practice uses invisible links that align with the spaces that are being made interactive.

5.8. Economies of Vision

Such practices provide discussion points for interactive 360° film that unite with Biocca's exploration of the contentious issues surrounding utopian models of seamless, real-time, immersive and infinite narrative possibilities versus the interactivity and narrative immersion debate (Green et al, 2013). However, rather than just focusing on how *virtual gaze interaction* offers new ways of approaching interactive film, I would also like to discuss the deleterious potential of data economies built around a perceptual form of interaction in which the majority of users have little or no point of reference. VR analytics offer unique insights, that in turn can feed back into the design and development of unique VR experiences, but a cautiously optimistic and informed understanding of these processes would be beneficial. Through VR our visual perception has become the "single homogenous body" that Plato originally hypothesised in his emission theories, but unbeknownst to him this homogenisation could also be produced by the gaze.

In *What Algorithms Want: Imagination in the Age of Computing* Ed Finn (2017) presents the model of "algorithmic reading" which is a proponent of an increased understanding and engagement with the cultural machines that we interact with. A prime example of this can be seen in the algorithmic entertainment heralded by Netflix, which Finn refers to as being "one of the most seductive myths of the algorithmic age" (2017, p.107). Applying such

cogitations to *virtual gaze interaction*, it becomes apparent that the types of interaction that are producing data in VR are as important to understand as the processes involved in computing this information – for example if we are to consider how heat maps are used to visualise hotspots, the benefits of knowing what your users are looking at becomes immediately apparent. This is fine in the scope of bettering the use of VR (which still involves much experimentation from a production standpoint), but its potential as a manipulative medium is an area demanding of critical discourse. Otherwise we run the risk of *virtual gaze interaction* becoming a programmable and privatised asset, the kind of which was predicted in *The Vision Machine* through Paul Virilio's (Virilio, 1994, p.59) thoughts on the new 'industrialisation of vision'.

To offer an extreme actualisation of this assertion I would like to generate the following mental-image. Imagine a virtual supermarket, where everything changes based on what you choose to look at. Advertising behest to your own vision – machine learning algorithms quantifying the value and meaning of your gaze. Such ideations were recently materialised via the rollout of Amazon Go (2018), a checkout-free shopping system that employs "the same types of technologies used in self-driving cars: computer vision, sensor fusion, and deep learning". These technologies all form part of a much larger discourse, one where the interactive gaze operates as a central component in the evolution of human-machine interfaces. Amidst these rapidly expanding and constantly evolving technologies it is more important now than ever to ask the question, where does sensory autonomy fit into these models? With this in mind, should we query that, as with other forms of body information, such as our heart rates or even our brain waves, that the act of looking will become a subject for systems of data capture?

Amazon's prototype indicates that this query has already moved from a form of speculative enquiry towards an economic potentiality. This is a process that is being fueled by uninformed users immersed in new forms of digital experience. However, as illustrated by my practice, VR and its related technologies also permit new modes of interaction and experience. Throughout this chapter I have referred to Berger's seminal (1972) statement, "perspective makes the eye the centre of the visible world" – which is an ideation that was complicated by the

invention of the camera. The ability to reproduce images feeds into much wider debates on authenticity and originality, but extending from such points I posit that VR has radically shifted our envisioning of perception yet again. Grounding a new form of ocular interaction in the history of philosophy, art and science aids in demystifying processes that are not unique to VR. The goal of which is to establish transparency for perceptual data, whilst elucidating a type of interaction that has made the eye the centre of the virtual world. The perspectives that manifest from these interactions have become a series of complex entanglements divided by a politics of vision still waiting to be accounted for. My work aims to establish a frame of reference for such discourses, towards an understanding that this system of seeing is potentially always being watched.

Chapter 6. The Reticle Effect: Aesthetics of Interaction

6.0 Mimesis

Figure 54 – Equirectangular image of *Mimesis* (Ambrose, 2018)

Experience:

Using invisible interaction points (no overlay beyond the reticle is used to represent interaction) users must navigate each scene looking for visual cues that relate to possible transitions. Between obvious visual associations and accidental discoveries users could begin to establish a mental map, allowing them to fluidly navigate the visual landscape of the installation. This idea corresponds with my interpretation of cognitive mapping as a component of narrative construction. Further details on the design of this application can be viewed in the poster in section 9.5 of the appendix.

Audio:

I acknowledge the role of audio in relation to this work, but given that the key focus of this thesis is on gaze interaction it is worth noting that in the context of this research audio is not a theoretical focal point – as this is a vast area of research in its own right.

Materials:

Display – Gear VR / Oculus Rift
Video – Monoscopic Film
Sound – Stereo Audio
Camera – Samsung Gear 360
Software – Unity / Premiere Pro / After Effects / Audacity

In the previous chapter I worked towards contextualising and critically engaging with *virtual gaze interaction*, which as a strand of perceptual interaction I argue is guided by the reticle. A simple definition of the reticle would be images such as fine lines, circles, dots, marks and cross-hairs that are used to aim a user's simulated line of sight in a virtual environment.

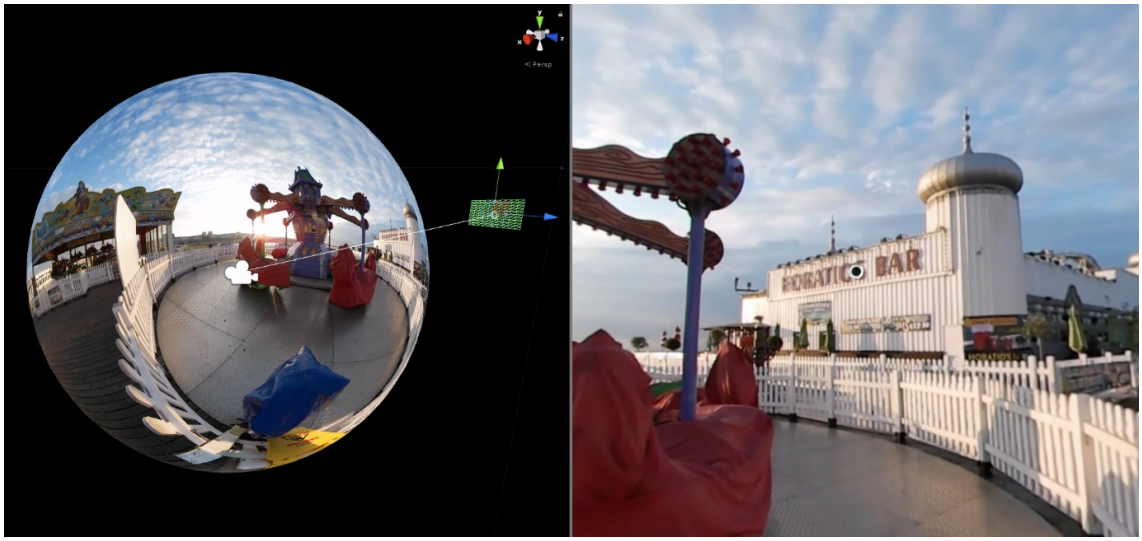

Figure 55 – Interactive Cue Mark active in Unity scene (Ambrose, 2018)

The reticle functions as a visual layer that represents a line of sight, but to be more specific it is also an interface. In Janet Murray's *Inventing the Medium* (2011) she conflates everything that is digital into a shared medium that she refers to as *the digital medium*. Inside of this unified concept she establishes the binary of mature and immature media, which provides a means to interpret the rules and traditions of established media forms such as film, against the more speculative and constantly evolving media types that pivot around interaction. Aligning with the need to address the interfaces of interaction Murray states that, "designers should be alert to opportunities to radically rethink familiar

interaction patterns when they no longer support the transparent interaction necessary for the experience of user agency." (2011, p.39). In the context of virtual reality and more specifically interactive 360° film such considerations are fundamentally linked to the augmented interactions that these systems permit. However, when considering the experience of user agency these interactions need to be positioned in a human-machine context. From a design perspective, whatever decisions are deployed to the machine will become symbolic of a perceptual augmentation in virtual reality – the aesthetics of which become embroiled not only in the user's experience of their interactions, but also with the work itself. In terms of transparent interactions, I refer to Norbert Wiener's (2013) black box as a cybernetic apparatus in the second chapter of this thesis. This refers to the inherent lack of information users have about the internal processes that mediate their interactions within these systems. Addressing this within the field of software studies Wendy Chun (2011) focuses on software as metaphorical systems that make visible the invisible components active in human-computer interaction. Embedded in this conversation Chun argues that interfaces should be interpreted as ideological systems, which is a concept that aligns with the goals of this chapter. Considering interfaces in a more traditional context Chun states that they:

> Offer us an imaginary relationship to our hardware: they do not represent transistors but rather desktops and recycling bins. Interfaces and operating systems produce "users" – one and all. (2011, pp.66-67)

The importance of the interface as a site of critical engagement is asserted through its representation as a site of user production. However, to expound such a line of enquiry we need to ask what kind of users do interfaces produce? Applying this question to interactive 360° film the reticle appears as a dominant ideological system, one severely lacking a critical discourse. In the previous chapter I speculated on the reticle's ability to change how a user experiences a work, but to unpack this further, the effects of these interactions need to be explored. To achieve this, I adapted a recent installation to use as a site of data collection. Here I interpreted the interfaces specific to my practice using a synthesis of qualitative and quantitative methods. The central goal being to actualise this model in relation to my own research. This was initiated through a

questionnaire that I used to map the user ratings of each reticle interaction type along with allowing room to discuss immersion, interactivity and more specifically framing this in relation to the idea of interactive 360° film. To support this data-set I also performed a content analysis where I identified key terms as a means to further explore and consider the data that this study generated.

Finally, I developed a data visualisation that supports the idea of *the reticle effect*, whilst offering a way for people to see these interactions in a manner more congruent with a systematic orientation in *Cynematics*. From the qualitative and quantitative data collected I apply the evaluative methods discussed above to explore how different reticles/interactions lead to a changed engagement with the work. The proposed outcome of this has many different applications, but a key one to this research is outlining and framing how some interaction aesthetics lead to interactive 360° film works being experienced as games, which has an impact on user perception. For example, a reticle that demarcates a gun-sight induces associations with first-person shooter games, which I will offer an alternative perspective on by framing this in relation to Paul Virilio's (1989) ideas on cinema and war.

Contrasting with interactive 360° films being viewed as games, I use this study to navigate the most suitable reticle for this medium to function as a type of interactive film. The result of which leads back into the history of film, which correlates with Lev Manovich's argument that, "the visual culture of a computer age is cinematographic in its appearance, digital on the level of its material, and computational (i.e., software driven) in its logic" (2002, p.180). The data visualisation that accompanies this chapter not only provides a method to explore these ideas, but also provides a way of portraying the experiences created by users. For now, I'd like to directly align and propose the idea that reticles are not just a new part of the audience experience of film, but are embedded in cinema history. Before providing a breakdown of research that I conducted in terms of the chosen interaction aesthetics, it is important to define the interface in relation to my *Cynematic* framework.

6.1. Interpreting Interfaces

> Interfaces are not simply objects or boundary points. They are autonomous zones of activity. Interfaces are not things, but rather processes that effect a result of whatever kind. For this reason I will be speaking not so much about particular interface objects (screens, keyboards), but *interface effects*. (Galloway, 2012, p.vii)

The above quotation was taken from Alexander Galloway's *The Interface Effect*, which is a seminal text in terms of considering the idea of the interface in relation to its impact on our experience of media. As discussed in the introduction to this chapter the autonomy of interfaces expands into larger discourses around the politics of digital media, which academics such as Wendy Chun (2011) and Janet Murray (2011) astutely address. However, such theories are not directly applied to forms of virtual reality practice. Akin to Chun's ideations on interfaces operating as ideological systems, Galloway (2012) engages in close readings that explore representations of interfaces inside of media. However, I would argue that these are static sites of analysis or considering them in relation to Murray (2011) they could be perceived as examples of immature media being read inside of mature media. I align with the central arguments in *The Interface Effect* (Galloway, 2012), in the sense that I am concerned with interpreting interfaces, but through my analysis I change these interfaces and interpret differences in relation to user experience. This offers a site to explore the dominant interaction aesthetics that operate within these interfaces. For this reason, I connect with Galloway's reading method, but feel that its application lacks a coherent methodology when considered in relation to forms of perceptual interaction**.**

In the first chapter I broke down the central tenets of *Cynematics*, which promotes the exploration of new narrative systems that stem from human-machine perceptual interaction. However, as my practice develops I realise that cognitive mapping also forms part of the user experience of my work. All of my interactive 360° film practice explores different spatial configuration where the user is offered a variety of ways to structure their experience of the work. In *Systems of Seeing* the user moves through different film spaces through and

with an art object that is linked to the environments that they are inhabiting. *Mimesis* plays with allowing the user move through a set space, whilst *Vanishing Point* (to be discussed in the next chapter) experiments with moving into new worlds combined with a familiar space constantly changing around the user. With these experiments in mind I suggest that cognitive mapping in this context functions as a cybernetic system where user experience and narrative production is regulated by the topographies their interactions create, but this extends beyond the individuals interactions. Connecting with the idea of *datascape mediation* that I presented in the second chapter, this process is best viewed as a systematic operation that is always in a state of flux between the designer/machine/user. Developing cognitive mapping as an interpretive method, Galloway extends Fredric Jameson's (1991) Marxist-framed appropriation of cognitive mapping as an aesthetic system that pivots around spatial mapping. In other words, the manner in which we build a mental map of space changes our political engagement with these spaces. This idea originated in the field of psychology where Edward Chace Tolman (1948) first coined the concept in reaction to his maze experiments with rats. Here Tolman refers to cognitive mapping as a "tentative map, indicating routes and paths and environmental relationships, which finally determine what responses, if any, the animal will finally release." (Ibid., p.192) However, in this instance cognitive mapping is not being viewed in an objectively scientific context. Contemporising this method Galloway builds towards an application that views cognitive mapping as:

> Something more than the mirror of geopolitical crisis. It is the subject formation plain and simple, as the individual negotiates his or her own orientation within the world system. This means that the cognitive map is also the act of reading. (2012, p.viii)

In relation to virtual reality and interactive 360° film, I view the idea of cognitive mapping as the world system that a user builds through their interaction, immersion and viewing – which leads to the production of emergent narrative experiences. This triptych of terms deviates from Ryan's thesis in *Narrative as Virtual Reality* which sees a "combination of interactivity, immersion, and narrativity as the formula for total art" (2015, p.251) – Ryan suggests that we

should instead view narrative as a product of rather than a process in these systems. This idea of a complete system or “total art” academically grounds a central motif strived for by those who create interactive film, but the user acceptance required to achieve this state is something that needs to be addressed. Here, Ryan offers a way of framing the concept of “total art” in relation to contemporary technological practices. The idea originates from the concept of the *Gesamtkunstwerk*, which arguably originates in the work of philosopher K. F. E. Trahndorff (1827). Earlier incarnations of this idea pivot around a multitude of mediums – each offered as sites for the synthesis of many forms of art. One of the best known uses of this terms stems from Richard Wagner’s application of it in relation to theatre (Packer and Jordan, 2001). Contemporising this concept Ryan explores how virtual reality functions as a metaphor for total art, which serves as another site of conflation for artistic mediums.

However, what I am attempting to demonstrate in this chapter is that although there is obvious merit to interpreting virtual reality in this way, we must also consider the aesthetic additions that permits its synthesis of artistic mediums. When considering *the reticle effect* it is important to note that its presence not only shapes the experience of the work, but it also determines viewer’s perceptions of genre. This is something that I will be directly exploring in the coming chapter through qualitative and quantitative analysis of a series of reticles, but for now I would like to consider further the space that the reticle as a medium offers.

The reticle operates in virtual reality and interactive 360° film in what can best described as a *shared media space*, which has commonalities with the idea of total art, but lacks the utopian ideals of this model. That is to say it simultaneously operates in immersive, interactive and narrative spaces, but its primary goal is to facilitate interaction rather than unify each of these spaces. It operates in a liminal space between designer, machine and user allowing communication to exist between each of these systems. Such an ideation cements the reticle as a catalyst for *datascape mediation*, whilst presenting the necessity of understanding the reticle as a site that permits these types of systematic exchange.

To return to the inclusion of cybernetics in my work it is possible to perceive *the reticle effect* as a type of feedback system – involving a visual artefact that permits our interactions, whilst repeatedly enforcing a cause and effect loop *between* the moving images that we are looking at and the invisible objects that we are interacting with. Roy Ascott (2003) employs cybernetics as a "descriptive method" (or metaphorical system) in relation to art, which is a process that I apply to interactive film in the *Cynematic* framework laid out in the first chapter of this thesis. Edward Shanken cements this notion when he states that:

> The bridge between art and cybernetics had to be constructed by creating metaphorical parallels. In other words, the application of cybernetics to artistic concerns depended on the desire and ability of artists to draw conceptual correspondences that joined the scientific discipline with contemporary aesthetic discourses. (2003, p.21)

As a model applied to practice-based research the *Cynematic* framework has led to a deep critical engagement with the components of an evolved interactive film discourse. In alignment with the tenets of *Cynematics* (as described in chapter 2), *the reticle effect* can be perceived as a by-product of adjusting the scope of this thesis to focus specifically on *virtual gaze interaction* as a type of perceptual interaction. Exploring the implications of my interactive 360° film practice is a necessary objective, but the reticle plays a larger role in this process than initially expected. Aligning with Marshall McLuhan's (1964) influential statement that "the medium is the message" *the reticle effect* employs McLuhan's (Ibid., p.1) idea that "the personal and social consequences of any medium – that is, of any extension of ourselves – result from the new scale that is introduced into our affairs by each extension of ourselves, or by any new technology." In the context of *virtual gaze interaction* it is presented as an augmentation, but embedded inside of this process is an illusionary prosthesis enhanced by *the reticle effect*. What I mean by this idea is that rather than making greater the act of ocular perception by offering a form of actual gaze interaction it tricks the user into believing an artificial instance of an incorrect perception of sensory experience is the same thing. Prior to delving into analyses focusing specifically on *the reticle effect* I would like to contextualise the practice from which this study originates. To reify the comprehensive

description intertwined with a reflective statement which follows will serve to cement an understanding of *the reticle effect*.

6.2. (Re)presenting Mimesis

In September 2017 I exhibited an interactive 360° film installation which was hosted by the British Science Festival, the University of Brighton and the University of Sussex. This was presented as part of a pier-side showcase of interactive artworks curated and including work by Professor Paul Sermon (2017). The aim of the event was to portray the works akin to Edwardian scientific experiments, whilst paying homage to the amusement arcades and attractions where many contemporary technologies found their first audiences. In the context of my research this draws obvious parallels with Tom Gunning's (1990) concept of "the cinema of attractions", which refers to cinema "less as a way of telling stories than as a way of presenting a series of views to an audience, fascinating because of their illusory power" (2006, p.382). We could consider 360° film as a site of resurgence for such ideas as many users of virtual reality focus more on the immersive and interactive qualities of the medium as opposed to deeply engaging with stories. However, this does not mean that immersive media works need to be devoid of narrative, instead virtual reality asks us to readdress our concept of narrative towards emergent experiences derived from immersion and interaction. In the final chapter of this thesis I will provide a more in-depth analysis of the narrative structure of *Mimesis* in an attempt to contextualise it as a narrative form – for now I would like to explore how it inspired my research into the idea of *the reticle effect*. The user testing methodology that I employ to achieve this is composed of three main parts: navigation survey, content analysis and data visualisation. Combined they allow me to explore a qualitative and quantitative approach towards developing a discourse around the impact the reticle has on user experience. The scope of this engagement was limited to eighteen participants as this was the maximum amount of participants I was able to obtain during the 360° workshop day I was involved with at the University of Brighton. User responses were elicited from information gathered from written questionnaires, keywords taken from participant responses to questions and finally data collected from user interactions with the work. In the coming sections I will

unpack these methodologies and use their outputs as a means to explore the user experience of reticle aesthetics. Prior to this I would like to elaborate further on the practice from which this research stems.

'Mimesis' as a term refers to the idea of an imitative representation of the real world, which is a trope in my practice that I wanted to focus on. In this interactive 360° film installation, the user becomes a ghost-like viewer – immersed in a series of curated moments in which their *virtual gaze interactions* allow them to possess uncanny perspectives of Brighton Pier. This is heightened through the sound design, which focused on capturing the ambience of each space when the pier is at its busiest, creating a strange state of mind for the user who is visually occupying empty versions of these spaces, whilst being bombarded with audio that contradicts this – the point of which was to further distort the user's sense of reality.

The imitation or reproduction of reality is an artistic endeavour accelerated by cinematic immersion. Using Robert Barker's (1796) patenting of the panorama as a point of initiation for embodying the idea of the all-encompassing image – the eventual fusion of this concept with moving images via 360° film has led to new and diverse ways to represent reality (as discussed in chapter 2). Operating alongside these are the ways image projections were used to represent windows into other realities. Framed in the histories of the magic lantern[32], the phantasmagoria used these devices to project apparitions to its audiences. Terry Castle describes 'the phantasmagoria' as the "technical application to the so-called ghost-shows of late eighteenth-century and early nineteenth- century Europe – illusionistic exhibitions and public entertainments in which 'specters' were produced through the use of a magic lantern." (1988, p.27) An early representation of this can be seen in the image below (Figure 56).

[32] Referring to an early type of image projector that projects images using glass slides.

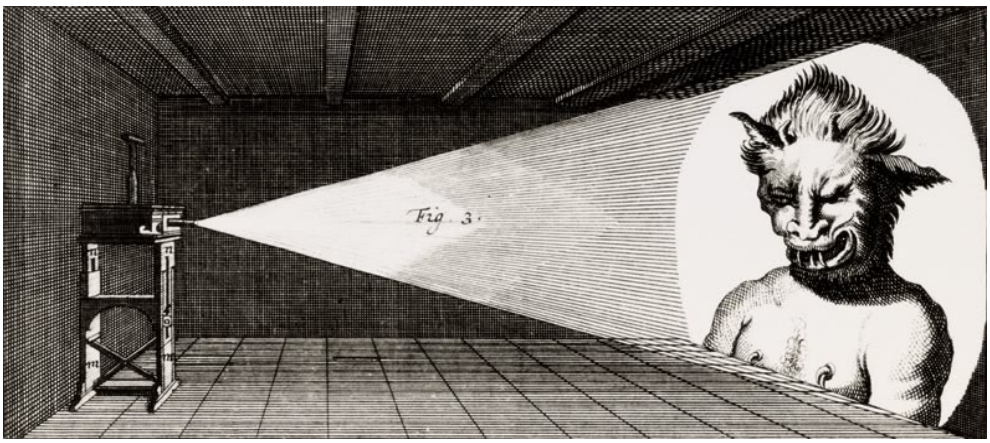

Figure 56 – *The Projection of the Horror Lantern* (Gravesande, 1748).

Inverting such practices, *Mimesis* allows its users to embody cinematic spaces and control their movements through time and space. Amounting to what I would refer to as a cinema VRité[33], this practice transforms the user into the proverbial fly-on-the-wall, whilst allowing for their creation of non-linear narratives established by their own interactions.

6.3. Reticle Types

In my description of *Mimesis* I referred to the *virtual gaze interaction* method that I employed as a system that promotes “accidental discovery”, but in hindsight, after these user tests I realised that there is a lot more nuance to this than I initially expected. Due to the location of the pier-side showcase there was a diverse range of users. At this stage of the research I was yet to establish a specific data collection method and was more interested in observing how people responded to the work. Given that there was no other version of the application for users to compare and contrast interaction methods it was difficult to obtain data on alternative interaction methods from a non-specialist audience. The version of this work that I exhibited used what can best be described as a *static reticle* to represent a user’s interaction in the video space. This refers to a reticle that does not visually interact with the user. It still functions as a visual representation of the ray tracing system that allows *virtual gaze interaction*, but it does not give the user any indication that they are looking at something that is interactive. With this work I was hoping that people

[33] A term I have devised to make explicit reference to the cinéma vérité documentary practice.

would start to correlate their interactions with objects in the scene, such as bins, signage and anything that stands out in the visual space. In some instances this worked, but user feedback showed that in others it led to shallow-band engagement.

Following an extensive onsite discussion with a pair of game developers they suggested that I make the reticle interactive so transition points in the space would be more obvious to users. This suggestion is the origin point for this chapter as once I began to approach the different ways of employing the reticle I realised how much its aesthetic effects a user's interaction, immersion and interpretation of a work. Given that the reticle involves an image overlay there is an infinite amount of visual aesthetics that can be applied to this interface. For this reason I choose to focus specifically on the aesthetics of interaction, which as per Katja Kwastek's use of the term aligns with her focus "on describing and analysing the actions and the processes of perception and knowledge acquisition that are made possible through engagement with interactive media art" (2015, p.43). However, embedded inside of these "processes of perception" are interface systems that interrelate technology with phenomenology – which in the context of my research are embodied by the idea of *the reticle effect*. To articulate this I broke reticle interactions down into the following four categories:

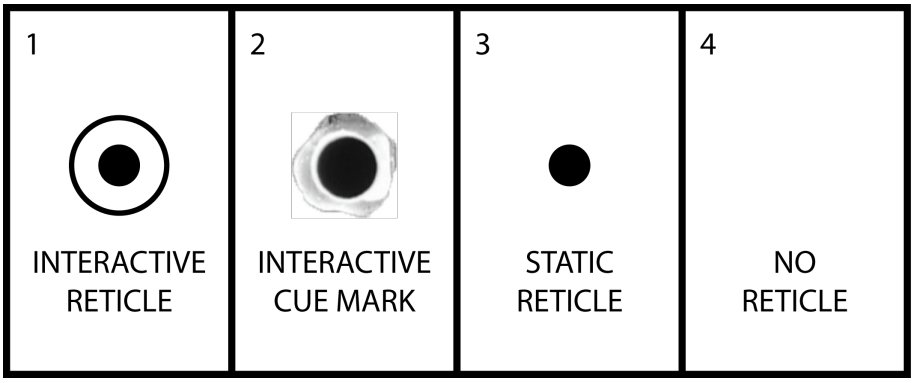

Figure 57 – Reticle Aesthetics (Ambrose, 2018)

1. *Interactive Reticle* - Point that activates when an interactive object is being looked at, but has a static reticle prior to this interaction. In this example this is portrayed by a thin circle appearing outside of a static dot.

2. *Interactive Cue Mark* - An image that only appears when an interactive object is being looked at. Otherwise there is no image overlay visible at all.

3. *Static Reticle* - As already described this is a fixed image that does not indicate to the user when they are looking at an interactive object.

4. *No Reticle* - The reticle has been removed from the installation.

In order to evaluate these approaches I built four versions of *Mimesis*, each using a different one of these reticle interactions. This allowed for comparative analysis to be conducted on each of these systems. To strengthen the data in this study I made sure to alternate the order of the versions for each user – starting with the most amount of interaction (interactive reticle) and working to the least amount (no reticle), and then reversing this order for each candidate involved in the study. I also modified the original work to no longer start outside the venue where we hosted the installation on the pier. Instead, I randomised the starting point to prevent users from learning a pattern and becoming familiar with certain spaces. The generalisability of my statistical analysis was hindered by the eighteen participants that I could interview and collect data from. However, there were some very interesting outcomes from this part of the study that not only cement *the reticle effect* as a method, but also serves to propagate discussion on the positioning of *virtual gaze interaction* in relation to interactive 360° film. When referring to *the reticle effect* as a method I am alluding to the representation of how different reticle aesthetics impact user experience and therefore is a factor that should be considered when making content that employs *virtual gaze interaction*. Embedded in the viewer's responses is an innate desire to conflate immersion and interaction, which serves to mitigate the physical interaction paradox referred to in the second chapter. The evidence for this claim is best represented in the results from the immersion scale which indicates that the presence of the reticle does not overtly impact user immersion.

6.4. Navigation Survey

Prior to discussing this qualitative data more specifically, I would like to state that the individuals selected for this study were chosen based on their suitability and interest in digital media. As students on the BA in Graphics and Illustration at the University of Brighton these tests were hosted as part of a practice-based 360° film workshop. Given that candidates were chosen on a first-come, first-served basis there was no pre-decided selection criteria for the eighteen participants. On the second day of testing I also used three PhD candidates and one interested member of the public. Although this was an engaged audience the age demographic was capped between 19-30, which is somewhat limiting in terms of overall perspective. If I was to conduct these experiments again it would be ideal if I was part of a larger research team, one that could look at a much wider age demographic – as well as a much larger amount of users in order to increase the statistical validity of the research.

In order to explore the effect the reticle has on a user's experience I designed a *Navigation Survey* (Appendix – Navigation Survey) that started by explaining the interactions to the user before each test – this used similar descriptions to the ones provided in the reticle types section detailed above (Figure 57). The point of this was to get participants thinking about their interactions in the space prior to experiencing the work. I then asked them a series of questions after each experience (Appendix – Navigation Survey). Initially, I wanted to measure how long users would stay in each experience, but what became immediately apparent was that the first couple of users were spending significant amounts of time in each version, which would have led to a limited number of participants being able to do the study. With this in mind I limited each interaction to a maximum of 10 minutes, but also informed people that they could take the head-mounted display off at any point. The questionnaire consisted of four main sections, each of which explored different parts of the user experience, these involved an: immersion scale, interactivity scale, overall experience rating and finally the best approach in relation to interactive 360° film. (Appendix – Navigation Survey)

6.5. Immersion Scale

For this scale I asked users to rank their experiences in order of how immersive they found them after they had experienced and rated all 4 of them. The scale went from 1-4 (1 being the least immersive and 4 being the most immersive). The averages from the data I collected suggested something quite interesting in relation to immersion. If we are to interpret immersion as a state of involvement with the work then the most logical assumption would be that there would be no visible reticle. The reason for this assumption is that there is no graphical layer distracting the user. In relation to the static reticle this would appear to be the case as no reticle's rating is higher than that of the static reticle in every instance (Figure 58).

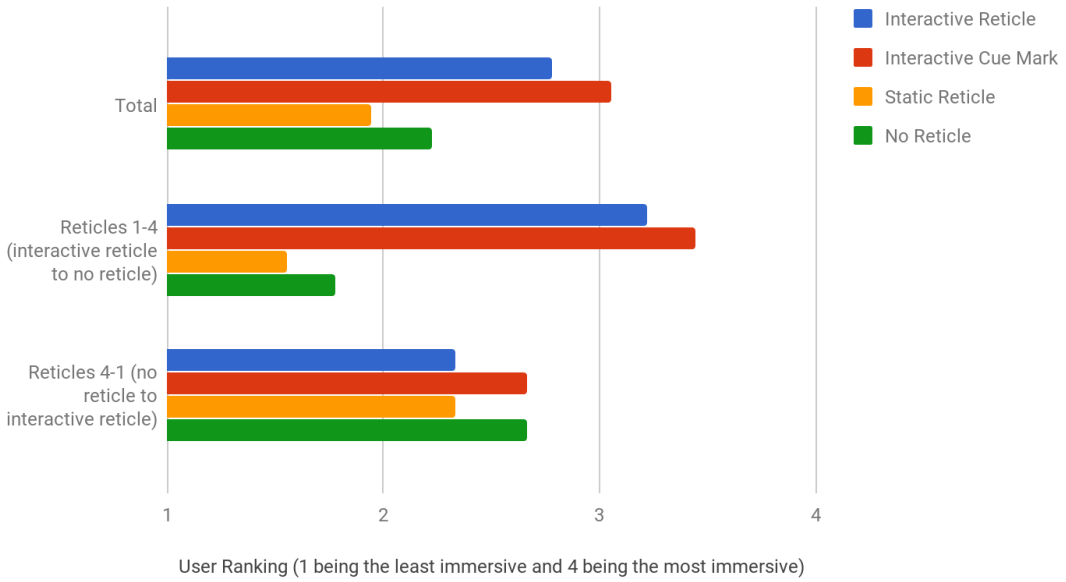

Figure 58 – Average Immersion Scale for the *Mimesis* Tests (Ambrose, 2017)

However, as we consider the two interactive reticles it becomes apparent that there is a degree of acceptance with interactivity and in some cases it is potentially leading to a heightened state of immersion. Whether the interactive reticles are on par or above that of the average scale for no reticle it is fair to speculate that the interactive reticles do not overtly interfere with user immersion. What this scale also starts to illustrate is that each interaction aesthetic leads to a different outcome – serving as an actualisation of *the reticle effect*. It should also be noted that the interactive cue mark stands out as either the top form of immersion or at least on par with no reticle. The immersive

qualities of the interactive cue mark will be considered throughout this chapter as this scale helps articulate the idea that *the reticle effect* if anything helps create a greater sense of user immersion. In these tests I consider interaction from reticles 1-4 (interactive reticle to no reticle), 4-1 (no reticle to interactive reticle) and the total averages of these ratings. This serves to illustrate that the order users experience reticle interactions changes their immersive ratings. There are a number of possible causes for this, but it is interesting how when a user starts with the interactive reticle they find both the reticle and no reticle far less immersive, whilst when they start with no reticle they equate the reticle and the interactive reticle differently to the interactive cue mark and no reticle. The content analysis section in this chapter will address some of these outcomes by looking at how users described their experiences of the work. For now, I would like to continue looking more generally at user ratings building towards a discussion on how some obvious trends are disrupted when the user is asked to consider their ratings in relation to the genre that they are engaging with.

6.6. Interactivity Scale

The next scale that I employed was for a measure of interactivity, which like the immersion scale was captured after they had completed each of the experiences. This followed the same rating system as the immersion scale. The average scale is indicative of a logical pattern – that being users found the interactive reticle and the interactive cue mark to be more interactive than the static reticle and no reticle. There is fluctuation between the interactive reticle and the interactive cue mark, depending on whether interaction starts with the interactive reticle (1-4) or no reticle (4-1), but in every instance the static reticle and no reticle fall far below either of these ratings.

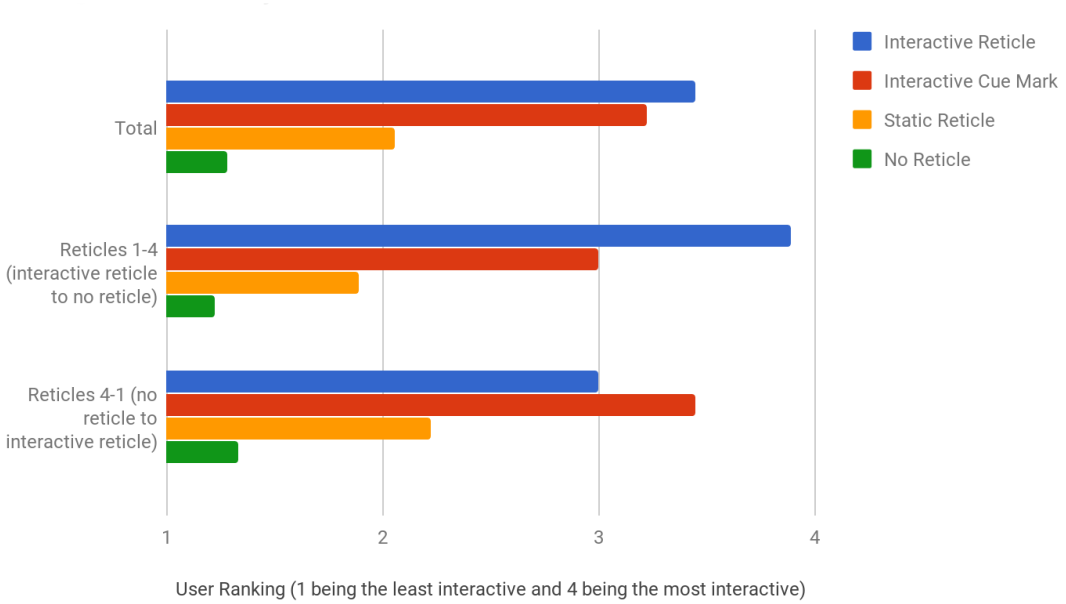

Figure 59 – Average Interactivity Scale for the *Mimesis* Tests (Ambrose, 2017)

This scale (Figure 59) illustrates the importance of the reticle to the user's interactive experience, as the more integrated it is into the work the higher the users rate their interactive experience. For interaction to be at its most fluid you would expect the more nuanced interactivity is the more users can accept interfaces operating amid such forms of ocular interaction. In the context of *virtual gaze interaction* users are forced to augment their eyes, which allows interaction to propagate immersion. This process is initiated as soon as the head mounted display that they are wearing presents them with a world to inhabit and once they realise that their virtual gaze is interactive a greater sense of immersion stems from the control that they are being given inside of this environment. With this in mind, it appears that users are willing to accept reticles as an augmentation of their sight. However, as indicated so far, this is not a fixed system of experience.

6.7. Overall Experience Rating

To explore user experience in a manner more specific to *the reticle effect*, I asked participants in each stage of the test to rate their experience whilst considering the reticle that they had just used. The rating system was from 1-10 (1 being the lowest and 10 being the highest). If *the reticle effect* had no impact on user experience then you would expect every test to follow a similar line (allowing for some deviation), rather than the fluctuations expressed below.

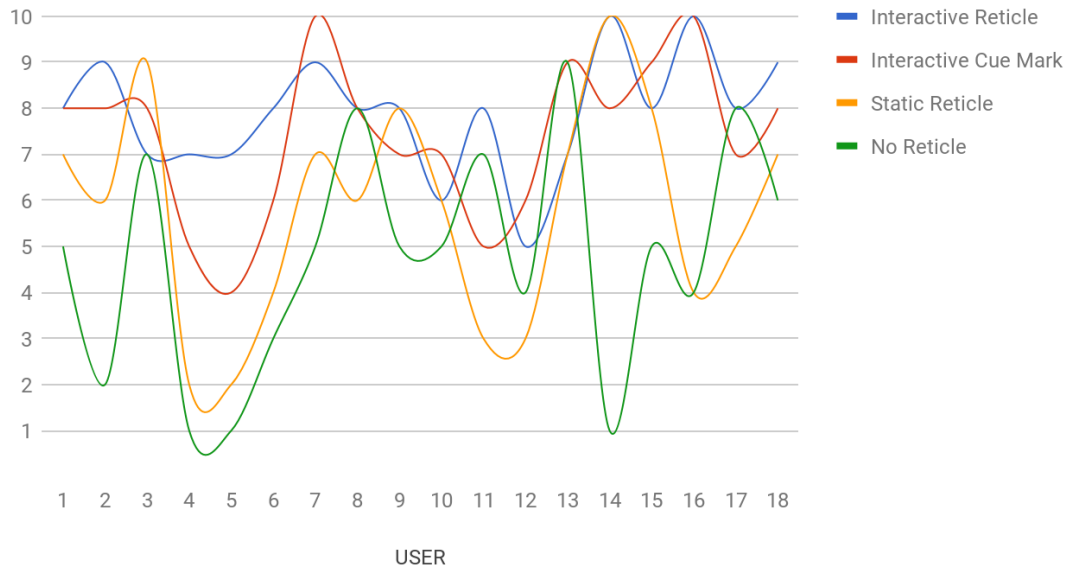

Figure 60 – Total Experiential Ratings for the *Mimesis* Tests (Ambrose, 2017)

Within this chart you can start to see how there is a trend where participants tend to rate the static reticle and no reticle far less than the other two approaches. This could suggest that interactivity leads to an enhanced user experience, which is something that was mirrored in the interactivity scale already discussed. In order to get a better picture of this downward trend I looked at the average experiential ratings for: totals, interaction from no reticle (4-1) and the interactive reticle (1-4) (Figures 61-63). In each instance the interactive reticle has the highest average rating and the order descends from this point. This illustrates that the more interactivity the user has the higher they rate the work, but we must also question how the work is being perceived. During the tests it appears that users favour the interactive reticle, but this starts to shift as they reflect on their interactions retrospectively.

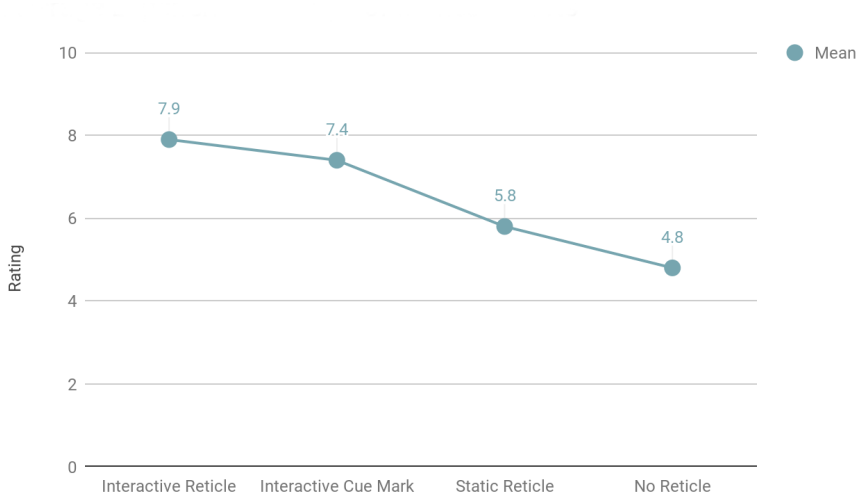

Figure 61 – Average Experiential Ratings of *Mimesis* Tests (Ambrose, 2017)

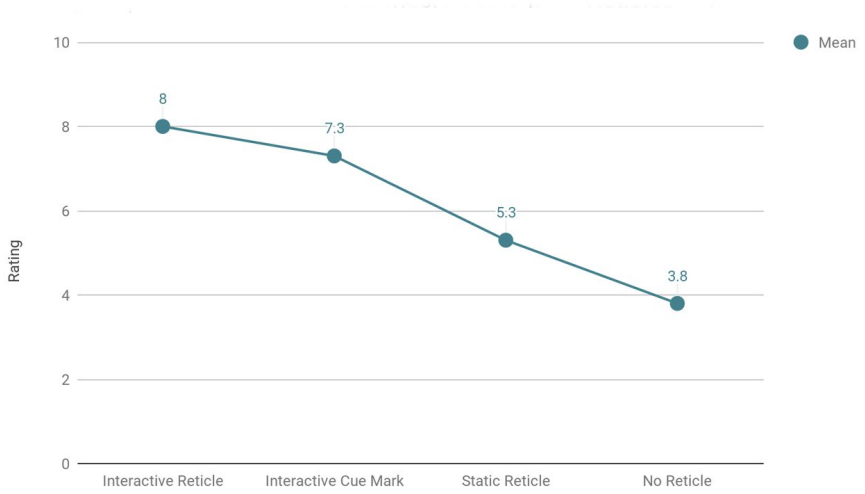

Figure 62 – Average Experiential Ratings of *Mimesis* Tests from Reticles 1-4 (Ambrose, 2017)

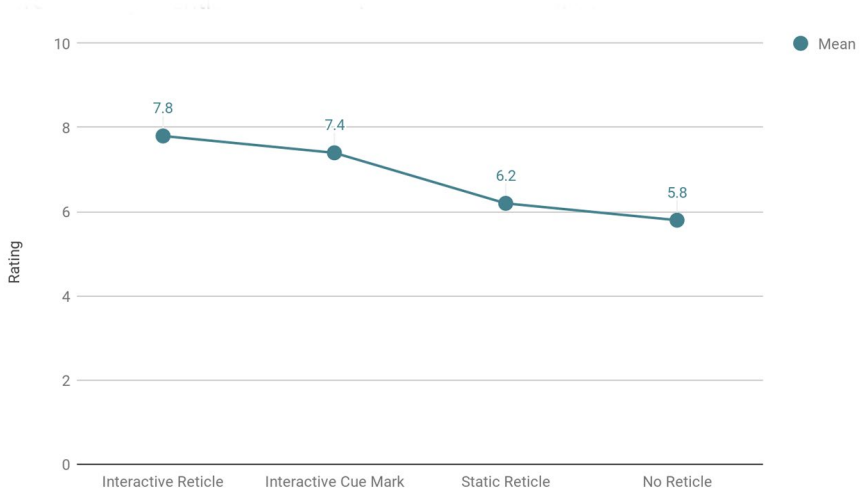

Figure 63 – Average Experiential Ratings of *Mimesis* Tests from Reticles 4-1 (Ambrose, 2017)

6.8. Considering Interactive 360° Film

To explore how user perception impacted these ratings and to look towards explicating reticle aesthetics in a *Cynematic* context I asked each participant the following question, “after using these four different VR reticles, which one do you think was the best overall approach to interactive 360° film?” The point of this question was to steer them away from perceiving the work as a type of game, which to some degree has become a preconditioned expectation of anything that is interactive and employs VR technology. If we are to consider that each user has been rating the work in relation to this genre then the outcome of this query should correlate somewhat with the average experiential ratings already discussed. What became apparent throughout this test was that as soon as candidates were asked to consider the work from this perspective there was an overwhelming shift towards the interactive cue mark. This is evident in all of the approaches that I assessed, but each of these provides a different insight into how users relate interaction to filmic experience.

To speculate, I would first like to look at the results in relation to interactions starting with no reticle (4-1) (Figure 64). Looking at the data from this perspective it places the interactive reticle and the interactive cue mark relatively on par with one another. Both the static reticle and no reticle are barely considered in this context. It seems that although people are now viewing the work from a filmic perspective, the identification of interactive 360° film helps to indicate that interaction is required in order for it to meet the requirements of this genre. This could be an outcome of frustration acquired from starting from the point of least interaction, but evidently from this approach users are happy to choose either of the two more interactive approaches.

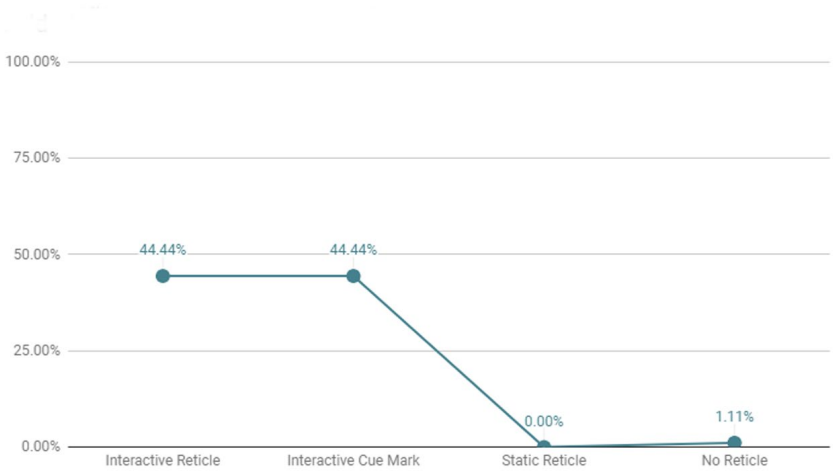

Figure 64 – Best Reticle Approach for Interactive 360° Film with Interactivity Added (Ambrose, 2017)

If we are to consider user responses in relation to interaction that started with no reticle (4-1) (Figure 65) there is a significant majority that rated the interactive cue mark as the best approach (88.88%). It is difficult to determine why users that start with the most interaction predominantly lean towards the interactive cue mark, but it is possible that the process of removing interaction makes them more aware of the aesthetics of interaction as opposed to the opposite approach, which could be interpreted as an underlying scale of interaction. As in, the act of moving up through these different interactions magnifies the user's experience of the interactive reticle as opposed to no reticle and the static reticle it offers a heightened state of immersion and interaction.

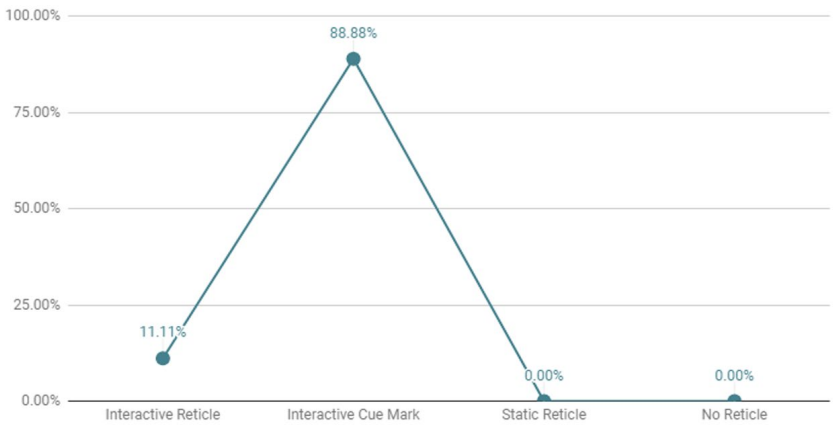

Figure 65 – Best Reticle Approach for Interactive 360° Film with Interactivity Removed (Ambrose, 2017)

Looking at the total percentage values for this part of the survey we can consider a number of factors. First of all, no reticle is rated very low in relation to interactive 360° film, which validates the necessity of the reticle in relation to guiding a user's gaze interactions. Ideally a form of *virtual gaze interaction* where the user is not being distracted by an interface would allow them to conflate the act of watching with these interactive systems. This relates to a point established in my second chapter where I introduced the idea of a *narrative break*, referring to this as the site where symbolic interactions decrease the immersive and emergent potential of the form. The difficulty with referring to perceptual interaction is that in this instance it requires invisible symbolic interactions to function – so it should be noted that it does not function counter or binary to symbolic interaction. Instead, it should be perceived as a cybernetic augmentation where biological sensory interactions and machine/user representations of these processes coincide.

Prior to conducting this part of my research, I would have considered the less visual overlays are used the better as they have a tendency to distract users leading to reduced immersion, but what these tests have made evident is that users are willing to accept a visual prosthesis as long as it remains nuanced. Overall the static reticle failed to receive a rating in any of the breakdowns I explored, which could be indicative of it being either the worst approach or closely aligned to no reticle. When applying the static reticle to my original *Mimesis* installation I was considering it in relation to guiding user interaction in relation to a mental topography established by certain objects in the film space being interactive, which is an idea that some users understood. However, when we consider how low people rated their experience of the static reticle it might be fair to say that this is not the most suitable approach when making an interactive 360° film.

The charts included in this section of the chapter provide a window into perceptions on reticle aesthetics, which serves to actualise the need to critically engage with *the reticle effect*. However, they do little to illustrate why certain decisions were made. To explore this in more depth I interviewed every participant asking them a series of questions, with the aim being to see how their responses relate to the data already discussed.

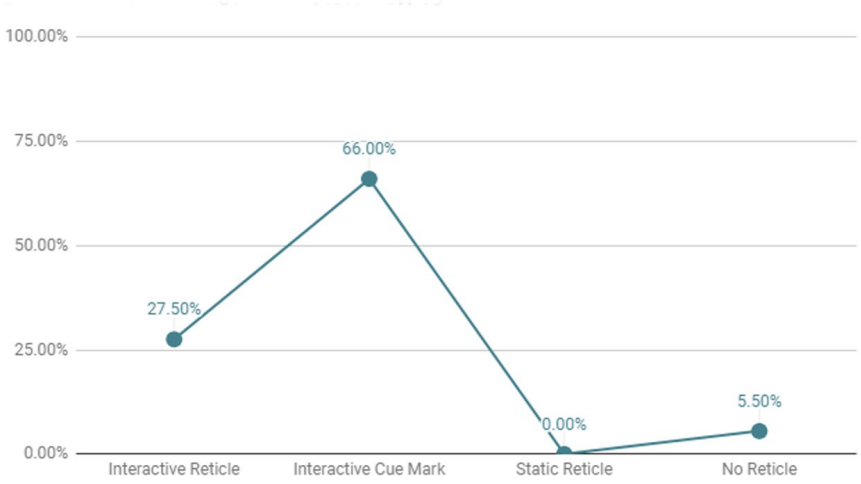

Figure 66 – Best Reticle Approach for Interactive 360° Film (Ambrose, 2017)

6.9. Content Analysis

In order to collate the most pertinent and relevant information from the discussions I had with the participants, I decided to employ a form of content analysis. When looking to define and contextualise this approach I referred to Satu Elo and Helvi Kyngäs' (2008) "The qualitative content analysis process". This served to elucidate the most suitable methodological application for this mode of approach. Given that this emergent field of study lacks an established critical discourse I opted to apply an inductive method, meaning that "the categories are derived from the data" (Ibid., p.109). This part of my research seeks to subjectively review part of the user experience of the reticle. From here we can build on many of the points alluded to in the previous section. To initiate this process, I transcribed keywords from all of the interviews conducted. I then created categories based on the types of terms appearing in their language. These did not cover every keyword, instead I focused on a shared commonality, creating a category system that would allow for discussion to be generated about the more predominant themes in how the participants chose to speak about their experience of each reticle system. The most obvious of these categories was the positive and negative emotional language used to describe the work. In the content analysis chart positive values are portrayed in yellow and negative values are portrayed in blue. Upon inspection of the overall chart it becomes immediately apparent that the majority of the emotionally negative responses are directed towards the static reticle and no reticle.

Key
EMOTIONAL +
EMOTIONAL -
GAME
IMMERSION
CHALLENGE +
CHALENGE -
AUTHORED AGENCY
USER AGENCY
WEAPONISED

	USER	INTERACTIVE RETICLE			INTERACTIVE CUE MARK			STATIC RETICLE			NO RETICLE		
F	1	GAME	FOCUS	GUIDED	DIFFICULT	ENGAGING	FIND	GAME	DIFFICULT		STUCK		
M	2	AIMING	FAST	GUN	SCAN	LOOK	FIND	DIRECTED	INVOLVED	AIMING	BORING	DAUNTING	
M	3	INTUITIVE	FOCUS		NATURAL	IMMERSIVE		INTUITIVE	FOCUS		FRUSTRATING	DIFFICULT	
M	4	EASY	FIND	NAVIGATING	PURPOSE	INTERESTING	COMPELLING	FOCUS	PURPOSE	EXPLORE	CONFUSING	UNINTERESING	
M	5	GAME	GUIDED	PURPOSE	ALIEN	DIFFICULT	NAVIGATING	BORING	DIFFICULT		STUCK		
M	6	EASY	NAVIGATING		REALISTIC	INTERESTING	NAVIGATING	GUIDED	NOT INTERACTIVE		DIFFICULT	NOT INTERACTIVE	
F	7	GUIDED			IMMERSIVE	NATURAL		GUN	AGGRESIVE	SLOW	BORING	TRAPPED	FRUSTRATING
F	8	GUIDED			LOOK			ANNOYING	BORING	CONFUSING	NOT INTERACTIVE		
M	9	EASY	UNDERSTANDABLE		EASY	UNDERSTANDABLE		HARD			NOT INTERACTIVE		
M	10	GAME	OBJECTIVES		INTUITIVE	EASY		GAME	GUN	AIMING	POWERLESS	AIMLESS	RANDOM
M	11	GAME	USEFUL	AGENCY	SEARCHING	INVESTIGATE	NAVIGATING	UTILITARIAN	FRUSTRATING	DIFFICULT	EMERGENT	BORING	
F	12	OBVIOUS	BORING		INTERESTING	ENGAGING		FRUSTATING	BORING		BORING	NOT INTERACTIVE	
F	13	GAME	GUIDED		ENTICING	ENJOYABLE		DIRECTED	POINTED	GUN	IMMERSIVE	SLOW	DELIBERATE
F	14	INTERACTIVE	FUN		IMMERSIVE	TRACE		INTERACTIVE	LOOK		NOT INTERACTIVE		
M	15	GUIDED			IMMERSIVE	ENJOYABLE		FRUSTRATING	ANNOYING		NOT INTERACTIVE	ANNOYING	
M	16	FUN	GUIDED		FUN	SEARCHING		NOT INTERACTIVE	BORING		NOT INTERACTIVE		
F	17	GAME	REWARDING		DIFFICULT	SLOW		TRAPPED	NOT INTERACTIVE		IMMERSIVE	UNGUIDED	
M	18	CONTROL	EXCITING	REWARDING	GAME	REWARDING	ENJOYABLE	GAME	CONTROL	ENJOYABLE	BORING	IMMERSIVE	

Figure 67 – Content Analysis Colour-Coded Category System (Ambrose, 2017)

If we are now to look at the positive emotional language used in the interviews, apart from one instance only the interactive reticle and the interactive cue mark are discussed from a positive perspective. In particular the interactive cue mark has a predominant lead in positive emotional language, which might give some insight into why users considered it the best reticle approach in relation to interactive 360° film. The next and most obvious category to establish was whether the participant referred to the work directly as a *game*. This was another emergent outcome from my content analysis as at no point during the survey did I ever refer to any reticle or aspect of the work as a game. Throughout all of the tests there were numerous instances where users referred to the static reticle and the interactive reticle directly as games. In one instance a participant referred to the interactive cue mark as a game, but overall this term was predominantly used to refer to the interactive reticle and less so the static reticle.

As mentioned in the introduction, one of the intended outcomes of this chapter is to present the argument that gamified interpretations of the reticle actually stem from film, but the dominant discourse (in relation to how VR is being marketed) aligns such interactions with the realm of gaming – more specifically the first-person shooter genre of gaming. To unpack this idea, I would now like to address the role of the reticle in relation to the technologies of cinema.

6.10. Weaponised Vision

Alongside the dominant perception of the interactive reticle and the static reticle as sites that shift the work into the realm of gaming there are times when both of these reticles are referred to directly as *guns* and in the context of *aiming*. To this end, I suggest that when users are interpreting these types of interaction they are doing so from a weaponised perspective. As already suggested such approaches are more commonly associated with gaming, which leads to people applying a different set of expectations to their experience. However, these do not stem from gaming, in fact it could be argued that their history in gaming stems from a perceptual process that started in the science of optics. In *War and Cinema: The Logistics of Perception* Paul Virilio (1989, p.3) presents a precursor to *virtual gaze interaction* in the ‘line of aim’, which he presents as “a

geometrification of looking, a way of technically aligning ocular perception along an imaginary axis".

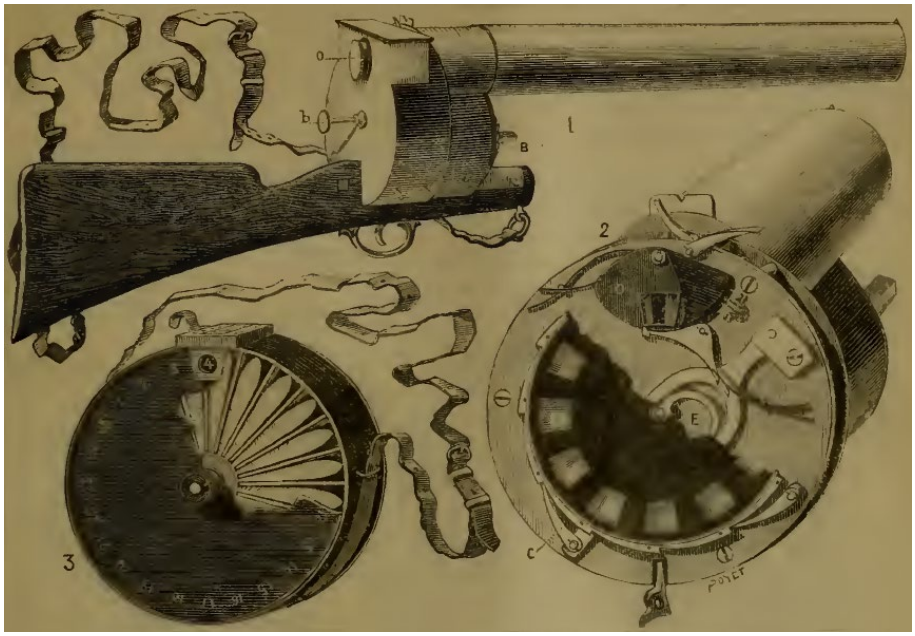

Figure 68 – Mechanism of Gun (Marey, 1882).

This perceptual process was eventually subsumed by military systems which helped develop the reticle's position as a violent embodiment of the act of killing. However, running parallel to this, the reticle also forms part of the cinematic apparatus of warfare. Intertwining the history of the Gatling gun with the development of Etienne-Jules Marey's chrono-photographic rifle (Figure 68), Virilio's discourse on cinema and war reconfigures the camera as a weapon. For the purpose of my own work, rather than focusing on the destructive qualities of the camera, I would like to consider how the reticle mediates its film shots. In the context of *virtual gaze interaction*, the reticle is the only remaining visible interface in this system. Virilio presents the physical replacement of a gun with a camera in his text (Figure 69), which serves to illustrate cinema's synthesis/adaption into military systems. However, in relation to gaming and 360° film the camera has been replaced by a virtual version of itself. As an invisible object the user no longer has the context of its physical presence, instead they embody the camera from a first-person perspective. Once the static reticle or the interactive reticle enters this space the virtual camera inverts previous practices and steers users towards a game-like perspective. To this end these reticles abnegate interactive 360° filmic experience – arguably

leading to a new genre of expanded film being contracted by the aesthetics of interaction and such demarcating a powerful instance of *the reticle effect*.

Figure 69 – Camera mounted to a machine gun (Virilio, 1989).

Virilio (1989, p.15) frames his vision of cinema with a paraphrase of Nam June Paik which states that “cinema isn’t I see, it’s I fly” (Taussig, 1993). This seamlessly correlates with the aerial adoption of the camera in military scenarios and translates perfectly to the role of the camera in virtual reality. Users in VR relate to their spatial movements in a way that moves beyond the act of looking, which naturally corresponds with the user’s embodiment of an invisible camera. They are no longer themselves or the camera, they have disputably become a liminal cybernetic system that conflates the two. However, in interactive 360° film the reticle can lead to a targeting of vision that weaponises the liminality of the user and their perception of the media they are engaging with.

In 1990, Lynn Hershman created a piece of interactive media art titled *America’s Finest* (Figure 70). The work consists of an M16 rifle that has been

adapted to display a sequence of images in the scope of the gun. Lynn describes this work as:

> A cameragun designed to expose the horrors of this century perpetrated by weapons and translated into memory through media. Viewers squeeze the trigger to have their own image inserted into the viewfinder as they hear the screams and shots as they convert from viewer to victim. (Hershman, 1993)

Figure 70 – *America's Finest* 1 (Hershman, 1993)

This work references Etienne-Jules Marey's chrono-photographic rifle discussed earlier in this chapter and in that sense represents a merging of camera and gun. However, the crux of this piece happens inside the scope of the gun which lacks any form of reticle (Figure 71). Turning the scope into a screen means that a user's attempt to target with the gun transforms into a viewing experience. Given that the pulling of the trigger places a version of the user inside of the scene the act of using the gun creates a connection between the user and the material they are looking at. In a sense they become the overlay in that moment or as the ZKM Media museum exhibit description phrases it, "visitors will thus find themselves in their chosen field of fire".

In the case of interactive 360° film the user is always present in a film space as they occupy both camera and screen at the same time. Considering this, the *virtual gaze interaction* that represents and permits interaction between these

points is arguably a site of control hidden by intuitive[34] interfaces that induce weaponised game-oriented perspectives. To deconstruct such experiences and look towards alternative approaches I will now discuss the interactive cue mark, which offers a more suitable way of navigating these systems.

Figure 71 – *America's Finest* 2 (Hershman, 1993)

Looking at the content analysis again (Figure 67), we can see that in the same way that *game* appears as a reoccurring turn of phrase for users of the interactive and static reticle – *immersive* appears for users of the interactive cue mark and no reticle. This appears a handful of times in relation to no reticle, but with almost the same consistency as game was referred to for the interactive reticle in the case of the interactive cue mark. As mentioned when referring to the immersion scale earlier in this chapter the expected site of most immersion would logically be where there is no reticle at all. However, as per the user responses it appears that immersion does not require interaction to be completely hidden.

When considering why the interactive cue mark stood out as the best approach to interactive 360° film it is apparent based on the language used in the

[34] In relation to user acceptance without conscious reasoning and in the context of computer software, referring to ease of use.

interviews, participant feedback demonstrated that it was perceived as immersive and with positive affectivity. The interactive cue mark balances immersion with interaction allowing people to have unguided views of the scene until they want to seek out a transition point. Participants regularly used language such as searching, scanning, looking, investigating and so it became apparent that the user experience of this reticle type is encapsulated by a state of exploration – rather than the sense of ocular targeting that the interactive reticle and the static reticle induced. In what follows I will present the idea that the interactive cue mark is an adaptation of an early aesthetic of cinema.

Figure 72 – Cue mark scene in *Fight Club* (Fincher, 1999)

The role of the cue mark in contemporary cinema is best illustrated in a scene from *Fight Club* (Figure 72) where the fourth wall or suspension of disbelief is broken and the viewer is made aware that the cue mark was an indicator for the projectionist to switch projectors at the exact moment when one reel ends. This sequence can be described as a ‘meta-fictional’ moment which Patricia Waugh defines as “a term given to fictional writing which self-consciously and systematically draws attention to its status as an artefact in order to pose questions about the relationship between fiction and reality.” (1984, p.2) However, in this instance David Fincher uses it to allude to an invisible history of cinema in the same breath as confronting the physicality of the medium. The interactive cue mark changes this relationship as instead of the cue demarcating a need to change to the projectionist it is now representing a

possible changeover point for the user. However, it is also a designed point that communicates with the software and triggers a sequence of interactions that transports the user to an entirely new scene. It functions as a site of *datascape mediation* in the sense that user interaction, system design and the machine-led interface conflate into a shared media space where the user is allowed to be immersed in the video, but also through exploration find and choose when they leave the scene. As an apparatus of *Cynematics* the interactive cue mark illustrates how previous film devices can be adapted into dynamic and live processes. Applying such a thought process to the selection of the interactive cue mark for the *Mimesis* tests, I started to look for aesthetically pleasing cue marks in examples of early cinema. After scanning a plethora of cue mark screenshots on Google I eventually decided on a cylindrical cue mark that appeared in *The Locket* (Brahm, 1946) (Figure 73). I extracted the cue mark from this scene using Photoshop and then added it to the graphical user interface for the interactive cue mark in Unity (Figure 74).

Figure 73 – Cue mark in *The Locket* (Brahm, 1946)

Figure 74 – Cue mark extracted from *The Locket* (Brahm, 1946)

With this selection and implementation, I retrieved a 72-year-old film artefact and transformed it into an interface of *virtual gaze interaction*. Rather than being a visual indicator to a projectionist it now functions as a visual prosthesis for the ocular interactions of the user. The importance of this technique is grounded in the re-appropriation of the early interactions of film display. To assert the relevance of such an approach the first interactive film, titled *Kinoautomat* (Činčera, R; Roháč, J.; Svitáček, 1967), employed projector switching based on user votes, but this process lacked the seamless integration of the cue mark system being used for non-interactive films in the projection room. The practice that I present as part of my research conflates this early method of film display with a form of perceptual interaction. Vital to this form is the need to deviate away from game-like perspectives and offer a means to visualise media futures pertaining to new applications of interactive 360° film.

6.12. Virtual Gaze Interaction Network

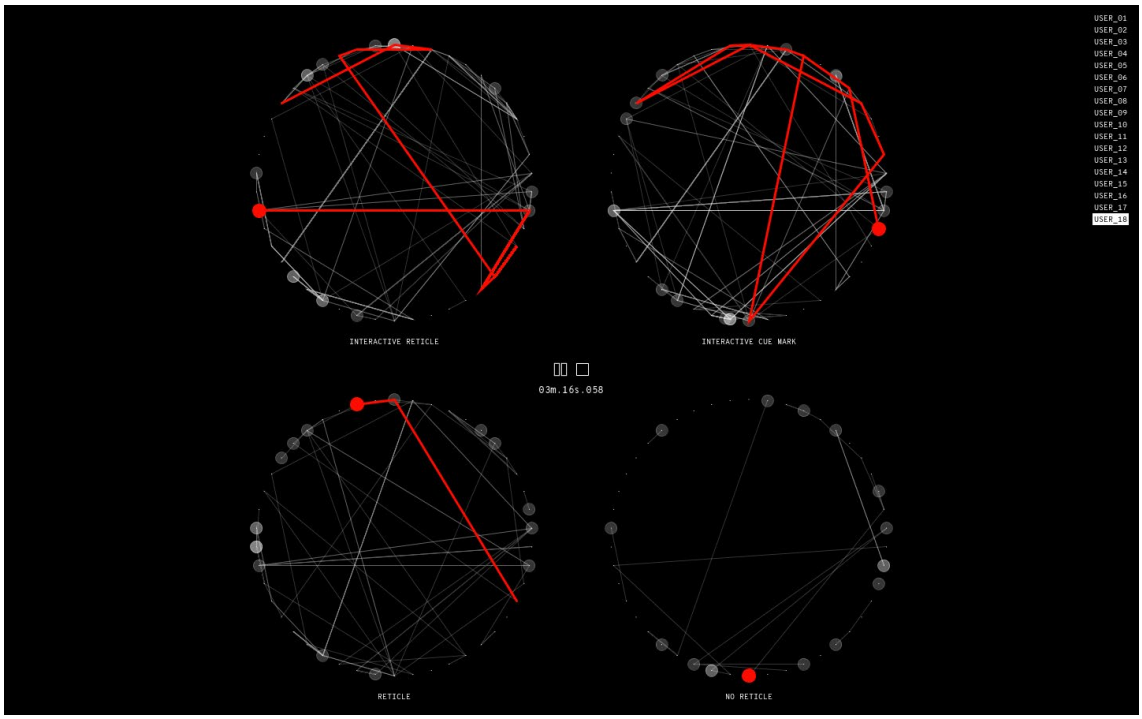

Figure 75 – *Virtual Gaze Interaction Network* screenshot (Ambrose, 2017)

Experience:

Please download and use the *Virtual Gaze Interaction Network* via the section with this name on the main page at www.jeremiahambrose.com/vgin.html.

Working alongside Data Technologist and Researcher David Young we designed and developed a tool to help visualise data collected as part of my practice-based PhD research. The *Virtual Gaze Interaction Network* (VGIN) allows users to navigate participant interactions with four different reticle aesthetics. Here individual and collective participant interactions can be controlled towards an aesthetic apprehension of the effects these different interfaces have on user experience. The circular design of this application complements the spherical scenes made visible by hovering over the nodes in each network. Alongside this function, is the metadata for each scene allowing users to conduct macro and/or micro level analysis of these interactions. Embodied in this aspect of my research is the potential to expand and develop open source toolkits for exploring how people engage with interactive 360° film. In this thesis, it is best perceived as an artistic collaboration that addresses new ways of looking at how we interact with virtual worlds and their dominant interfaces.

In the previous chapter I referred to the new economies of vision that stem from *virtual gaze interaction* presenting this model as a means to understand how the idea of the gaze has radically shifted through the technologies of virtual reality. Rather than just theorising about said data and its dystopian qualities I have opted to use it to help elucidate the idea of *the reticle effect*, whilst providing an overview of the virtual topographies navigated in the various versions of *Mimesis*. The image below is a design reference used to establish the style of the data visualisation. I wanted to keep this in a circular context given the connections to the panorama and 360° film, but also use the tapestry of interactions inside of this circle to demarcate user movements between each of the spheres that compose the entire circle.

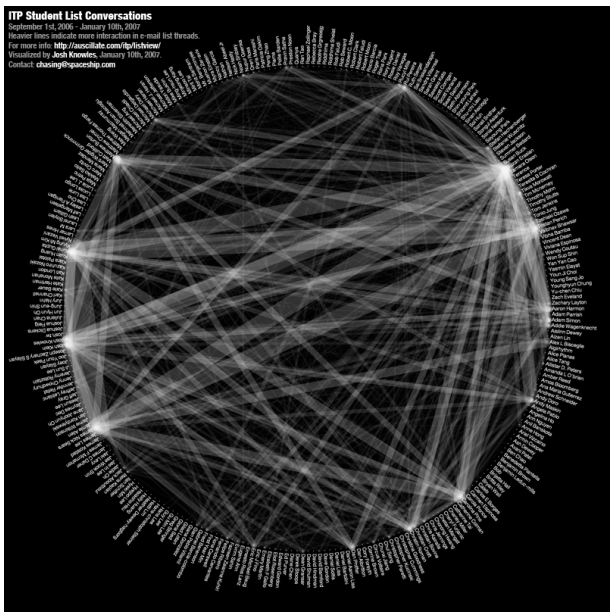

Figure 76 – Reference visualisation (Knowles, 2007)

Given the amount of information I collected (Ambrose, 2017) and the ways that this can be processed I adapted the reference visualisation by removing the names from the edges of the circle and replacing these with circles which when you hover the mouse over a spherical image along with additional metadata appears in the application. This offers a way for users to inspect the data on a micro and a macro level coinciding with a graphical integrity that aligns with the approaches discussed throughout Edward Tuft's (1983) *The Visual Display of Quantitative Information*. The primary concern here being to display this information in the most truthful way possible.

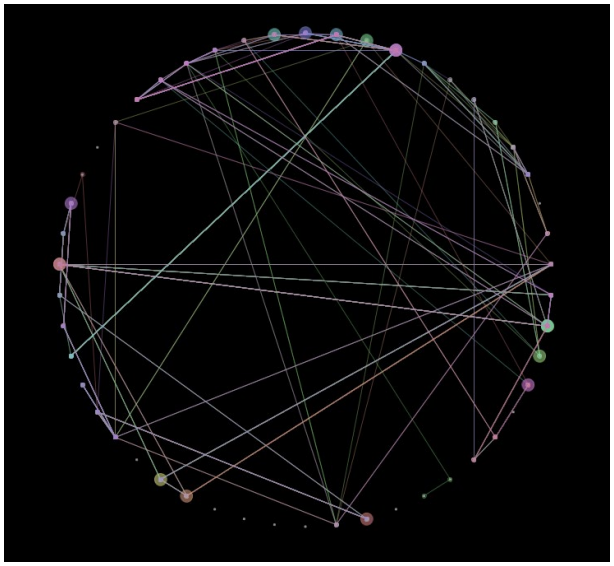

Figure 77 – Development image of the *Virtual Gaze Interaction Network* (Ambrose, 2017)

The above image (Figure 77) illustrates an early prototype of the application in Processing where every user was assigned their own colour, however the more users added to a visualisation that works in this way the more difficult it is to get an idea of the overall paths and to see an individual's specific pathway. To accommodate for this every user's strand was made the same colour in the final version, but using opacity certain routes would become brighter the more they are traversed - just like in the manner designed in the reference image that I used for this visualisation (Figure 76). Each user then got their own toggle which activates a red strand which demarcates the way they navigated *Mimesis*. This allows the user of the visualisation to zoom in on a particular user and see their journey play back to them in real time. At this point in the development the application still only showed one of the reticle tests on the screen at a time. Given that I wanted to use the *Virtual Gaze Interaction Network* to demonstrate the difference between how each reticle aesthetic is navigated the application had to be redesigned so the workflow would allow all four versions to be played back and interacted with on the same screen. The aim here was to develop a way of visualising and researching user experiences of interactive 360° film. In this context it was applied and developed to visualise the impact the reticle has on user experience/narrative generation, but also functions as a prototype for ways to visualise the spatial movements of users. The following overview (Figure 78) of all user interactions with each reticle type cements many of the discussions explored earlier. As in there is an obvious fall off in movement as the reticles used are less overtly interactive. This correlates with much of the ratings offered by the users along with their personal receptions of each version.

In addition to offering a way to see *the reticle effect* in action this visualisation also allows us to see the more general interaction design, which is most similar in the case of the interactive reticle and the interactive cue mark. This would be an expected outcome of a system where every user starts at the same position, but in the case of these experiments the start point was randomised in every test. What this means is that even though every user with every reticle type starts at a random position when viewed as a collective tapestry there is an obvious commonality to the patterns being formed. This can be viewed as a visualisation of *datascape mediation*, which suggests that there is an inherent

order on a macro level. Such a suggestion demarcates an inevitable future for media studies – one where the output from the conflation of designer, machine and end-user provides the clearest portrait of a user's narrative experience. Outside of the scope of this thesis this also functions as a speculative system for the design and development of interactive 360° film and research in this area.

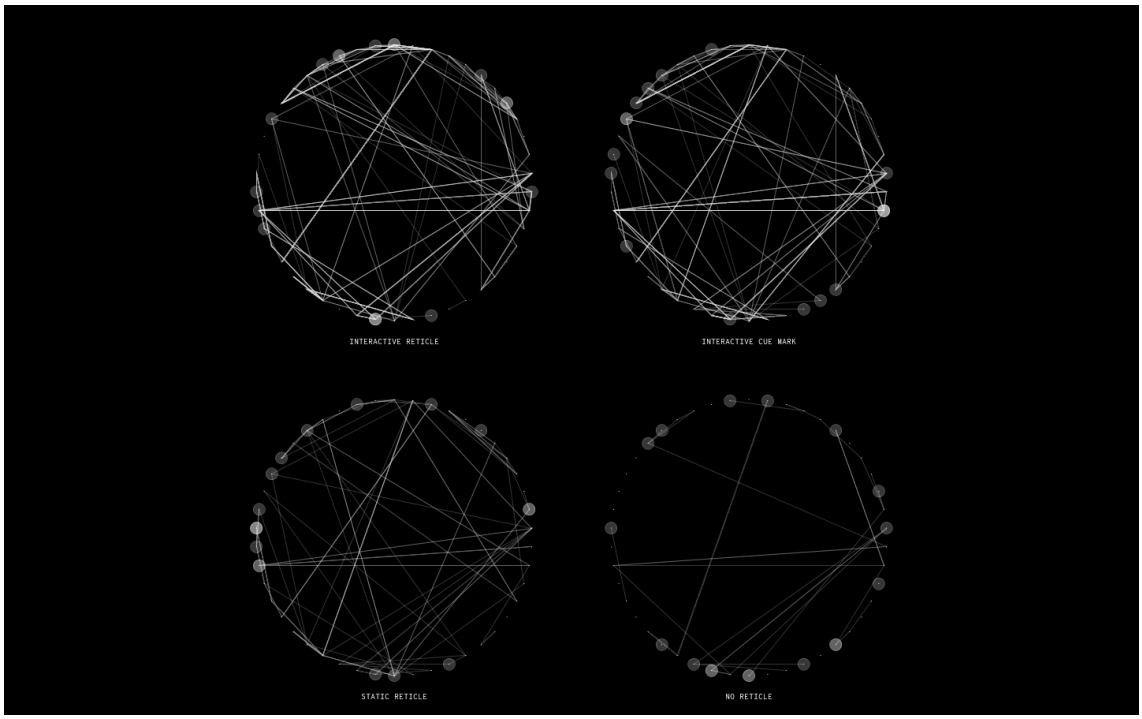

Figure 78 – Overview of Complete *Virtual Gaze Interaction Networks* in *Mimesis* Tests – developed using Java in The Processing Development Environment (Ambrose, 2017)

6.13. Conclusion

Prior to conducting the research for this chapter the reticle was implemented in my work as an object that did not visibly demarcate interaction. This was employed as a means to avoid the game-like associations created by the interactive reticle. Like many interfaces the reticle operates on either a subtle or invisible level, but extending Alexander Galloway's (2012) discussions on the impact these systems of interaction have – when producing new methods of interactive film, new tools will need to be created to visualise these processes.

In addition to this, such a prototype offers ways to draw attention to the importance of our visual data, which has become an innate part of my research.

The downsides of this study involve statistical validity, in the sense that I didn't have large enough of a dataset as a single practitioner to scientifically prove this concept. However, as a conceptual model for drawing attention to the aesthetics of interaction that surround the reticle the qualitative and quantitative data aptly supports it as a site for consideration when creating an interactive 360° film application.

By reintegrating these outcomes back into my practice, I have reiterated and redesigned all of the applications that I have built to use the interactive cue mark as opposed to the reticle, which was previously being used. The methodologies employed in this chapter operate as interconnecting forms of feedback all of which inspire my practice, whilst untangling the tapestries of data and interfaces that surround *virtual gaze interaction*. As apparatuses of *Cynematics*, both reticle and interaction aesthetics allude to discourses that present themselves as forms of gameplay, but as explored in this chapter these weaponised allusions actually stem from how we "shoot" moving images. Likewise, the idea of the interactive cue mark can be viewed as a form of playful exploration commonly associated with games, but it also resonates in the machinations of early cinematic projection.

Challenging the form and expectations of a genre so closely aligned with game-like expectations is further complicated by the modular nature of the interactive 360° film genre. However, such issues are merely another manifestation of the film/game narrative hybrids referred to in chapter 2. Given the nature of my approach *the reticle effect* serves to demarcate the interfaces of *virtual gaze interaction* and in the process demonstrates a suitable interaction aesthetic for navigating interactive 360° film. Given the impact this has on user experience it is pertinent that such considerations are made as well as realising that *virtual gaze interaction* is part of the narrative process. From here we can begin to establish suitable theories and practices for media futures and beyond.

Chapter 7. Vanishing Point: The Loop as Narrative System

7.0. Vanishing Point

Figure 79 – *Vanishing Point* (Ambrose, 2018)

Experience:

The user enters a domestic space inhabited by a couple separated by screen. When the everyday routine loops the user is allowed to disappear into the systems of perspective that permit these immersive illusions – lingering, until the machine returns them to another private space. This process continues, until they reach a point that converges their explorations into different states of visibility. Further context on the design of this application can be viewed in the poster in section 9.6 of the appendix.

Audio:

I acknowledge the role of audio in relation to this work, but given that the key focus of this thesis is on gaze interaction it is worth noting that in the context of this research audio is not a theoretical focal point – as this is a vast area of research in its own right.

Materials:

Display – Gear VR / Oculus Rift
Video – Monoscopic/Stereoscopic 360° Film
Sound – Stereo Audio
Camera – Insta360 Pro
Software – Unity/Premiere Pro/After Effects/Mocha VR/Audacity/Reaper

In this chapter I plan on conflating many of the theoretical conversations discussed in this thesis, towards articulating my overarching method and presenting how I used my final piece of practice to explore a hybrid form of the narrative systems developed alongside previous chapters. This starts by reiterating the notion of interaction paradoxes, whilst outlining the key academics and practitioners that I used to frame this exploration. Presented as part of this is the resulting augmented interactive narrative structures that are discussed in comparison to the approach taken for the final piece of practice. What becomes apparent in these discussions is the role of the loop as a process that aids interactive 360° film practice, which is explored as a catalyst for a narrative system in *Vanishing Point.*

From here I unpack the artistic and conceptual influences that helped shape this practice. Such a process leads me to expand on my practical outputs, which I envision as a form of applied *Cynematics*. Discussing this thoroughly allows me to articulate a pedagogical logic that exists in my work and one that correlates with the perspective of agency presented in the second chapter. Finally, I frame my thesis as a cybernetic process with theoretical outcomes that require a posthuman context to be provided in order to theoretically consolidate how I envision my work. Although a vast field of research that theoretically engages with the idea that we are now in a period where we exist in a state beyond being human – this field is particularly relevant in relation to considerations of the anthropocene. However, in the context of my research I consider *Cynematics* as a type of posthuman discourse due to the manner in which cybernetics is used as a metaphor for exploring interactive immersive media as a site of human-machine hybridity. Once this correlation is established I compound the ideas explored in this chapter in preparation for the concluding chapter of this

thesis, whilst illustrating how the outcomes of this research project simultaneously exist as a starting point for expanded critical, conceptual and practical discussions.

7.1. Navigating Interaction Paradoxes

In chapter 2 I referred to the interaction paradoxes that surround interactive film, referring to the idea of the *narrative break* as the point where symbolic interactions detract from the narrative flow leading to a reduction in immersive experience. I previously referred to this process as the point where the user becomes aware of their machinic role in a narrative process, but considering this specifically in the context of interactive 360° film it could be argued that it degrades the synthesis that occurs between human and machine in an all-encompassing HMD experience. Using Nitzan Ben-Shaul (Ben-Shaul, 2004) to frame this inherent conflict I then referred to Chris Hales (Koenitz *et al.*, 2015) to elucidate the need to establish terminology to assist with understanding the problems associated with interactive film. Reconciliation for this is offered by Marie-Laure Ryan (2015) through embodied internal interaction that conflates interactivity, immersion and narrativity.

To combat the *narrative break* I aligned with Myron Krueger's (Krueger, 2008) emphasis on perceptual interactions, which operates as a practice that coincides with the theories of Ryan (2015). Interactive 360° film is perfectly aligned with such ideations as the HMD allows users to embody cinematic spaces and internally interact with them as well. To scope the type of perceptual interaction explored in this research and address the most commonly used form of interaction in VR, I decided to focus on *virtual gaze interaction*. I defined and contextualised this process in chapter 4, using its associated practice (*Systems of Seeing*) as a pedagogical tool to help actualise this discussion. As a form of perceptual interaction, the interactive gaze is not a fixed concept and as I unpacked the idea of *virtual gaze interaction* it became apparent that both the reticle and its aesthetics of interaction play a huge role in how these systems are experienced. Although offering a transformative perspective to the interaction paradoxes that impede interactive film, each form of perceptual interaction introduces its own complexities. Expounding such a statement

became the primary goal of chapter 5 towards exploring the relationship between immersion and interaction in the context of *virtual gaze interaction*. This was achieved through the conversion of another form of practice (*Mimesis*) into a site where different reticle types could be quantitatively and quantitatively assessed. As per this analysis it became apparent that the more interactive something is does not equate to a reduction in immersion/narrativity. A key outcome of this study was demonstrating how one of the more interactive approaches led to the creation of more immersive experiences. What this output demonstrates is that a designer/machine driven interaction aesthetic (interactive cue mark) can propagate user interaction-immersion. Such an outcome supports Ryan's idea that external interaction is counter to immersion and propagates the role of internalised perceptual interaction (Ibid). However, during this act of choosing there must be a visual constant. In the context of 360° film this is best achieved through the use of video loops, which serve to propagate immersion whilst the user is learning how to navigate these film environments. Such a statement brings us back to the concept of John Banvard's mechanism for a moving panorama (1848) as discussed in the first chapter.

In flat interactive films such as *Late Fragment* (Cloran, Daryl; Doron, Anita; Guez, Mateo; Lee, Anita; Serrano, 2007) the loop is used as a mechanism for interaction in a linear narrative film work. However, the lack of visual material in each scene makes the loop become repetitive and symptomatic of Ruth Aylett and Sandy Louchart's narrative paradox, where spatiality is what dismantles the narrative experience of the work. To artistically explore the loop in the wake of interactive 360° film practice offers new alternatives to such approaches, whilst emphasising the cybernetic principles of *Cynematics*. In Lev Manovich's *The Loop and Spatial Montage* he asks the question "can the loop be a new narrative form appropriate for the computer age?" (Denson and Leyda, 2016) As discussed by Manovich in this chapter the loop not only gave birth to cinema, but is also central to the development of computer programming. Another point of reference can be seen in the resurgence of the animated GIF. According to Kate Miltner and Tim Highfield this is due to the fact that:

> GIFs are polysemic, largely because they are isolated snippets of larger texts. This, combined with their endless, looping repetition, allows them to relay

> multiple levels of meaning in a single GIF. This symbolic complexity makes them an ideal tool for enhancing two core aspects of digital communication: the performance of affect and the demonstration of cultural knowledge. (Miltner and Highfield, 2017, p.1)

Such a process aligns with Hito Steyerl's *In Defense of the Poor Image* (2009), where the mass dissemination of digital imagery is also propagated in part by the GIF. However, as per Manovich's consideration of the loop it exists as more than a repetition of moving images. Inside all of my interactive 360° practice there exists sequences of scripted loops controlling elements such as scene transitions, fade animations and interaction timings. Manovich elucidates these processes in relation to the idea of the loop when he states that "programming involves altering the linear flow of data through control structures, such as "if/then" and "repeat/while"; the loop is the most elementary of these control structures" (Ibid).

Although abstracted from the experience of the typical end-user all of these processes do play a role in the experience of narrative form. Linear film has established the loop as a form of low art. However, in the advent of 360° film there is space for such perspectives to be augmented. A suggestion for this is that there is more visual space for the user to get immersed in a loop. From the practice associated with this chapter I will discuss how the loop can be used as a narrative catalyst, rather than being a process that alienates users. Although I concur with Manovich's ideations, I think that in practice looping flat videos are more likely to induce detachment due to the fact that the established conventions of linear cinema are framed to a limited position, whilst 360° film practice offers more visual space to circumvent such traditions. In the second chapter of this thesis I referred to Dziga Vertov's (Vertov et al, 1995) exploration into the symbiosis of the camera and the eye – presenting this as a pre-cybernetic process I articulated this as a seminal point for considering the human relationship to the apparatus of film. However, Manovich also uses Vertov to illustrate the importance of the loop in relation to the history of cinema when he states that:

> Cinema's birth from a loop form was reenacted at least once during its history. In one of the sequences of the revolutionary Soviet montage film, *A Man with a*

> *Movie Camera* (1929), Dziga Vertov shows us a cameraman standing in the back of a moving automobile. As he is being carried forward by an automobile, he cranks the handle of his camera. A loop, a repetition, created by the circular movement of the handle, gives birth to a progression of events—a very basic narrative which is also quintessentially modern: a camera moving through space recording whatever is in its way. (Denson and Leyda, 2016)

Considering this in relation to the idea of *Cynematics* it becomes apparent that the cybernetic principles of circular causality and feedback are relevant considerations, especially inside of systems that depend on video loops to sustain user interaction. In *Mimesis* and *Systems of Seeing* 360° video loops function as a form of repetition that invariably transforms a user's narrative experience. In both of these works *virtual gaze interaction* allows users to move between different 360° video loops creating a new way to experience the concept that Manovich titles as "The New Temporality: The Loop as Narrative Engine" (Manovich, 2002: p.314) As mentioned already our relationship with time is further complicated in the context of 360° film.

The experience of the loop stands more as an immersive glitch reminding users that they are inhabiting a cinematic space, but such a process also has its merits. Depending on the type of loop that the designer creates it is possible to make huge interactive film spaces, whilst optimising the file size of the work. Both forms of practice that I mention here operate as instruments that propagate emergent narratives due to the creation of complex network topologies. Built around using different forms of spatial movement these works allow users to either move around a space (Appendix – Narrative Diagrams/Research Posters – Research Poster) or have the space move around them (Appendix – Narrative Diagrams/Research Posters – Network Topography). Such approaches demonstrate *the new temporality* that Manovich refers to in the *Language of New Media* (Ibid), although this is a process that is not fixed to recursive viewing experience. Manovich's consideration of the position of the loop as a narrative form in the wake of the computer age aligns with my own research questions that explore the types of narrative that can emerge from interactive 360° film. In all of the practice referred to in this chapter the loop has served to maintain visual spaces, whilst waiting for user interaction.

To illustrate another sequence of “the new temporality” and to actualise the narrative engines of cinema and code, I have chosen to converge these spaces in my final practice (Appendix – Narrative Diagrams/Research Posters – Expanded Temporospatiality: The Loop as Narrative System). However, rather than fixing my practice to Manovich’s idea of “the new temporality” I have opted to refer to it as an *expanded temporospatiality*. There are two key components to this term, the first element is “expanded”, which is being used in reference to Gene Youngblood’s Expanded Cinema (Youngblood, 1970), which was one of the first books to present video as an art form. Speaking of this in an extricably cybernetic manner Youngblood states that, “the messages of society as expressed in the intermedia network have become almost totally irrelevant to the needs and actualities of the organism. The situation is equivalent to one’s own nervous system transmitting erroneous information about the metabolic and homeostatic condition of one’s own body” (Ibid: p.41) Viewing media networks as “the nervous system of mankind” (Ibid) Youngblood presents a need to explore new types of moving image technology, but more importantly consider how such systems offer new communicative possibilities. Such an ideology is shared with the practice-based research in this thesis.

The “temporospatial” element alludes to the fact that the loop in an interactive 360° film is not completely framed by the time-based elements that permeate Manovich’s discussions of flat film forms. Instead the loop occupies new spatial and temporal relationships further accentuated by the user’s ability to interact in each of the scenes. Rather than seeing the loop as just being a recursive filmic process I decided to merge the loop with user interaction meaning that in certain scenes user interaction is not possible until the first loop has been triggered. Such a practice transforms the loop into a coded narrative system. Once a full scene has played the interactive object in the scene becomes active, meaning that the user’s *virtual gaze interaction* is made possible by the video communicating with the machine allowing user interaction to exist. As I unpack and describe this work, how this process functions in its entirety will become more apparent.

For now, I would like to address the type of reticle employed in this practice. After exploring the complexities of *the reticle effect* in the previous chapter I

decided to redesign all of my practice to use the interactive cue mark as opposed to the static reticle that I was previously using. Given that the interactive cue mark promotes exploration and discovery as well as the user responses that promoted it as the most suitable interaction aesthetic for interactive 360° film, this appears as the ideal form in relation to the use of *virtual gaze interaction*. Both the aesthetics of interaction and the role of the loop highlight that interaction is not a process that inherently erodes immersion and narrativity. In the context of interactive 360° film they operate as components that deconstruct cinematic homogeneity. Narrative linearity is either masked or removed in favour of new spatial and temporal relationships with moving images. The final piece of practice functions as a designer/machine/user controlled linear narrative system, one that subverts linear expectations in favour of an approach that is best perceived as a hybrid of the narrative systems used in *Mimesis* and *Systems of Seeing* (Appendix - Narrative Diagrams/Research Posters).

7.2. The Vision Behind Vanishing Point

The initial concept for *Vanishing Point* came from the early *Cynematic* experiment titled in chapter three as *Routine Error*. Reflecting on topics such as domesticity, banality and private spaces the work expands on the concepts and aesthetic of Jeff Wall's *A View from an Apartment* (Figure 80) to create an interactive 360° film that explores issues with the technological gaze. In *Beyond the threshold* Sheena Wagstaff interviews Jeff Wall and presents the idea of Michael Fried's 'facingness' (Fried, 2008), which she defines as "a self-conscious illusionistic pictorial engagement of the subject with the viewer" (Wagstaff, 2005). In response to *A View from an Apartment* being perceived through such a lens Wall states that "the picture has 'facingness' too, not just the figure in it. This facing you but not acknowledging you is a form which says something about modern life, where people are more detached from one another than they might have been before. Contemporising this assertion I chose to create a binary in each internal scene in *Vanishing Point* having one member of the couple engaged in a typical domestic loop, whilst the other person's gaze is transfixed on a screen.

Counter to Wall's external panoramic landscape viewable through the apartment windows, in *Vanishing Point* externality is offered to the user when they emulate the process that divides the couple in this work. Such a condition makes the user implicit in a process of immersive separation. In Sherry Turkle's *Alone Together: Why We Expect More from Technology and Less from Each Other* she continues to explore the relationship between humans and computers looking specifically at how constant connection creates new interpersonal dilemmas. Considering this she states that "technology proposes itself as the architect of our intimacies." (Turkle, 2017: p.1) The idea that our intimacies are being configured and disrupted by technology is something that permeates throughout *Vanishing Point*. In Wall's work the windows represent externality offering a perspective of another world. Wagstaff summates this process when she states that "in *View from an Apartment*, two pictorial worlds are depicted, one within the other, one inside and one outside, each framing a reconstruction of the world, each representing a different reality, each with its own logic of illumination." (Wagstaff, 2005)

Figure 80 – *A View from an Apartment* (Wall, 2005)

In contrast to *View from an Apartment* in *Vanishing Point* the television (to the left of the equirectangular frame) is turned on. It's representation of an external landscape offers the same externality as the windows in Wall's work. However, this point also demarcates the allure of the digital and presents it as the site that impacts interpersonal relationships. Rather than using actors I chose to make myself and my partner the focus of the work as it allowed me to construct these scenes from a more naturalistic perspective. Inverting the framing of Wall's piece, the subject to the right of the equirectangular image is trapped in an endless loop of washing dishes. The ironing that is visually depicted in Wall's photo is depicted in a later scene, but to open this work I wanted users to be met with a more common domestic trope. To the left of the space the other subject is lying on the couch staring at the television. As mentioned in the previous section once one loop has been completed user interaction is activated. At this point the user can continue to visually explore this loop indefinitely or if they choose to look at the screen they will disappear into the environment that entrances both the user's and consequentially their own gaze. All of the spaces in this work include ambient recordings which are used to reinforce the sense of domesticity and externality. In the internal scenes the sounds of the everyday ranging from hoovering, cleaning places and eating dinner take over the scene, whilst in the external landscapes it is more about capturing a sense of the nature in these sublime spaces.

In chapter 4 I referred to how VR evangelists are engaging with the hype machine in a bid to consolidate their own territories. This equates with a great period of renewed growth similar to the development of VR in the 80s and early 90s, which is the primary focus of Howard Rheingold's *Virtual Reality: Exploring the Brave New Technologies of Artificial Experience and Interactive Worlds from Cyberspace to Teledildonics* (Rheingold, 1991). However, such rapid developments run the risk of isolating mainstream audiences and creating confusion around what VR actually is. Such a point is evident in the difference between 3dof and 6dof that I presented in the first chapter, but also in how 360° film and gaming are both presented as the key genres of a medium that is yet to be fully defined. A secondary aim of my research has been to illustrate where interactive 360° film is situated in relation to VR and how it offers new ways of considering interactive film as a genre. My work serves as a refutation to

immersive media practice being presented within the framework of existing narrative traditions or being used as a form that promotes aesthetic artifices – meaning it should be a site that promotes experimentation, rather than being enveloped by the structural specificities of narrative film or being reduced to the allure of being an interesting visual experience. A prime example of such processes can be seen in the 360° film *Rose Coloured* (Cosco, 2016). Here we find a 360° film that is edited in the same way as a traditional linear flat film. The core problem with this method is it assumes that the viewer is looking at the location that the subjects in the film inhabit. If the viewer decides to look at something else in the scene when there is a cut they will abruptly move to this space in the next scene which is a process that is disorientating for the viewer. For this reason, rather than following traditional linear processes the loop needs to be exploited as a tool for promoting user interaction, rather than sustaining a form where the viewer's movements inhibit their immersive experience. *Vanishing Point* serves as a site that incorporates user interaction making reflection on their role in this system part of the narrative process. In Merriam-Webster's dictionary "vanishing point" is defined in two ways (Merriam Webster, 2018):

1. A point at which receding parallel lines seem to meet when represented in linear perspective.
2. A point at which something disappears or ceases to exist.

With regards to point one I align with the definition that "the vanishing point is used as part of a system of perspective, which enables the creation of the three-dimensional world on a two-dimensional picture surface" (Tate, 2018b) However, my practice aims to actualise this illusory process by making the act of looking at the screen in each scene a transitionary process that takes the user to the environment that is being looked at. With regards to the point of disappearance or non-existence this functions akin to the idea of 'facingness' discussed earlier, but in this context there are two different types of existential conflict at play. In chapter 4 I referred to Jean-Paul Sartre's existential gaze in relation to *Systems of Seeing* (Sartre *et al.*, 2003), but the lack of acknowledgment of the user's presence in *Vanishing Point* makes the user question their presence inside of this space. However, once the video loop

activates their gaze takes on a new existence. Moving from active to interactive they now have the ability to disappear into the screen inverting the existential crisis making this version of the couple in their domestic environment cease to exist. Playing with the idea of the vanishing point every environment that the user enters via a screen is a stereoscopic sublime landscape lacking any human presence.

In the second chapter I contextualised a brief history of stereoscopic vision presenting it as part of the evolution of the dimensionality of the image. The aim of this practice is not to just use stereoscopic film to create more immersive environments, but play with the unexpected shifts between two different types of 360° film. In addition to this there are a series of quote on the chalkboard in each internal scene that aim to add a degree of polysemy to the user's movement through the work. Such transitions are used to heighten the allure of the work and to promote a recursive practice that places the user in the same position as the subject that is consumed by looking at environments in the monoscopic footage. It is useful to note here that monoscopic in this context refers to 360° footage that is recorded from a single point perspective, whilst stereoscopic is the "3D" version of 360° film. This means that rather than being composed of a single 360° image it uses two offset versions of the same scene to create the illusion of depth. With regards to *Vanishing Point* all of the internal footage is monoscopic, whilst all of the stereoscopic footage is shot externally creating a different sense of remoteness to the experiences in the internal scenes. However, each of the stereoscopic environments I shot were then converted to monoscopic video and displayed on the screens in the internal environments meaning that users move to the exact same environment that they are looking at. Each of these stereoscopic scenes function as sites of reflection, but they also interlink with the internal scenes via the poetry lines written on the chalkboard in each internal space. These quotations are taken from Coleridge's *Kubla Khan: or a Vision in a Dream*, which is a poem presented as a series of fragments remembered from a dream (Coleridge and Keach, 1997). The ethereal qualities of this poem are reconstructed again, creating a literary correlation between the internal and the external environments. In chapter 4 I referred to the exquisite corpse when discussing Jacolby Satterwhite's *Reifying Desire* (Satterwhite, 2013). Using a method akin

to William Burroughs' cut-up technique I discussed how his work can be read as non-interactive emergent narrative systems (Jones, 2018). The more abstract conceptions of this were explored in my own practice via *Narrative Maze* in chapter 4 where I used emotional labelling and sentiment analysis as a means to connect words to a user's pulse data. Using these words as hashtags I called user generated videos via the Vine API, which led to the creation of an emergent narrative system. However, as per the outputs of these experiments this approach to user data was too disconnected leaving users feeling as If these interactions were completely out of their control.
Re-approaching the idea of the exquisite corpse as a type of collective assembly process every scene in *Vanishing Point* is connected by the act of reading poetic fragments on the walls of the internal scenes, but this is not explicitly required to understand the work. Instead it functions as an embedded polysemic quality that promotes the creation of emergent narratives from within the system that I have designed. Rather than using the loop-based user interaction that is used in all of the internal scenes the external environments use a completely machine-driven approach. Using timer-activated interaction the external scenes run for a designated period of time. Once this timer hits zero a scene transition is activated moving the user to the next internal scene. The decision to approach this work in this way rather than user-interaction becoming the key component in every scene was a decision based on the user emulating the subject's gaze in the internal scenes. Once they travel to these external environments the focus shifts from user-interaction to user-immersion. Such a decision empowers the technological line of sight that disrupts each internal scene, whilst promoting the escapist qualities of these screens. It also plays with the user's expectations of interaction and immersion presenting them as processes that work in synthesis with one another towards the creation of emergent narrative experiences. Marie-Laure Ryan states that it is "through the mediation of the body that VR developers envision the reconciliation of immersion and interactivity" (1999, p.133)

However, as discussed in chapter 2 the mediation of the body is not a wholly human activity – instead it functions as a form of cybernetic exchange mediated by perceptual interaction both as a human and as a machine process. The *Cynematic* framework that I have developed for my research has assisted with

the creation of a practice that focuses on new types of filmic interaction, but more importantly it has led to the development of work that aligns with the emerging genre that I have been calling interactive 360° film. I previously referred to the technological phases that Chris Hales (Koenitz *et al.*, 2015: p.37) used to define interactive film, which upon reflection I would argue has now entered another new phase. Operating as a heterogenous conflation of Hale's film-based, HCI and online phases – immersive media allows for the creation of new genres of interactive film, most notably interactive 360° film which in the context of my research serves as an immersive-interactive approach that is both film-oriented and HCI-based. Although indicative of a new phase for interactive film this site also re-phases interactive film into a form of media grounded by the types of screen practice elucidated in the first chapter. As an augmentation of previous forms of interactive film this type of immersive-interactive practice converges a rich history of ocular perception into a *Cynematic* framework where the user's conception of narrative is challenged. The online phase that Hales refers to in his research is applicable via the introduction of 360° live streaming which is an element that can easily be synthesised with interactive 360° film. However, in order to scope my research I have opted to focus my thesis and creative practice around explicating the fusion of 360° and interactive film into a perceptually grounded filmic form. In doing so I have developed a discourse that assists with understanding how such hybrid technical forms permit new ways for thinking about this type of creative practice.

7.3. Applied Cynematics: Live-Editing Practice

Throughout this thesis I have referred to the idea of *datascape mediation*, which is a term that reflects a post-author collaborative perspective that views the role of the designer, machine and user as having equal value in terms of authorial control. This ideation is a key output of the *Cynematic* framework, but appears speculative as opposed to an idea with the ability to be actualised. As I continued to develop a creative practice that led me to developing types of interactive 360° film I came to realise that when I spoke about my work there was another key element yet to be expounded. In opposition to traditional editing practice the development of interactive 360° film requires what I have been referring to as a *live-editing practice* as a type of applied *Cynematics*. This

embodies the idea of *datascape mediation* and can be perceived as an emergent creative practice that warrants the synthesis of designer, machine and user by the manner in which it is used to create emergent user experiences. The interactive design of a work dictates how it is mediated by these systems, but interactivity as a concept is something that can obscure this process. In *The Many Forms of Interactivity* Marie-Laure Ryan (2015) speaks about the fact that some scholars think the term interactivity is too vague. Janet Murray (Murray, 2017: p.128) prefers the terms agency over interactivity as it insinuates the user having more purposeful control, rather than engaging in routine actions. However, such viewpoints disregard the agency of the designer and the machine which are key to the user's sense of control being possible. Offering another alternative to interactivity Espen Aarset (Aarseth, 1997: p.48) uses the term ergodic instead of interactive to encapsulate the idea of non-trivial choice. I align with Ryan's challenging of the ergodic as this in itself can consist of non-interactive and interactive forms, which is indicative for her why interactivity has its place in media studies. To delineate the position of interactivity she states that "interactivity appears on two levels: one constituted by the medium, or technological support, the other intrinsic to the work itself" (Ryan, 2015: p.161). In the context of practice-based research this division is not so clean cut. I would argue that to separate the work from the medium and/or technology is an impossible process. Interactivity is better conceived as a form of mutual reciprocation between all of the nodes in the system (designer/machine/user). However, when Ryan attempts to define the different types of interactivity she presents nine different interactive architectures that she claims "support various types of narratives and antinarratives" (Ibid: p.165). The idea of interactive architectures housing narrative and antinarrative forms aligns with the process of *datascape mediation* and can be perceived as the point of convergence for all of the agencies involved in this process.

As per Chris Hale's (Koenitz *et al.*, 2015) HCI phase of interactive film it was common to associate non-linear narratives with interactive film and view linear narratives as components associated with traditional film. However, such a binary does little to assist the development of perspectives on new narrative forms. Offering alternative perspectives to such a binary Jeffrey Shaw and Peter Weibel presented transcriptive (multi-layered), recombinatory (algorithmic) and

networked interactive digital narratives in *Future Cinema: The Cinematic Imaginary after Film* (Shaw, Weibel and Zentrum für Kunst und Medientechnologie Karlsruhe., 2003) as the key narrative modes. Expounding these terms further Margot Lovejoy defines them as:

> *Transcriptive* forms involve mutiple layering of interactive narrative that can create loops and the reassembly of narrative paths. *Recombinary* permutation strategies are controlled by the algorithm that defines the artistic definition of each articulated work. *Distributed* forms grow out of the modalities of Internet telecommunications accessible on mobile phones or multiuser devices. (Lovejoy, Paul and Bulajić, 2011, p.18)

As demonstrated in *Vanishing Point* linear/non-linear narrative hybrids can also become an output of an interactive system meaning such a division is no longer productive. When considering this in relation to interactive 360° film it is no longer about whether narrative is linear or non-linear, it's about the experience of database assembly, which in this context is the output of *datascape mediation*. For this reason, in the context of the practice developed alongside this thesis each work can be interpreted as transcriptive in the sense that loops are used in different ways to permit the creation of narrative pathways. Recombinary in the way sequences of scripts are used to permit a live-editing process through *virtual gaze interaction*. Finally, these works have the potential to be distributed on a variety of different platforms due to their development in the *Unity* real-time engine.

In chapter 3 I referred to how Marie-Laure Ryan's (2015) exploration into interactive architectures provides ways to think about how interaction permeates *datascape mediation*, but this provided no context for the databases that function inside of these interactive systems. Viewing these as embedded qualities of the narrative systems that we generate I align with Manovich's considerations of the database (1999), but as discussed in chapter 3 I refute his countenance of the database being a system that operates counter to narrative instead viewing it as an inherent aspect of any filmic construction. Narrative is the means in which the user processes these experiences, which is predetermined and rule-driven and/or undetermined and experimental, whilst

the database represents the structured set of data that holds the input for the interactive systems that allow users to navigate the work.

Before a narrative system is exported to either a film or application format it exists on the software level as a series of database structures. With traditional editing practice all of the project videos are loaded into a temporary database, which is used to construct the timeline of a film. The timeline functions as another type of database holding all of the information of the edit, such as cuts, transitions, fades, overlays and audio. Once the film has been exported the database moves from a series of active processes to becoming a static database of edited visual material, which can be considered as a predetermined database structure. In a system where *live-editing practice* is being used the user starts their experience with either a scene that is pre-selected by the designer or one that is randomised or by the machine. Once initiated the user triggers an interactive object using *virtual gaze interaction* and these access either a name or a number that identifies the next video scene and loads this from the database. Operating in the same mode as how a live VJ cues and mixes moving images, *live-editing practice* allows users to access a sample bank of videos from a database and create an experience based on the movements between the scenes assigned to the application. They are limited to the bounds of the interaction system implemented by the designer and the machine, but the user is also allowed room to assign meaning to the experience they are having and the manner in which they navigate these visual spaces allows for the formation of undetermined database structures. When considering the idea of *live-editing practice* as a form of applied *Cynematics* it becomes apparent that this is a site where augmented interactive narrative structures can be generated. As per my central research question this articulates the impact this framework and resulting practice could have on the future of film narratology, production and reception.

Aligning with the human-machine symbiosis that permeates this entire thesis the idea of narratives as systems is an expected ascension of the posthuman condition. In chapter 3 I presented a common term for the shared interactions of the designer/machine/user (*datascape mediation*). Such a process is indicative of how emergent narrative experiences are processes that no longer solely

involve human interactions. Andrew Pickering (2010, p.106) phrases such systems as “as ontological theatre, then, a multihomeostat setup stages for us a vision of the world in which fluid and dynamic entities evolve together in a decentered fashion, exploring each other’s properties in a performative back-and-forth dance of agency.”

7.4. Closing the Loop: Providing a Posthuman Context

Throughout this thesis, I have attempted to expand and develop a discourse around the emergent outcomes derived from practical experimentation with new types of interactive film. However, embedded in the outcomes of this emergent practice I situated both my theory and practice around the *Cynematic* framework, which was derived from the consolidation of practice and theory into a model where I could look at the relationship of human and machine in the context of interactive 360° film practice. As discussed in chapter 2 such experimentation formed the bedrock of Roy Ascott’s (Ascott and Shanken, 2003) practice and pedagogy and akin to such processes I have approached this entire thesis not just with a framework to explore my central research questions, but also as a cybernetic viewpoint on the structure of this thesis. This is evident in the input/output structure of my initial practical experimentation (chapter 4), but also later on when I use my practice to inform my theory and vice versa.

In this final chapter, I aim to “close the loop” by reflecting on a hybrid narrative system where the loop becomes a central component in the interactive process. Such processes return us to the moving panoramas discussed in my first chapter, whilst giving new relevance to the loop in terms of interactive film practice. To demarcate my initial practical methodologies, I presented a mixed methods approach composed of reflective practice, action research and human-computer interaction. However, when looking at the aesthetics of *virtual gaze interaction*, I thoroughly discussed the qualitative and quantitative methods used to explore the role of the reticle. Overarching these specific methodologies is a decentred approach derived from the emergent outcomes of my practice. The central reason for framing my thesis in such a manner was to allow a framework to appear that consolidates and provides scope to both my theory

and my practice, whilst presenting the practical and theoretical outcomes of the *Cynematic* framework as key contributions to knowledge. As stated in chapter 1 the creation of an interactive 360° film practice/theory is a fundamental output of this research, but the process that led to the formulation of this novel practice and the theoretical and practical outputs involved afterwards are equally as important to consider. To make this process more explicit I have split these results into the following three categories: practice, theory and impact. Where appropriate I have included a focal chapter from which these develop.

Practice:

All of the practice below directly contributes to the fields of immersive/interactive media art. However, given the interdisciplinary nature of this research it also contributes to research in fields such as: VR, 360° film, expanded cinema, narratology, post-human theory, digital art and creative technologies.

- *Virtual Embodiment* (chapter 4)
- *Narrative Maze* (chapter 4)
- *Eye Artefact Interactions* (chapter 4)
- *Routine Error* (chapter 4)
- *Systems of Seeing* (chapter 5)
- *Mimesis* (chapter 6)
- *Virtual Gaze Interaction Network* (chapter 6)
- *Vanishing Point* (chapter 7)

Theory:

The following key theoretical contributions add to fields such as: cybernetics, 360° film, immersive media, VR, narratology, interface theory and software studies.

- *Cynematics* (chapter 2)
- *Virtual Gaze Interaction* (chapters 4-6)
- *Datascape Mediation* (chapter 2)
- *The Reticle Effect* (chapter 6)

- *Live-Editing Practice* (chapter 7)

Impact:

- Developed the first course in interactive 360° film in the UK[36].
- Anonymous interview published in *The Re-Emergence of Virtual Reality* (Evans, 2018).
- Article printed for the journal of Virtual Creativity (Ambrose, 2018).
- Exhibition of PhD practice at the: Brighton Digital Festival, University of Brighton, British Science Festival, John Berger Now Conference, Chelsea College of Art, Oculus Go Store.
- Presentation of PhD theory at the: London Science Museum, John Berger Now Conference, VR Diversity Initiative, XR Circus, University College London.
- Residency with Prof. Paul Sermon and Dr. Charlotte Gould for Reset> Mar Menor in Spain.
- Created a mixed media approach to VR that synthesises interactive 360° film and full computer-generated environments.
- Prototyping software for use in a live 360° telematic workflow (Sermon, 2018).

To explore a macro level positioning of my research framework it is important to situate it in relation to suitable contemporary theoretical discussions. Cybernetics has a unique relationship with posthuman theory as is best depicted by Katherine Hayles (1999, p.3) when she states that “the posthuman view configures human being so that it can be seamlessly articulated with intelligent machines. In the posthuman, there are no essential differences or absolute demarcations between bodily existence and computer simulation, cybernetic mechanism and biological organism, robot teleology and human goals.” However, the vast nature of posthuman theory is demonstrated in Rosi Braidotti and Maria Hlavajova’s *Posthuman Glossary* (2018) where 169 different concepts are provided in relation to the idea of the posthuman. What’s most interesting about this text is that it presents practice as a key component in

[36] http://www.ucl.ac.uk/lifelearning/courses/interactive-vr-360-degree-film-introduction

explicating such concepts, but our symbiotic relationship with the mediums that permit these transformations is a lacking part of the discourse. Film is used to articulate aspects of the posthuman condition, but our relationship with new cinematographic forms is not presented as a posthuman construct in its own right. Bruce Clarke presents the concept of *Neocybernetics* in this text, which he states:

> Disarticulates the spurious unity and universality of the humanist subject to redistribute its virtual multiplicity within a world nexus inter-embedding semi-autonomous systems and their respective environments. Co-evolutionary self-referential systems construct complex co-dependencies and co-observances. (Ibid: p.282)

Such a statement aligns with the idea of *datascape mediation*, framing agency as a complex entanglement built on the constantly evolving relationships between human and machine. With this is mind it could be suggested that the *Cynematic* framework is viewed as a Neocybernetic process, but this would disregard its specific function as a framework that focuses on the development of new interactive film practices. I prefer to maintain a metaphorical relationship between cybernetics and film, but it should be noted that such a practice demarcates a long-standing part of the posthuman condition. Robert Pepperell refers to the posthuman condition as “a kind of self-awareness that in some ways pre-dates us by decades, even perhaps centuries, but also seems strangely new”. (Pepperell, 2009: p.1) Such a statement aligns with the perspectives of immersive media explicated in chapter 2, but also with the technologies permitting such practices to operate under the terms VR and/or 360° film.

Throughout my research I have aimed to consolidate my practice and its relationship to both film theory and history alike. Although there are specific histories for interactive film (Koenitz *et al.*, 2015) there is also a more nuanced and interconnected relationship shared between immersive media and film theory. Such conflations are represented by the term “cinematopanoramic” which was used to describe the negatives captured by Grimoin-Sanson’s Cineorama apparatus over a century ago (American, 1900:pp.20631-20632). As

we continue to develop and expand the languages of moving image it becomes increasingly more important to locate and contextualise discourses that allow us to explore the impact of our synthesis with filmic forms. Although the state of being posthuman is a difficult subject to quantify if we are to align with Gene Youngblood's ideation that media networks operate as "the nervous system of mankind" (Youngblood, 1970: p.41) then is it fair to consider interactive immersive media networks as the nervous system of the posthuman? Embedded in such a query is the need to develop approaches that allows us to understand the perceptual networks that we are embroiled with. The interactive 360° film practice developed alongside this thesis started as an exploration into new modes of interactive film, but the results of my iterative experimentations have not only coincided with what could be argued to be a new genre of interactive film, but has also evolved into considerations on how perceptual interactions not only change our relationship with film, but are processes that are already embedded in the history of film.

7.5. Conclusion

The primary goal of this chapter was to explore the role of the loop in interactive 360° film, both as a renewed site of conceptual consideration and as an interactive process that can form a subtle part of an emergent narrative experience.

In addition to elucidating the concepts explored in *Vanishing Point* I wanted to demonstrate how it serves as a hybrid exploration of the narrative systems designed for both *Systems of Seeing* and *Mimesis*. In addition to this I wanted to provide a comprehensive breakdown of the conceptual layers and artistic inspirations that inspired me to create *Vanishing Point*. The discussions around the development of the emergent narrative systems developed throughout my practice led into conversations surrounding what I phrase as *live-editing practice*, a term which seeks to explain how my interactive 360° film practice differs from conventional approaches to linear film making. Such a process serves to actualise the idea of *datascape mediation*, which until this point has existed more as a conceptual consideration rather than being perceived as a practical application that exists in my practice.

Migrating from this ideation I sought to discuss how this concept relates to a posthuman perspective that permeates this entire thesis. Framing my methodologies in a cybernetic perspective I aimed to consolidate the practice developed in previous chapters towards creating a work that functions as a site of reflection for many of the theories and concepts discussed throughout this thesis. With this in mind, *Vanishing Point* not only functions as an end point for the experimentation aligned with this thesis, but also operates as a starting point for an applied *Cynematic* practice and the parallel academic contexts that will continue to appear as I develop the idea of an interactive 360° film practice. As 360° film prepares to move further into the spatial realm through the use of volumetric capture the lines will continue to blur between film and games. A speculative result of such an inevitability will be the need to reset our perspective of moving image genres and come to realise that we are not watching a film or playing a game, but we are now using a form of interactive immersive media. Despite its existence as a convergent form it stands unique as its own format, one that has been conceptually incubating and evolving alongside the history of film.

Chapter 8. Conclusion

There were four main questions that steered this thesis, each of which pivot around the exploration of new forms of interactive film. The purpose of this line of questioning was to unpack and establish a discourse for the new types of moving image practice that derive from the conflation of interactive and immersive media.

The research problem that I wanted to address involved the immersive shortcomings of interactive film and through the development of a research framework I used iterative practical experimentation to explore alternatives to the symbolic interactions that permeate this genre.

Updating such processes, I asked the question in what ways do virtual reality, 360° film and gaze interaction contribute to the production and study of interactive film? The purpose of this question was to explore how these new technologies develop the discourse of interactive film, whilst demonstrating a parallel history of film that includes Robert Barker's (1796) idea of the all-encompassing image as presented in chapter 2. Rather than offering an alternative timeline I presented immersive media as a key component in the development of film language and as an intellectual concept that stems from the realm of art. To address how these new technologies augment interactive film, I created a research framework that fuses cinematics and cybernetics towards considering how the synthesis of human and machine has led to the development of new cycles of making and interacting with moving image content. This employed a diverse range of academics from different fields, including: Stan VanDerBeek (1963-1965) (experimental filmmaker), Gene Youngblood (1970) (media arts), Gregory Bateson (2000) (anthropologist/cyberneticist), Katherine Hayles (1999) (literature/science), Roy Ascott (2003) (cybernetics artist), Peter Galison (1994) (history of science), Myron Krueger (1999) (computer artist), Ross Ashby (2015) (cyberneticist)… The tenets of this framework provided a way for me to scope my research leading to emergent outcomes from iterative practical experimentation that focused on the idea of gaze interaction in relation to 360° film, which became a specific research focus in chapters 5 and 6. These initial experiments are

explored through a series of prototypes and key points of practice that each inform a cyclical phased structure. The overarching output from these experiments is the development of an interactive 360° film practice that leads to gaze interaction becoming the key focus of this thesis. In chapter 3 I tailored a mixed methods approach that is guided by my research questions, but also allows for emergent outcomes derived from practical experimentation. A key aspect of this was the unexpected convergence on the theme of vision – starting with my overview of panoramics in the first chapter and focusing this more specifically throughout my thesis through a practice that explicates this area via the development of narrative systems that employ the idea of *virtual gaze interaction*. These emergent outcomes also demonstrate the potential of viewing the relationship between practice and theory as parts of a shared system that can both be used to inform each other.

VR was initially being used to promote immersion, but as I became more involved in working with this medium, its associated technologies eventually allowed for the inclusion of a form of perceptual interaction perfectly aligned with my research framework. The mixed methods established in this part of the thesis focused on the need to view all of the research methods that I employ as parts of a collective system. The first of which was reflective practice (Schön, 1983), which was used to reflect on each stage of experimentation in order to see if any new lines of thought emerge. The primary focus of this was not about research questions, but about exploring new forms of practice and how to move forward and position the research after each phase. Action research (Scrivener, 2000) was used to keep the work aligned with my research questions and not allow the practice to deviate too much. Combined with reflective practice I wanted to explore potentialities, whilst still focusing on resolving a practical pathway to engage with my research questions and scope my thesis. Human-computer interaction (Mcgrath, 1984) was used as a model to explore inherent flaws, but also build towards final output streams that are robust enough for sustained user engagement and accessible to the largest VR audience possible.

The outputs of these experiments allowed me to explore my second research question which asks how can augmented interactive narrative structures create

new experiences and what impact could these have on the future of film narratology, production and reception? Such a question was explored in a multitude of ways throughout my thesis. In chapter 3 I compare and contrast a range of ideas and concepts towards exploring the evolution of narratology via digital interaction, the paradoxes this creates and querying the position of agency within such complex systems. These explorations include but are not limited to: Marie-Laure Ryan (2015) (immersion and interactivity in literature and electronic media), Lev Manovich (1999, 2002, 2005) (media history and installation art), Chris Hales (2015) (interactive digital narrative), Janey Murray (2017) (narratology, emerging technology and digital storytelling), Mark Stephen Meadows (2003) (storytelling, visual art and interactivity), Ted Nelson (1965) (information science), Nitzan Ben-Shaul (2004) (interactive cinema), Umberto Eco (1989) (semiotic analysis), Roland Barthes (1967) (authorial intent)… Expanding from these ideations each piece of work that I later developed explores the different narrative potentials of this practice, ranging from: simplistic pedagogy orientated structures that also demonstrates new spatial relationships with objects (*Systems of Seeing*, 2018), a more vast network topography that allows new ways to document and experience spaces (*Mimesis*, 2017) and finally a narrative system that conflates non-linear and linear methods into the same timeline and supports the loop as a key component in these types of interaction (*Vanishing Point*, 2018).

Each of these works assist in actualising the research question where I query, where is authorial control positioned in these narrative systems? Earlier in the thesis I explored interactive digital narrative towards developing a concept that I referred to as *datascape mediation*. Such a term was used to define the designer/machine/user as collaborative systems, whilst also providing a fluid definition of interactive digital narrative inspired by cybernetics that aligns with the processes involved in the production and reception of interactive and immersive applications. I also used this practice to feedback into theoretical discussions that aim to develop a critical discourse around the primary methods of interaction that I employ. I start this process by elucidating the importance of *virtual gaze interaction* as a posthuman perceptual interaction that overarches critical theories that involve the gaze. To expound this, I present a history of *virtual gaze interaction* that frames it in the areas of philosophy, science and art.

This is achieved through the creation of a timeline that includes: Albrecht Dürer (1525) (painter/printer/theorist), Joanne Zahn (1702) (author/illustrator), Arthur Appel (1968) (computer graphics), John Berger (1972) (art critic), Scott Roth (1982) (computer graphics). Such an approach aligns with my final research question that asks how do audiences respond to *virtual gaze interaction* becoming part of the interactive process? Alongside providing a historical contextualisation of this mode of interactivity I also perform a qualitative and quantitative analysis of the aesthetics of interaction associated with this kind of interaction. The role of the reticle became apparent as I critically engaged with and presented the idea of *virtual gaze interaction*. However, it wasn't until I exhibited *Mimesis* that I realised how much the reticle impacted a user's experience of the work. To explore this topic further I used a conflation of theorists, but the following stand out as key to the reading method that I develop: Katja Kwastek (2015) (interactive art history), Alexander Galloway (2012) (media studies) and Marie-Laure Ryan (2015) (immersion and interactivity in literature and electronic media). To expound this, I devised four different versions of this installation and designed a data visualisation to represent user movements in this space using different reticle types. Users were then interviewed and invited to rate each experience alongside being allowed to engage in more open conversations about their experiences, which I later compiled into a thematic analysis. Aside from illustrating the different types of ocular interaction and how these aesthetics can change a user's experience of the work, I realised that interaction and immersion are not invariably separate processes. In fact, in the case of *virtual gaze interaction* my analysis indicated that reticle interactions actually led to a greater sense of immersion, meaning that an overlay representing what is being looked at was creating a greater sense of immersion than just looking around in the scene. However, the most ideal approach is making the reticle appear only when the user is looking at an interactive object and not something that is turned on all of the time. A limitation of this part of the study was the time and user numbers needed to statistically validate these observations.. However, the act of considering the nuances of *virtual gaze interaction* is a novel research process that opens up valid and important areas for further research.

The data visualisation that accompanies this work is indicative of such potentials as this work can be expanded on and used as a means to represent other interaction types as well as developed into a 3D model, which would be more aligned with the spherical nature of the 360° format. The reticle's relationship to a form of weaponised vision that coincides with the first cinematic panning technique discussed in the second chapter is another prime example of the interconnected relationships that exist between the technologies of cinema and that of the panorama leading towards contemporary immersive media. This is achieved by putting Étienne-Jules Marey (1882) (chronophotographer), Paul Virilio (1989) (aesthetic philosopher) and Lynn Hershman (1993) (digital media art) in conversation with one another to explore and discuss the role of the reticle in relation to cinema's relationship with war. This discussion started in chapter 2 via the alignment of Marey's photographic rifle as a site where the panorama formed part of the language surrounding the development of the first form of cinematic movement (referred to as panning) and the relationship this has with head tracking. However, alongside this we also got the term "shooting", which derived from the photographic rifle that Marey (1882) used to capture his moving images. The origins and development of this weaponised interpretation of cinema is expanded on greatly by Virilio (1989) in *War and Cinema: The Logistics of Perception*, but alongside such histories I use Hershman *America's Finest* (1993) as a means of discussing the role of the reticle in reference to the new cinematographic relationships that are developing from the technologies, but more specifically forms of interaction being deployed in immersive media. Alongside placing the reticle as part of the development of such discourses my discussion between reticle aesthetics and the cue marks employed in cinema projection systems illustrates a form of interaction that moved from being designer and machine-driven to be a user-led process. Such ideations form part of a holistic claim that the framework I use to explore human-machine interactions in the context of contemporary interactive 360° film environments, illustrates that the elements that comprise this system are not a wholly new process. Instead I would argue that it forms part of a rich and underexplored part of film theory and history that interconnects with developments in immersive media that interweaves these elements into an interdisciplinary dialogue that conflates rather than separates out these dialogues. Only in

understanding and considering these lost histories can we begin to articulate the creative potential for these new genres of moving image practice.

In the introduction to this thesis I presented my plan to interrogate and explore new types of interactive film, but what has become apparent over the course of the four-year period of this research is that many of these conversations stem from the histories of artistic processes that grew up alongside film, but only now have the capacity to be disseminated and considered in relation to creative practice. This is a direct consequence of mass distribution and ease of access via mobile devices, a process akin to the panorama being more widely distributed after shifting from the circular panorama to the moving panorama as illustrated by Erkki Huhtamo (2013).

In order to refine and scope my work I developed a research framework from the literature that I reviewed to assist with my practical experimentation and help develop an approach that falls within the confines of my original research expectations. The results of this research have transcended such expectations as conflating a novel form of interaction with 360° film has opened up a range of cutting edge discourses that are not only direct extensions and aligned with my research areas, but this research also marks the beginning of a constantly evolving research practice. In terms of the broader impact of this work this practice and its associated theories form part of a much more expansive and timely shift in how we interact with moving images. Such processes will inevitably have a cultural impact on the future of cinema, but more importantly represent part of a seismic set of media convergences that will merge gaming and cinema. Rather than debating the specifics of an area that is still speculative, I would prefer to highlight at this point that no matter what the outcomes are, how we experience narrative and film has entered a period of radical transformation – a process that is reflected throughout this entire thesis. Encapsulating such theories inside a broader philosophical model I position the *Cynematic* framework as part of a posthuman construct in the sense that as the technologies of immersive media perpetuate a state of extended human experience – how we interact and consider the theories of these mediums need to be considered in a similar manner. Once established we can then start to consider what impact these systems are having on the more specific aspects of

being human, something overtly explored in a different capacity by Sherry Turkle (2017).

In terms of future work, I am looking forward to collaborating and developing immersive/interactive media art installations that allow me to integrate methods developed over the course of this thesis, whilst also allowing me to expand and develop on these skills. Current ideas involve considering how the interactive 360° film practice developed in this thesis can be merged with full computer-generated environments – allowing users to interact with objects and move in and out of 360° film scenes. Once devised conceptually framing this in a suitable project would be my next port of call.

For now, an emphasis on academic engagement with the processes involved in these systems is a pertinent endeavour. To experiment and explore interactive 360° environments aids in establishing such rigour, whilst the historical contextualisation and theoretical considerations that emerges from this promotes critical engagement with the types of sensory interaction that are embedded in these technologies. The practice that accompanies this thesis explores these ideas in more detail, whilst allowing room to develop creative practices befitting of the emerging narratives associated with our cybernetic movements through these new cinematographic landscapes.

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Appendix

9.0 Technical Documentation

Overview:

Virtual Embodiment:

Narrative Maze:

Eye Artefact Interactions:

Overview:

Technology Workflow

This interactive workflow provides a visualisation of the avenues I exhausted while searching for an approach that allows sensor technologies, virtual reality and video processing to work in unison. To view this please refer to the included digital appendix. After accessing the “PhD_Website” click on the “Technical Workflow”, which is the first section on this site.

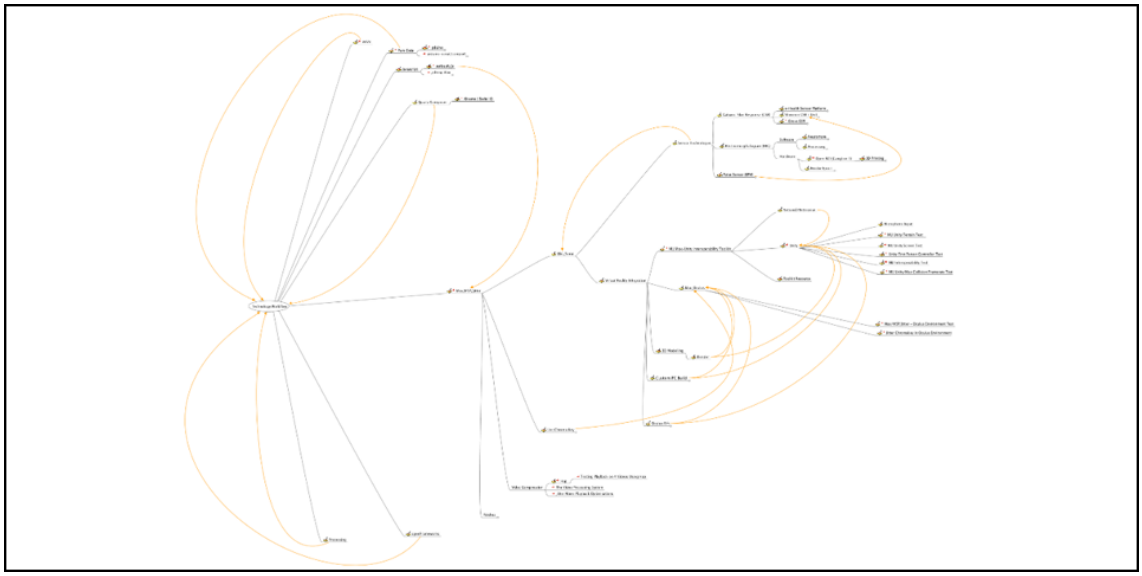
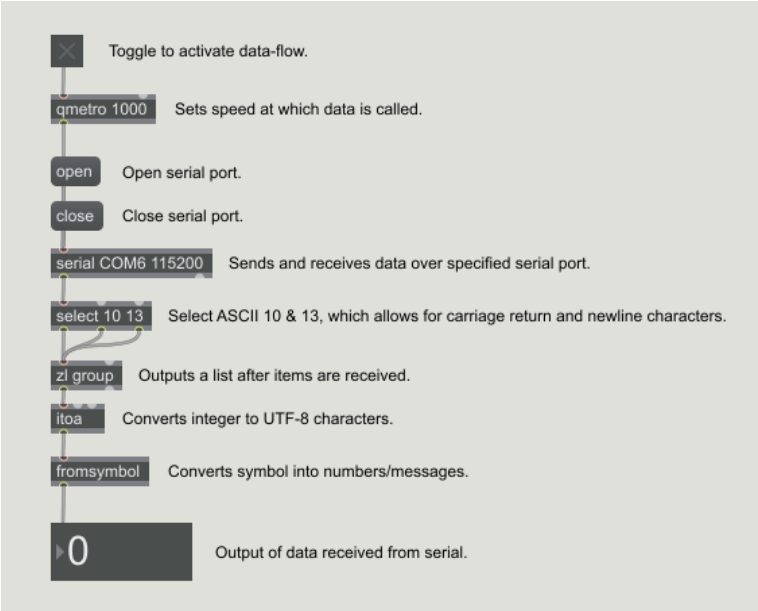


Diagram of the interactive technical workflow

Communication Methods

The main outcome from this rigorous software/hardware analysis was the establishment of a series of communication methods that I have built upon as I develop my practice-based research. To start I opted to write sensor data to Arduino’s serial port, which sends data to the serial port as human-readable ASCII text. Key things to note when using this method is that the baud rate in the serial monitor matches the baud rate that you have established in your code. This allows you to set the data rate in bits per second, which translates to the speed in which data is being communicated.



MAX/MSP/Jitter patch receiving data from an Arduino

An added benefit of using Max/MSP/Jitter is that it has a serial object which assists with the sending and receiving of information from a serial port. Once data is being received into Max/MSP/Jitter I use this to perform video processing, which is then outputted via jit.net.send to a jit.net.recv object via TCP/IP. This allows for the sending of matrices and messages over a network connection. To import Jitter textures into Unity I worked with Virginia Tech's μ (mu) Max-Unity3D Interoperability Toolkit (2008), which required repackaging due to deprecation.

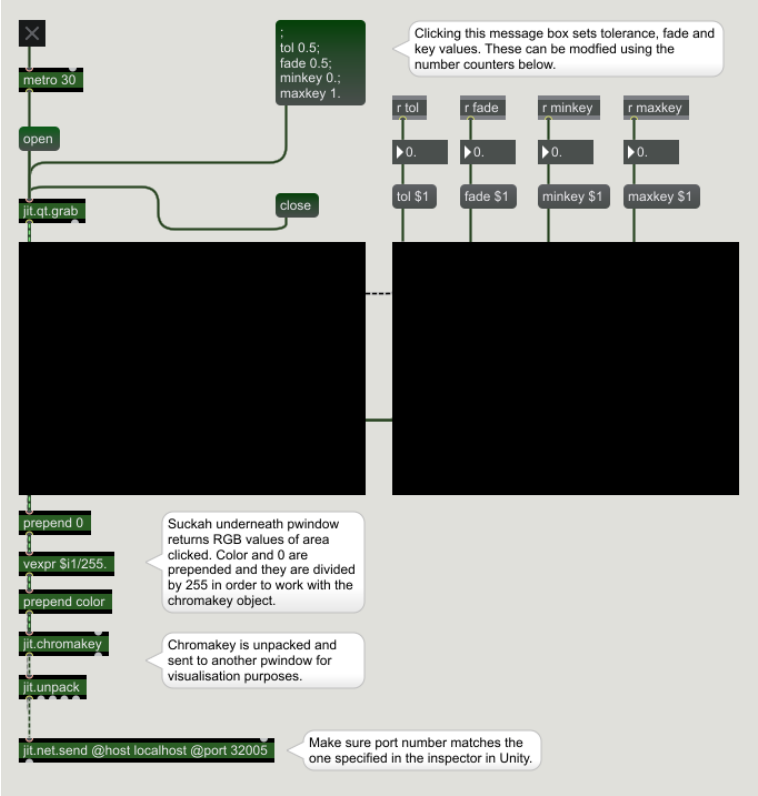
Virtual Embodiment:

Technological Contribution

https://github.com/owlwink/Max_Unity_Live_Chroma_Key

During my first phase of practical experimentation I created a method for live chroma key implementation from Max/MSP/Jitter into Unity through the combined use of a jit.chromakey object in Max/MSP/Jitter being sent via jit.net.send to Unity via the use of repackaged and modified version of Virginia Tech's μ (mu) Max-Unity3D Interoperability Toolkit (2008). This allows live chroma key to be outputted to Unity environments, which has a lot of

functionality beyond the scope of this PhD. Examples of this include application for digital art, theatre, telepresence and virtual reality installations.



MAX/MSP/Jitter patch sending chromakey video to Unity via jit.net.send

Galvanic Skin Response

After packaging the Max_Unity_Live_Chroma_Key in my Github I began building on the GSR components of the project. This starts with the Arduino programming side. My code expands on the open source code provided for the Grove GSR sensor module. The main thing wrong with their code is that it was actually measuring resistance instead of conductance. Once I realised this, I devised a way to calculate this value and modify the threshold to represent the average conductance threshold. I then converted conductance and resistance into microSiemens as this is the typical measurement value used for skin conductance. I have made all of this available in the following package:

Arduino GSR Script

https://github.com/owlwink/Arduino_GSR

Scaling Method

The version of this program I wrote for use with Max/MSP/Jitter uses a proportional scaling system that serial.prints an extra 1 for every 5% that the user's data is over the threshold (100%). I've capped this at 200% to allow for data up to double the threshold, which is the maximum I received in my tests. Outputting a series of numbers like this makes it easier to route on the Max/MSP/Jitter end.

Live Object Scaling in Unity

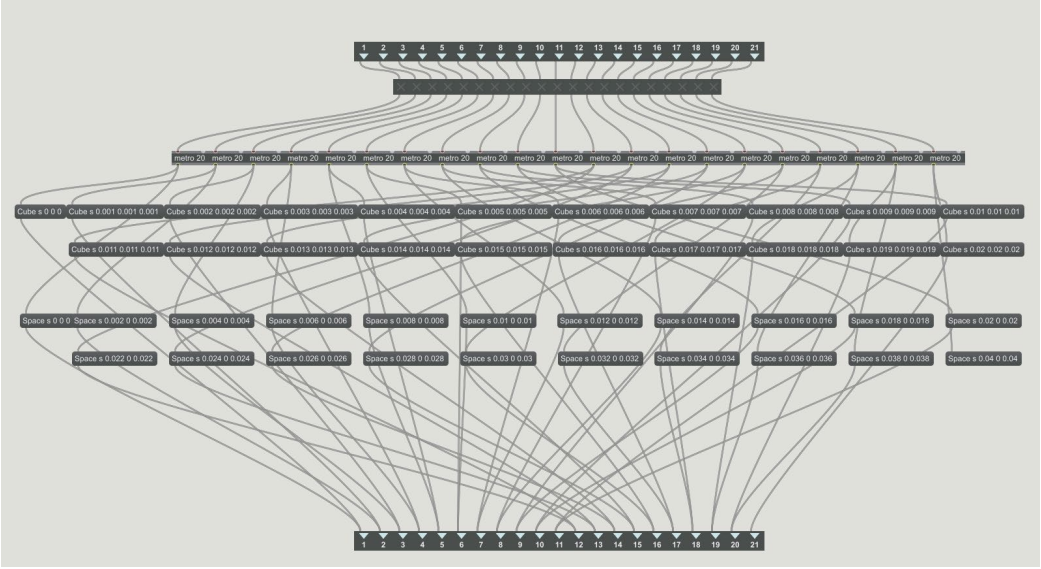
Starting with a random number generator in Max/MSP/Jitter I used this to simulate the values that will be received from the Arduino and built a prototype that would work with this kind of data input. When implementing part of the Mu Interoperability Toolkit I discovered that its netsend object does not work in the 64-bit version of Max 7. After much testing I realised that it still works with the latest 32-bit version of the software, so I have decided to proceed with this option. To handle the data being received I wrote a modular script that can handle any amount of data:

```
inlets = 1;
outlets = 21;

function msg_int(int_arg) {
	for (i=0; i <21; i++){
		if (int_arg == 0) {
			outlet(0, 1);
			}
		if (int_arg == i) {
			outlet(i, 1);
			}
		else{
			outlet(i, 0);
			}
	}
```

}

This uses one data inlet to receive the value being sent from the sensor. It then runs a for loop 20 times to accommodate the amount of outputs required in this instance. It then checks to see if any of the counter integers match the data coming from the inlet and based on this outputs a 1 to the matching value and a 0 to everything else. This approach allows only the toggle relative to the incoming value to be active and when this changes the previous one in turn is turned off as well. The importance of this is that otherwise messages start to stack on top of each other and the output is no longer proportionally relative. Once a toggle relevant to the received value is activated this starts a metronome, which while active repeatedly sends a message out of gsr_scale:

Using the MU toolkit as a reference I opted to send a relative scale assigned to a Cube (this name is arbitrary, it just has to match the name assigned to the object in Unity) and made the scaling of the X Y Z coordinates add values to correlate with the data being received by the Arduino script. These messages are then sent to outlets, which in the main program are prepended with send and then attached to netsend, which then sends them to Unity using port 32003 (this is also an arbitrary port number, which just needs to match the port specified in the C# scripts).



MAX/MSP/Jitter scaling system that outputs to Unity

Physics Issues with Scaling

Many of my early tests highlighted that the scaling created issues derived from the physics engine operating in the virtual environment. The majority of these issues were based around the scaling object eventually outgrowing the confines of the environment and exploding out into (in)finite space. The logical solution to this problem was to scale the environment as well, so the user can still deal with the issues of scale surrounding the screen and the image of self, but it would no longer have any unwanted physics based issues. With this in mind I added a “Space” message to the gsr_scale renderer, but made its values double of the “Cube” and increased its starting scale range in Unity. When I tested this in a live environment I noticed that there was jittering occurring. After looking into the FPS controller in collider view I noticed that the scaling Y axis of the “Space” was causing it to jump up and down. To resolve this I set the Y axis message to scale to 0. A degree of perspective chopping was also occurring, which I resolved by building a cube in Maya that has its inside removed. With a reduced height scale this removes the perspective issue that I believe was stemming from the inbuilt first-person controller. Later on in the development process I noticed physics issues still occurring which I resolved using the object destruction method that is discussed later in this document.

Double-Sided Surface and Object Stability

I wanted to make it that the user could walk around the screen, but this process had me running into perspective issues. If you use a plane then the reverse side of it is invisible, as by Unity’s design planes are single-sided surfaces. The alternative was to transfer the texture onto a cube, but this creates a surface on every side, which inevitably leads to some of them appearing upside down. Another issue with the plane is that when a rigid body is applied to it the physics engine cause it to fall over like a free standing wafer. There were two methods that I used to resolve these issues and allow a plane to be used in my work.

1. Using the built-in shaders in Unity I rewrote the default Unlit-Alpha shader to turn off culling. Once applied as a material to your object this allows double-sided transparent shading on a plane.

```
// Unlit alpha-blended shader.
// - no lighting
// - no lightmap support
// - no per-material color

Shader "DSUnlit/Transparent" {
Properties {
	_MainTex ("Base (RGB) Trans (A)", 2D) = "white" {}
}

SubShader {
	Tags {"Queue"="Transparent" "IgnoreProjector"="True"
"RenderType"="Transparent"}
	LOD 100
	Cull Off

	ZWrite Off
	Blend SrcAlpha OneMinusSrcAlpha

	Pass {
		CGPROGRAM
			#pragma vertex vert
			#pragma fragment frag
			#pragma multi_compile_fog

			#include "UnityCG.cginc"

			struct appdata_t {
				float4 vertex : POSITION;
				float2 texcoord : TEXCOORD0;
			};

			struct v2f {
				float4 vertex : SV_POSITION;
				half2 texcoord : TEXCOORD0;
```

```
                UNITY_FOG_COORDS(1)
            };

            sampler2D _MainTex;
            float4 _MainTex_ST;

            v2f vert (appdata_t v)
            {
                v2f o;
                o.vertex = mul(UNITY_MATRIX_MVP, v.vertex);
                o.texcoord = TRANSFORM_TEX(v.texcoord,
_MainTex);
                UNITY_TRANSFER_FOG(o,o.vertex);
                return o;
            }

            fixed4 frag (v2f i) : SV_Target
            {
                fixed4 col = tex2D(_MainTex, i.texcoord);
                UNITY_APPLY_FOG(i.fogCoord, col);
                return col;
            }
        ENDCG
    }
}

}
```

2. To avoid the rigid body physics causing the plane to topple over I added a box collider to the plane which gives it more stability in the environment. I also upped the weight of the plane to make it impossible to move by a character controller.

Screen Capturing

To record footage of the VEs I have opted to use NVIDIA's built-in ShadowPlay. This allows me to record 20 minute blocks, which are then automatically sent to a specified folder with a time and date stamp applied to them. This is turned on and off using Alt+F9 and Alt+F10 is used to save a specified time period.

Port Connections and Screen Flicker

During testing I also noticed another series of issues stemming from the fact that you need to leave Unity and click connect in Max to initiate the port connections, but this isn't exactly efficient or ideal from a user experience/interaction point of view. To resolve this I began experimenting with approaches that might allow the data connection before initiating the experience. My first consideration and one that I wanted to include either way was the addition of a start/exit menu. To do this I had to consult a wide variety of online documentation and work on developing my rudimentary knowledge of C#. A major bug I experienced during this was the cursor being deactivated when moving from the scene to the main menu. I resolved this by attaching a boolean true/false to the system's in-built Cursor.visible command.

```
using UnityEngine;
using System.Collections;

public class LevelManager : MonoBehaviour {

	// Use this for initialization
	void Start () {
	Screen.lockCursor = false;
	}

	public void LoadScene(string name){
		Application.LoadLevel(name);
	}
```

```
	public void QuitGame(){
			Application.Quit();
	}
}
```

Having built a prototype menu that allows quitting of the application and movement into the actual scene, I began testing to see if the port could be initiated in the start menu and would then continue being accessed for the rest of the application. Without getting into more complex variable sharing between scenes this was not an immediate success. Rather than delving into this approach further I decided to extend from the toggle in Max that initiates data flow and use this to send a request to initiate the port connection every 10th of a second. With a build only consisting of two scenes this was the most immediate and obvious solution to the problem I was having. Although this exposed another issue, when the scene was loading the almost immediate port connection was causing a screen flicker.

In my attempts to fix the screen flicker I decided to use a screen fade, which for some reason is not a built-in feature of Unity. After working through a multitude of approaches I decided that the best solution to my problem was to attach an invisible sprite to the first-person controller. This blocked vision of the scene until a timer converted the alpha levels of the sprite to make it invisible, giving the effect of a standard screen fade. Given that in VR you can move your head around I also needed to disable the first-person controller until the fade was complete. To maintain system performance I opted to destroy the sprite once the fade function has been completed.

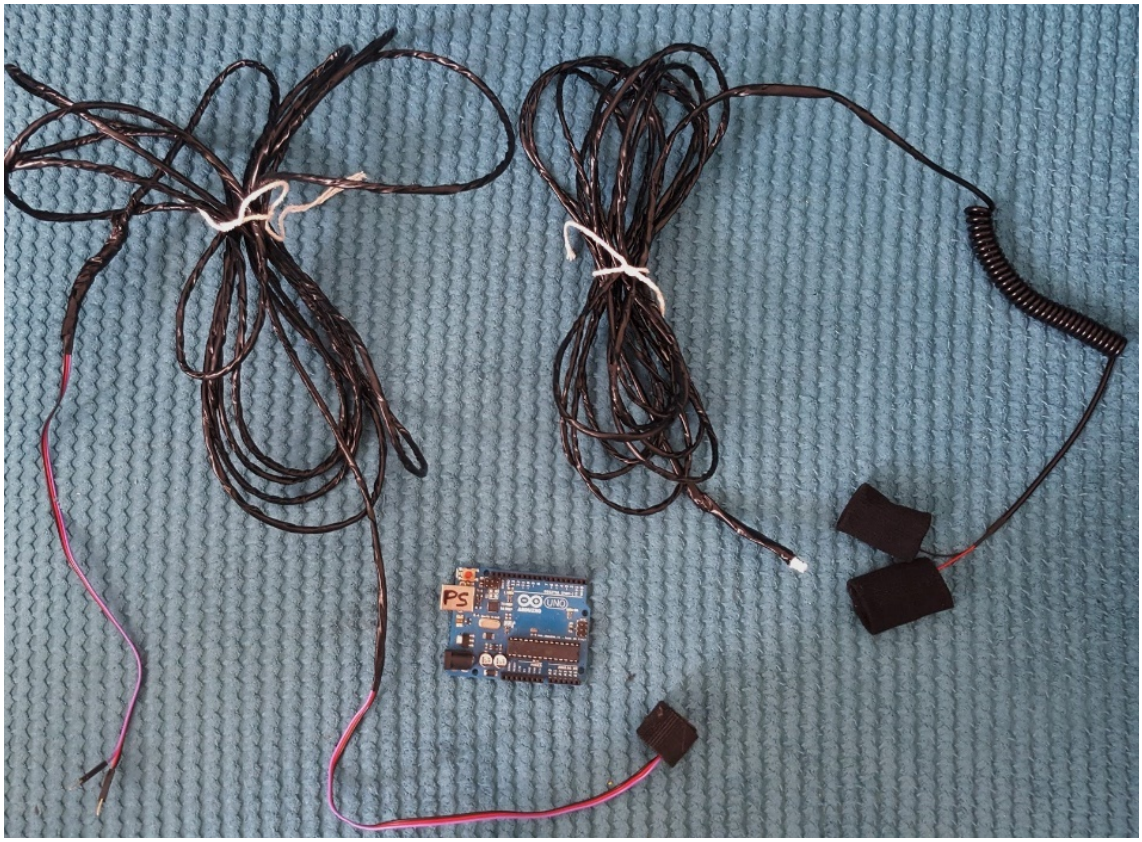
```
using UnityEngine;
using System.Collections;
using UnityStandardAssets.Characters.FirstPerson;

public class fadeIn : MonoBehaviour {

	public float alphaLevel = 1f;
	public float totalTime = 1;
```

```
	public float fadeSpeed = 1;

	// Use this for initialization
	void Start () {

	}

	// Update is called once per frame
	void Update () {

		totalTime += Time.deltaTime * fadeSpeed;

		if (totalTime >= .09) {
			GameObject.Find
("FPSController").GetComponent<FirstPersonController> ().enabled = false;
			alphaLevel -= .01f;
			totalTime = 0;
		}

		GetComponent<SpriteRenderer> ().color = new Color (0, 0, 0,
alphaLevel);

		if (alphaLevel < .01f) {
			Destroy (gameObject);
			GameObject.Find
("FPSController").GetComponent<FirstPersonController> ().enabled = true;
		}
	}
}
```

After testing in VR the limitations of this approach became apparent as the user can see the fader plane if they choose to look around. Due to this I compromised and went back to the original approach.

Sensor Cable Modification

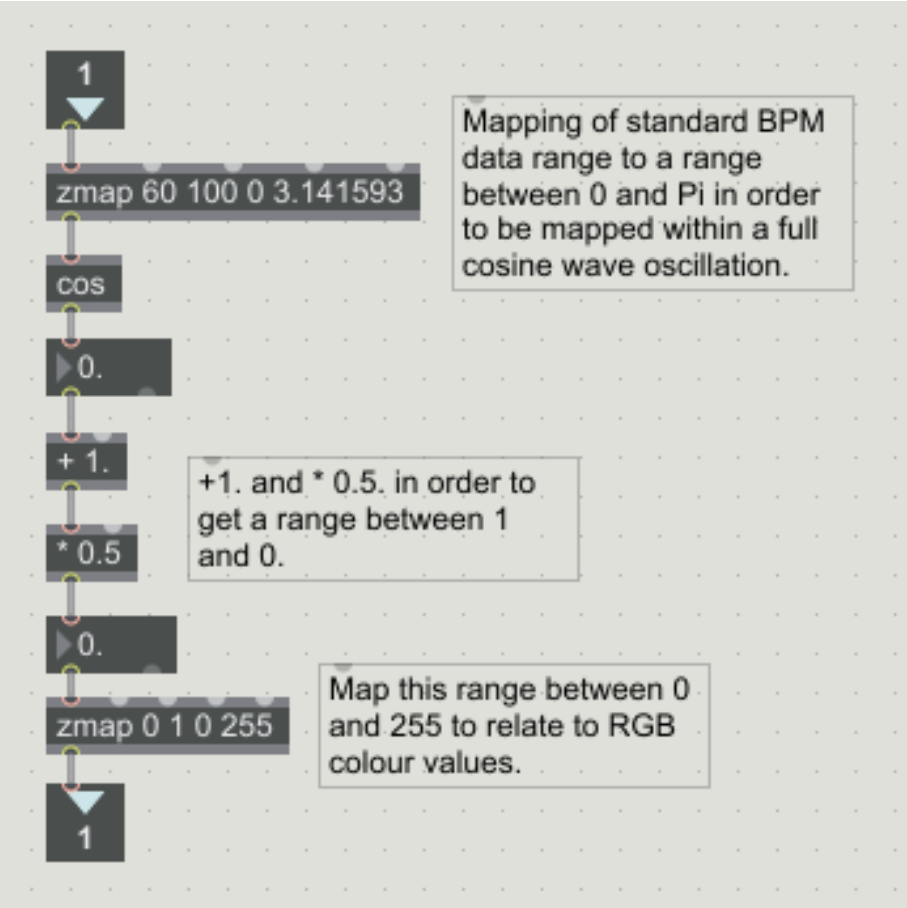
Given that both of the sensors had very short cables I had to expand these so the user does not have to be so close to the machine. I expanded both sensor cords to be approximately 12-foot-long with electrical wire that would easily carry 5 volts. To secure the extensions I used heat shrink sleeves on the connection points and wrapped all of the wires in electrical tape.



DIY GSR Arduino cable extensions

Dynamic Lighting

When experimenting with using the BPM data from the pulse sensor to control the colour of the environment I realised that the range of data being received was not dynamic enough as BPM has a tendency to float in the middle. To achieve a sloped range I opted to build a scale function that maps the data to a full oscillation of a cos wave. To get a Y axis between 1 and -1 the range of values received from the pulse sensor need to be proportionally mapped between 0 and Pi on the X axis. For further information please see the comments in the scale patch below:



Max/MSP/Jitter cosine frequency range conversion

Once I acquired a dynamic data range that outputs relative to RGB colour values I split these values into three streams to represent each of the value ranges. This was then packed as a colour value and sent to all of the environment objects. The outcome of this was a pulse responsive dynamic lighting that fluctuated between white and black based on the sensor data being received into Max/MSP/Jitter.

Controller Considerations

Given that I have allowed movement in the environment I needed to find a way that users could control movement through the environment using one hand. Initially I considered getting an analogue joystick module that works with arduino and building this into a glove type device. An alternative to this was sourcing a one-handed wireless trackball mouse. I eventually disbanded this approach in favour of using an Xbox One wireless controller as it was easier to map its input for use in Unity. To avoid the issue of index finger movement

affecting data being received from the pulse sensor I opted to clip it to the ear lobe, which is another method for collecting data. This approach allowed me to attach the pulse sensor to the Oculus CV1 and made for a less cumbersome and more reliable data collection method.

Microphone Input and Random Audio Production

Working through my audio approach I considered two methods that lead to a very different user experience. The first of these is more akin with telepresence and plays on the only audio being a playback of a live microphone playing back an amplified version of the scene that the installation inhabits. This would explore ideas of how the environment shapes our data production and also play between the shift between public and private spaces. Below is a script that adds live microphone input to Unity.

```
using UnityEngine;
using System.Collections;
[RequireComponent (typeof (AudioSource))]
public class MicrophoneInput : MonoBehaviour
{
    //A boolean that flags whether there's a connected microphone
    private bool micConnected = false;
    //The maximum and minimum available recording frequencies
    private int minFreq;
    private int maxFreq;
    //A handle to the attached AudioSource
    private AudioSource goAudioSource;
    //Use this for initialization
    void Start()
    {
        //Check if there is at least one microphone connected
        if(Microphone.devices.Length <= 0)
        {
            //Throw a warning message at the console if there isn't
            Debug.LogWarning("Microphone not connected!");
```

```
        }
        else //At least one microphone is present
        {
            //Set 'micConnected' to true
            micConnected = true;
            //Get the default microphone recording capabilities
            Microphone.GetDeviceCaps(null, out minFreq, out maxFreq);
            //According to the documentation, if minFreq and maxFreq are zero, the
microphone supports any frequency...
            if(minFreq == 0 && maxFreq == 0)
            {
                //...meaning 44100 Hz can be used as the recording sampling rate
                maxFreq = 44100;
            }
            //Get the attached AudioSource component
            goAudioSource = this.GetComponent<AudioSource>();
        }
    }
    void OnGUI()
    {
        //If there is a microphone
        if(micConnected)
        {
            //If the audio from any microphone isn't being captured
            if(!Microphone.IsRecording(null))
            {
                //Case the 'Record' button gets pressed
                                    if (Input.GetKeyDown(KeyCode.R))
                {
                    //Start recording and store the audio captured from the microphone
at the AudioClip in the AudioSource
                    goAudioSource.clip = Microphone.Start(null, true, 300, maxFreq);
                                        while (!(Microphone.GetPosition(null) > 0)){}
                                        goAudioSource.Play(); //Playback the
recorded audio
```

```
            }
        }
        else //Recording is in progress
        {
            //Case the 'Stop and Play' button gets pressed
            if (Input.GetKeyDown(KeyCode.T))
            {
                Microphone.End(null); //Stop the audio recording
            }
        }
    }
    else // No microphone
    {
        //Print a red "Microphone not connected!" message at the center of the
screen
        GUI.contentColor = Color.red;
        GUI.Label(new Rect(Screen.width/2-100, Screen.height/2-25, 200, 50),
"Microphone not connected!");
    }

  }
}
```

The other approach was to create a database of sound files that relate to relaxed and more stressful soundscapes e.g. nature versus industrial machining. These could then be randomised at the start of the installation. The potential for this is that the soundscapes could feedback into user's data production and in turn shape their overall experience. The following code sample creates an audiosource where clips are loaded randomly from a sequence of numbered audio files.

```
using UnityEngine;
using System.Collections;

[RequireComponent(typeof(AudioSource))]
```

```
public class RandomAudioGenerator : MonoBehaviour {

		void Start() {
		AudioSource audioSource =
gameObject.AddComponent<AudioSource>();
		audioSource.volume = 0.5f;
		audioSource.loop = true;

		audioSource.clip = Resources.Load("Audio/" + Random.Range(0,
12)) as AudioClip;
		audioSource.Play();
		}

}
```

Object Destruction and Random Phrase Generation

As previously mentioned in the section on physics issues with scaling I was still having underlying issues when the chroma key screen became too large for the environment. To resolve this I opted to write a script that destroys the object if it becomes too big. Once written I decided that the object should be replaced with something to indicate that the installation is complete. In an attempt to narrativise the experience I chose to frame it with a randomly generated pre-authored sequence of phrases. These were placed inside of a list that randomly attached these strings to a textmesh object that is created after the chroma key object is destroyed. The code below illustrates this process:

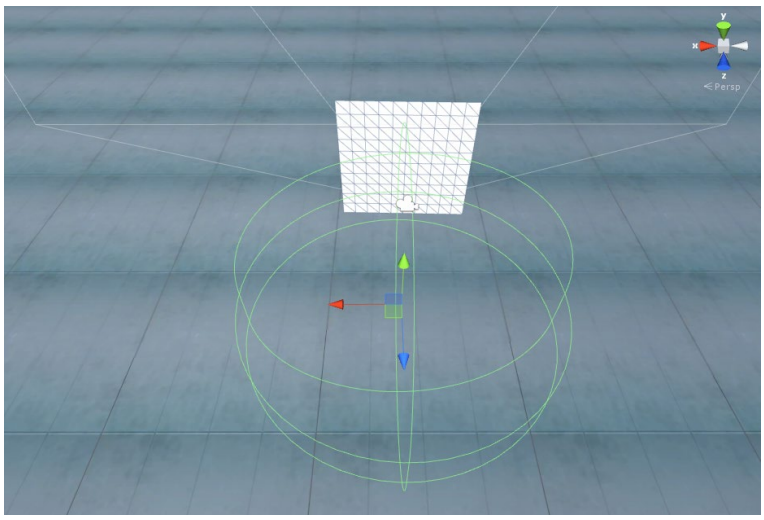
```
using UnityEngine;
using System.Collections;

public class text : MonoBehaviour {
public GameObject cube;
string[] texts = new string[]

	{
```

```
            "Your virtual self has been destroyed...",
            "Your virtual self flew too close to the sun...",
            "Your virtual self is free...",
            "Your virtual self no longer exists...",
            "Your virtual self is still present...",
            "Your virtual self is the camera..."

    };

    void Update() {
            cube = GameObject.Find ("Cube");
            if (cube.transform.position.y > -130) {
                    Destroy (cube);
                    GetComponent<TextMesh> ().text =
texts[Random.Range(0, name.Length)];
            }
    }
}
```

Narrative Maze:

Third-Person Chroma Key

The first idea developed for this part of the practice was a third-person chroma key object attached to the main camera. The main difficulty with this was its placement as it was easy to make the image appear cut-off. Later in the development there were issues with viewing moving images in front of the live rendered chroma key, the resolution to this will be discussed later on in the document.



Third-person chroma key object attached to the main camera in Unity

Single Video to Multiple Port Objects

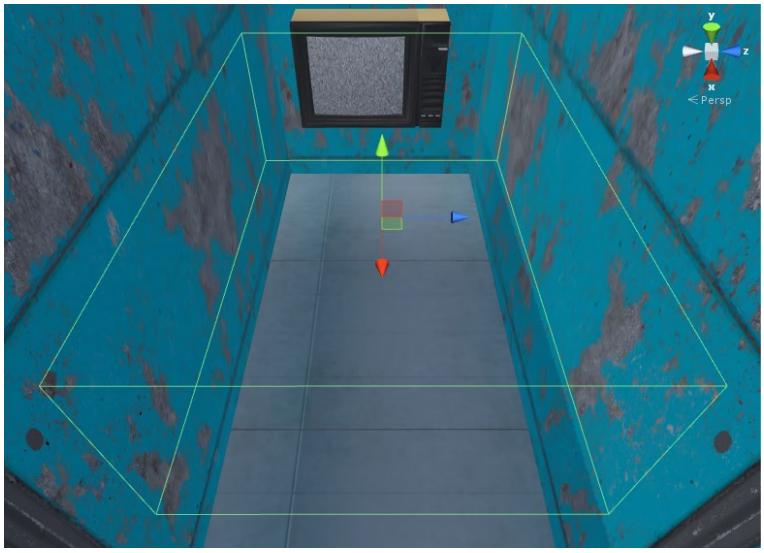
During initial testing it became apparent that when you send more than one moving textures from Max/MSP/Jitter to Unity incremental slowdown occurs. Beyond the performance issue this drops the framerate to an unacceptable level for use with virtual reality headsets. To overcome this issue I opted to read a single video file in Max/MSP/Jitter, which is then sent to a sequence of ports whose receiving connections are specified in the JitReceiveTexture.cs scripts attached to all of the screen meshes in the virtual environment. The idea here being that once sensor data calls a video that the port relative to the screen that you are in front of is activated, meaning that any amount of screens can be viewed, as there is only ever one screen texture actually active. To implement this I started by using Triggers in Unity.

Triggering Data in Unity

Built into the Unity engine are Triggers, which assist with detecting when an object is within a particular space. Availing of this I started by creating a series of box colliders which all have their mesh renderers turned off. This allows for the creation of an interaction trigger that is invisible in the game world:

Once created I attached activator scripts to each of these zones. Inside of these I specified that if the user was inside the trigger zone that the JitReceiveTexture.cs script would turn on. I also created a variable for the

screen, which calls the tag relative to the model inside of the trigger zone. Once the user exits the trigger zone the script is deactivated by setting its enable boolean to false. The next issue I had to resolve was how to get Unity to communicate with Max/MSP/Jitter in order to select and stop the content being activated in Unity.



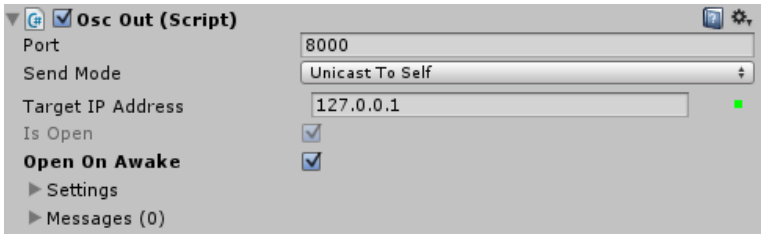
Trigger zone positioning in Unity

```
using UnityEngine;
using System.Collections;

public class activator : MonoBehaviour {

	public Renderer rend;
	public Renderer textRend;
	public GameObject body;
	public GameObject screen;

	void Start () {
		rend = GameObject.Find ("Cube").GetComponent<Renderer>();
		textRend = GameObject.Find
("Text").GetComponent<Renderer>();
	}
	void Update () {
		body = GameObject.Find ("RigidBodyFPSController");
		screen = GameObject.FindWithTag("screen");
```

```
    }

    void OnTriggerEnter(Collider other){
        body.GetComponent<simpleSend>().enabled = true;
        body.GetComponent<simpleSend0>().enabled = false;
        rend.enabled = false;
        screen.GetComponent<JitReceiveTexture>().enabled = true;
        StartCoroutine (processTask ());
    }

    void OnTriggerExit(Collider other){
        screen.GetComponent<JitReceiveTexture>().enabled = false;
        body.GetComponent<simpleSend>().enabled = false;
        body.GetComponent<simpleSend0>().enabled = true;
        rend.enabled = true;
        textRend.enabled = false;
    }

    IEnumerator processTask(){
        yield return new WaitForSeconds (2);
        textRend.enabled = true;
    }
}
```

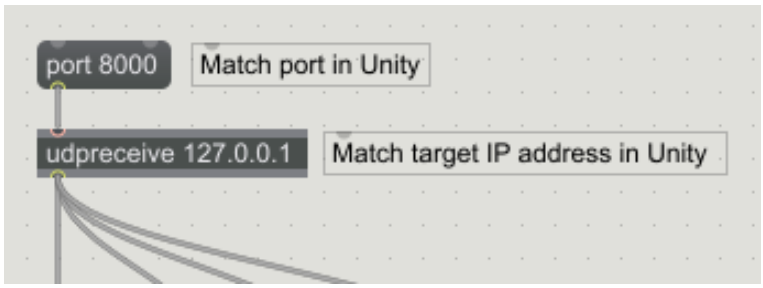
OSC Communication between Unity and Max/MSP/Jitter

I started by working with an open source OSC library for Unity, but found its documentation to be too vague so opted to get OSC simple from the Unity asset store. This offered an OSC implementation for Unity that included comprehensive documentation for using it. Once the Osc Out.cs script has been attached to the character controller the following inputs become available in the inspector window:



Osc Out outputs in Unity inspector window

In order to receive data via OSC in Max/MSP/Jitter the port and the target IP address must match on both ends. The send mode must also be set to Unicast to Self and Open On Awake must be ticked.



Setup for Osc input in MAX/MSP/Jitter

Once a connection is established between both pieces of software, Unity then needs a script to send data over the network. To simplify this process I wrote two scripts which just send either the number 0 or the number 1. As identifiers for on and off I can use this data to complete all the necessary interactions in Max/MSP/Jitter:

```
using UnityEngine;
using System.Collections;

[RequireComponent(typeof(OscOut))] public class simpleSend :
MonoBehaviour
{
        OscOut oscOut;
        void Start(){
                oscOut = gameObject.GetComponent<OscOut>();
        }
```

```
	void Update(){
		oscOut.Send("1");
	}
}
```

After attaching the simpleSend.cs script to the character controller I then established the on and off booleans for these in each of the activator scripts. This means that Max/MSP/Jitter will receive either a 1 or a 0 depending on whether or not a trigger zone has been activated.

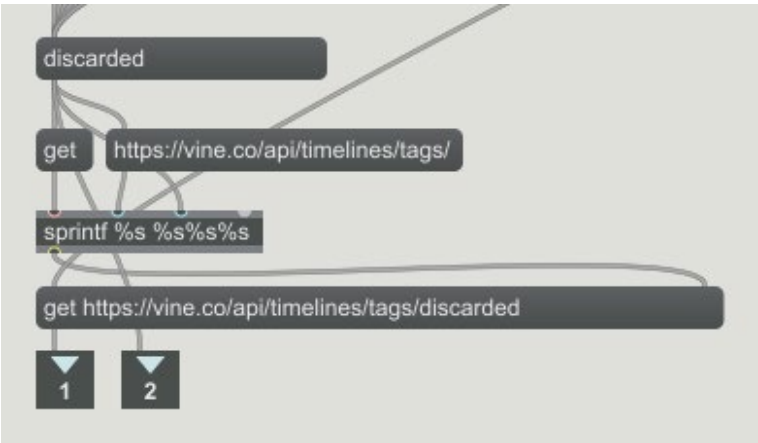
Vine API Integration

After reading into the jit.movie reference in Max/MSP/Jitter I realised that if the read message is followed by a parseable address that it will attempt to load a movie from the specified location. Integrating this with the Vine API was a little more complicated. Starting with official Vine API I read through their documentation, but found it difficult to figure out how I could get the API to work with the read message for jit.movie. After some investigation I found a tutorial that uses the Vine API with Max/MSP/Jitter by creating a script, which parses the JSON received from the Vine API:

```
inlets = 1;
outlets = 1;

function get(url) //calls function get with the URL argument.
	{
		var ajaxreq = new XMLHttpRequest(); //
		ajaxreq.open("GET", url); //tell ajax request to go to the URL with the GET request.
		ajaxreq.onreadystatechange = readystatechange; //Once the function comes back what function should you call with the data.
		ajaxreq.send(); //Sends the request.
	}

function readystatechange() //Calls as soon as the request comes back
```

```
{
        var rawtext = this._getResponseKey("body"); //Body of the data
that came back to us.
        var body = JSON.parse(rawtext); // Extracting JSON from body.
Returns a javascript object to pulls out specific data we want.
        outlet(0, body.data.records[0].videoUrl); //Spits out first URL
relative to API.
}
```

This worked perfectly for calling the most popular videos, but I was still having trouble with getting tag specific content. To achieve this I used the mobile app API to send a GET request to the javascript object above and found that it would output the top videos applied to any specified tag. Using the sprintf object in Max/MSP/Jitter I formatted a message that combined the get request, mobile API and a word generated from a list:

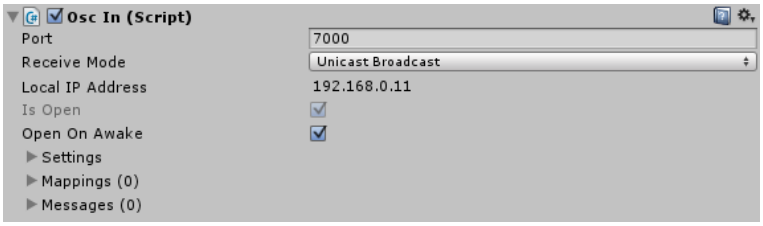


Vine API get request patch in MAX/MSP/Jitter

Creating 3D Text Objects in Unity from Max/MSP/Jitter

I also decided to output the chosen word as it would give context to the visual material, but in order to do this I had to send the word to Unity from Max/MSP/JItter and then create it in Unity as a 3D Text object. To start I sent the text to Unity via the udpsend object making sure to prepend a backslash as this is required for OSC communication and that the local IP address and ports match those specified in Unity:

Separate port output locations for each object in Unity



Osc In inputs in Unity inspector window

After adding the Osc script and running a test to see if it was receiving messages from Max/MSP/Jitter I then realised that I would need to write some code to make a 3D text object out of the received object. The following code was added to the the OscIn.cs script to achieve this:

```
print (groupedMessages[gm]);
textGeneration = groupedMessages[gm].ToString();

print (textGeneration.Trim('/'));
GetComponent<TextMesh> ().text = textGeneration.Trim('/'); //added this section to create TextMesh of received text input.
```

Creating a variable composed from the message stream, but converted to a string allowed me to trim the forward-slash from it and then insert it as the text in the TextMesh. I then added a textRend variable in each activator script that calls the empty text object in each space by a tag identifier. The triggers set the text renderer to true or false, but based on the slight delay while the video file is

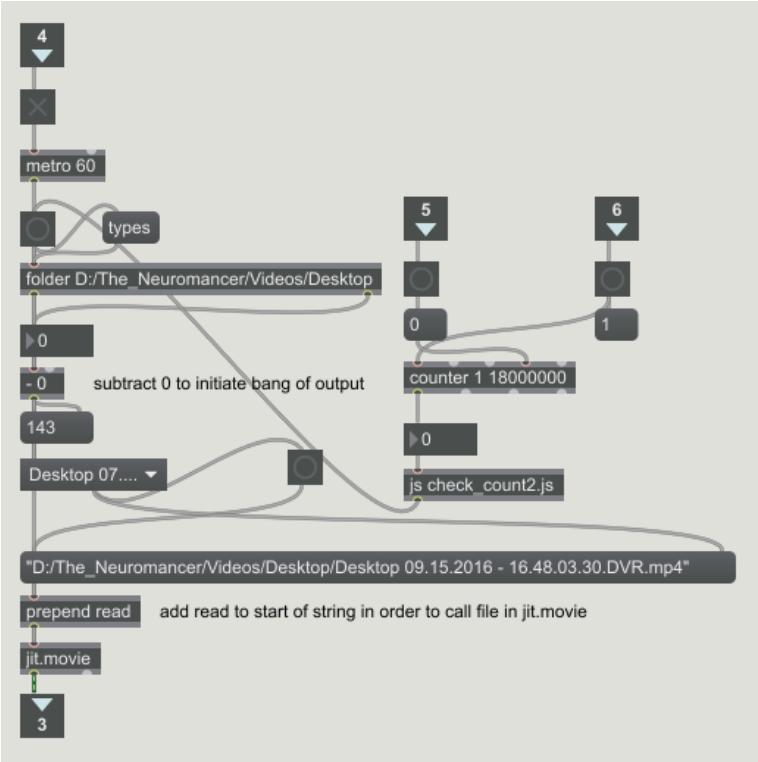
being called, I programmed a timer to activate the text renderer after 2 seconds to account for this.

Custom Shader for 3D Text

During testing I noticed that although the 3D text objects were working they were visible throughout the entire environment. Using the following code I managed to resolve this perspective issue.

```
Shader "3DText" {
	Properties {
		_MainTex ("Font Texture", 2D) = "white" {}
		_Color ("Text Color", Color) = (1,1,1,1)
	}
	SubShader {
		Tags { "Queue"="Transparent" "IgnoreProjector"="True"
"RenderType"="Transparent" }
		Lighting Off Cull Off ZWrite Off Fog { Mode Off }
		Blend SrcAlpha OneMinusSrcAlpha
		Pass {
			Color [_Color]
			SetTexture [_MainTex] {
				combine primary, texture * primary
			}
		}
	}
}
```

Input Simulation



MAX/MSP/Jitter patch that loads the screen capture video

In order to activate the screen capture software from within Unity I had to simulate the keypress associated to it. Using Windows Input Simulator I added the following code to the final activator script to achieve this:

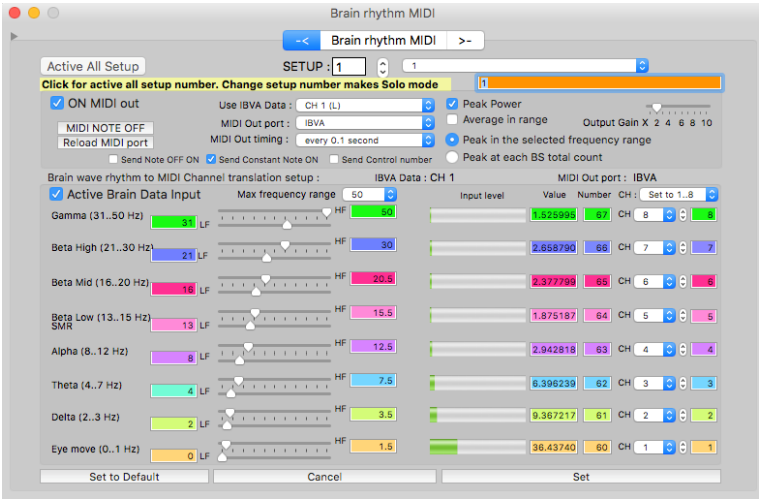
InputSimulator.SimulateKeyPress (VirtualKeyCode.F10);

Placing this in a trigger enter zone allows a capture to be called on the computer once the user enters the final area. Once this call has been made an OSC message is then sent to Max/MSP/Jitter (see image above), which turns on a metro and activates a counter. This is then connected to a JavaScript object that outputs a bang after a couple of seconds, this time allows for the capture to be generated. This output presses a button that parses the folder where the captures are generated. The amount of files in the folder is then outputted as an integer and sent to a message. Then using a umenu object I use this number to select the last file created in the folder. A read message is then prepended to this and they are sent to jit.movie where the last captured

video file is outputted to a netsend object, which sends the video texture to Unity.

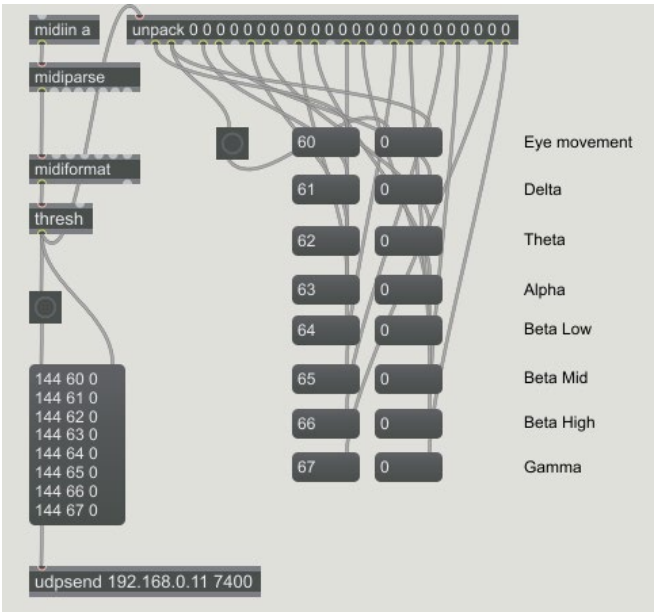
Eye Artefact Interactions:

Brain Midi with IBVA, Max/MSP/Jitter and Unity



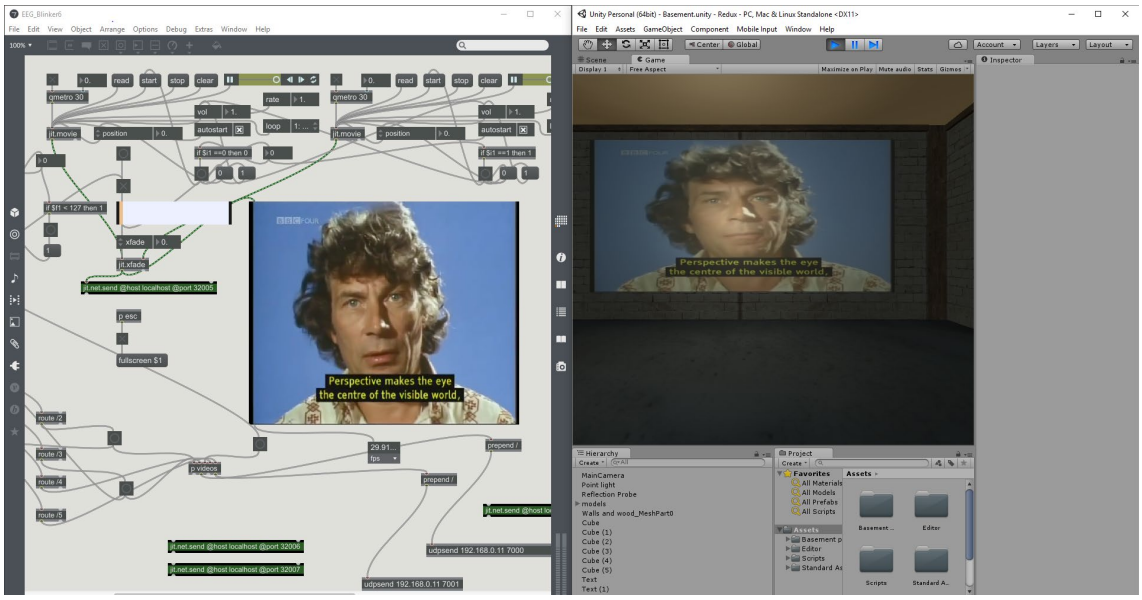
MIDI output system for EEG in IBVA

Using IBVA's brain rhythm MIDI function I managed to output each of the active brain data inputs via MIDI and using a custom-made patch I parsed the MIDI data from each of these channels in MAX/MSP/Jitter and recreated this EEG data for use with audio and moving image.



MAX/MSP/Jitter patch that received the EEG MIDI signals from IBVA

Once established and coherently working with MAX/MSP/Jitter I used this process in conjunction with the jit.net.send procedure I had been previously working with to send a video crossfader into Unity that changed depending on eye movement in VR. Although an interesting experiment the cumbersome and limited nature of this type of interaction led me to pursue types of interaction that worked more fluidly in a VR environment.



Comparison view of my MAX/MSP/Jitter patch sending EEG video interactions to Unity

9.1. Narrative Diagrams/Research Posters

These are available from the following locations in the attached digital appendix:

Systems of Seeing – Documentation ► Network Topography
Mimesis – Documentation ► Research Poster
Vanishing Point – Documentation ► Expanded Temporospatiality: The Loop as Narrative System

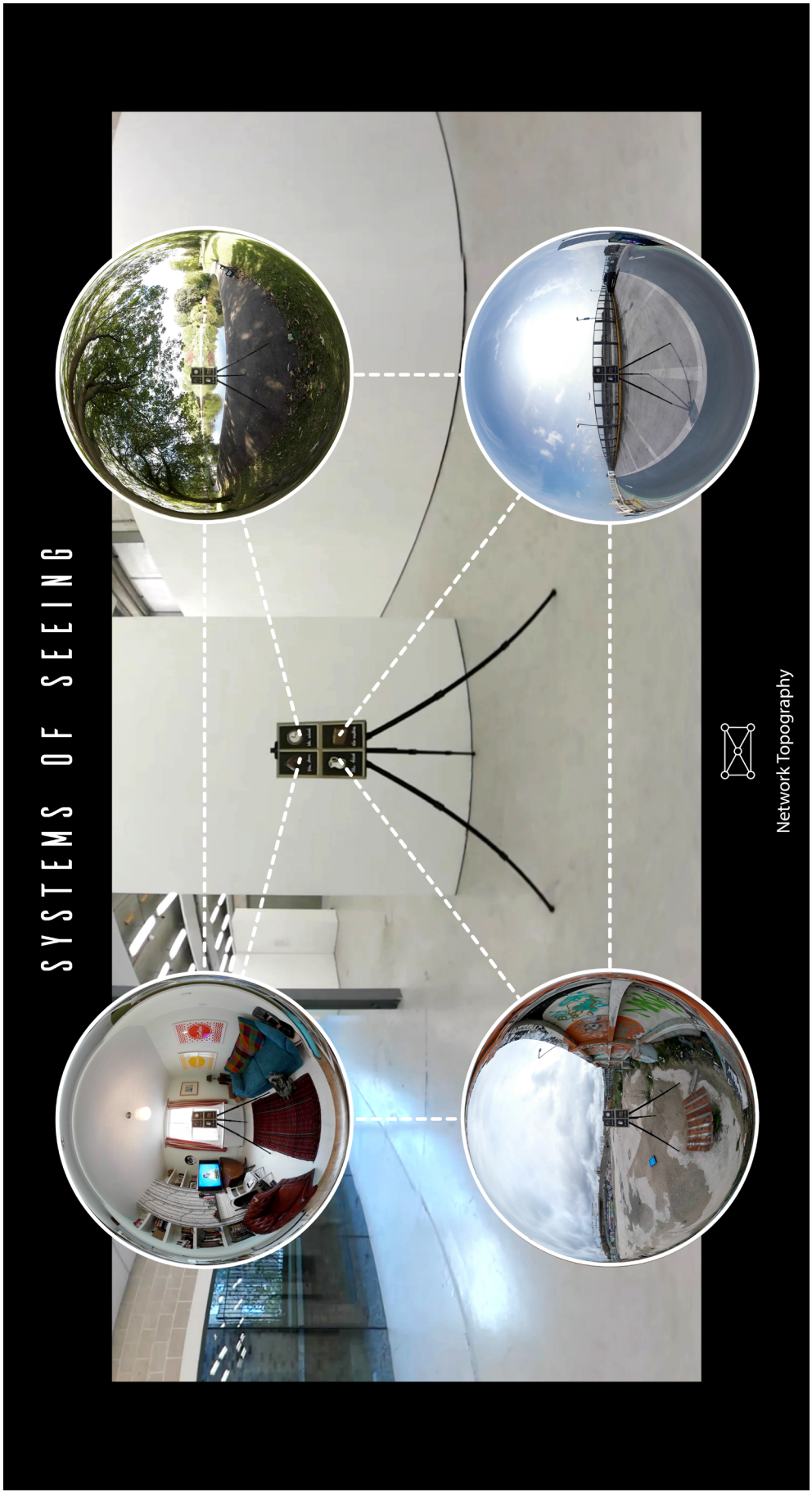
9.2. 360° Photo Galleries

Alongside the included interactive 360° film application I have also added 360° photo galleries for each of these applications. This additional documentation is available via the documentation section for each piece of practice listed in the "PhD_Website".

9.3. Unity Package Files

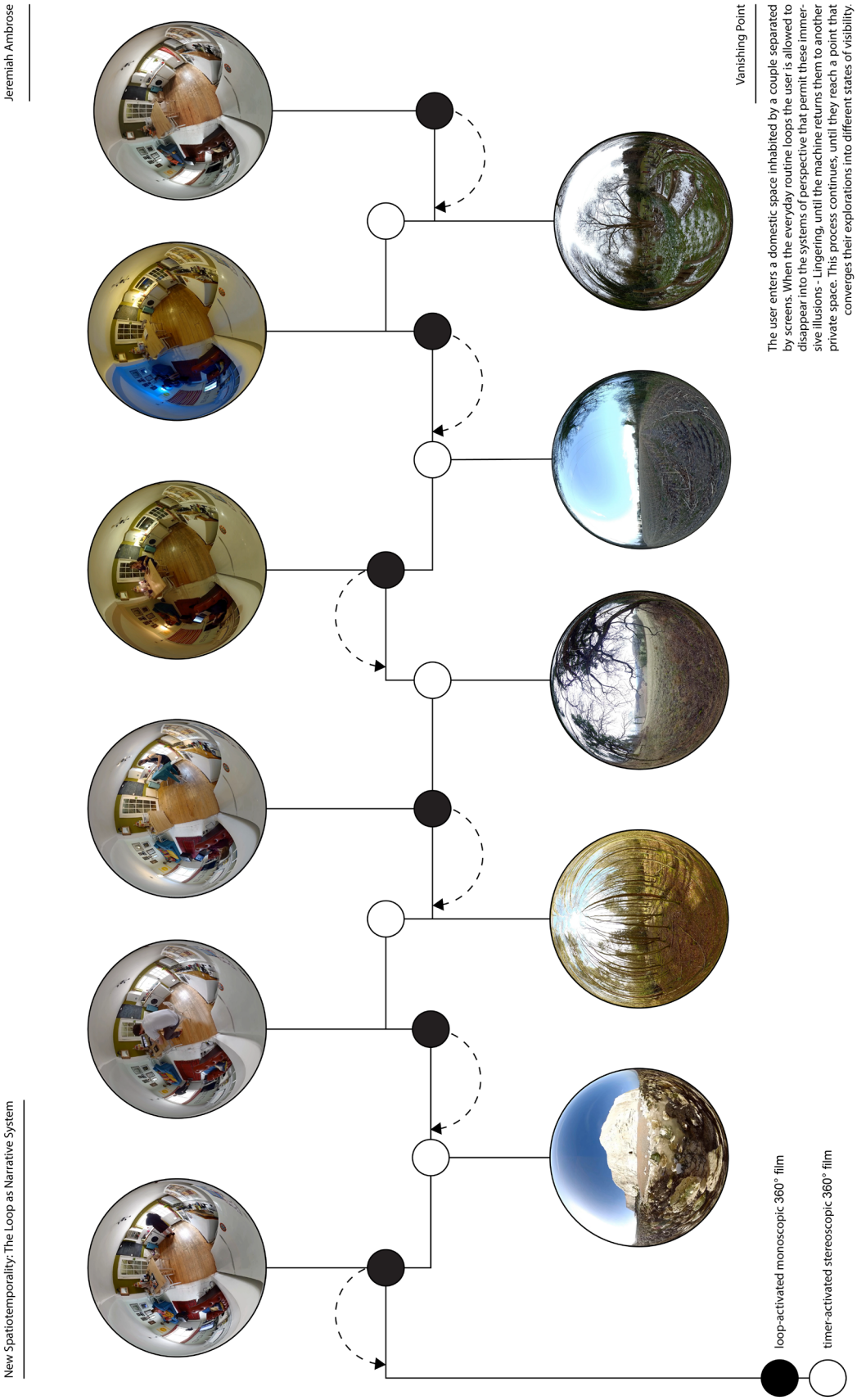
Please refer to the Unity package files attached in the digital appendix if you want to further explore each of the projects that I presented alongside this thesis. They are available via the "Unity_Packages" folder.

9.4. Systems of Seeing: Network Topography



9.5. Mimesis: Network Topology

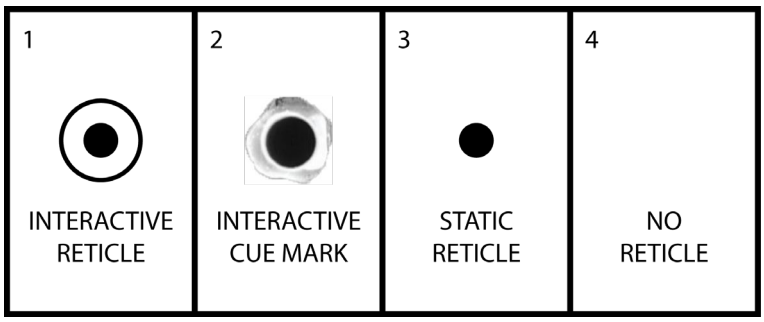
9.6. Vanishing Point: New Spatiotemporality



9.7. Navigation Survey

Definition of a VR Reticle: **[1]**

Images such as fine lines, circles, dots, marks and cross hairs that are used to aim a user's simulated line of site in a virtual environment.



- **Interactive Reticle** - Point that activates when an interactive object is being looked at. In this example this is portrayed by a thin circle appearing outside of the main dot reticle.

- **Interactive Cue Mark** - Image of a cue mark that only appears when an interactive object is being looked at. Otherwise there is no image overlay visible at all.

- **Static Reticle** - There is a visible dot over the user's simulated line of sight, but it doesn't respond to interactive objects. Therefore the user must explore and build their own topography of the interactive landscape.

- **No Reticle** - The reticle has been removed from the installation. This promotes the fullest sense of immersion, but makes interactivity become quite an abstract process.

Navigation Survey 1

User #

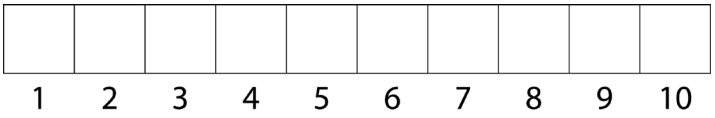
Date:

Installation 1 - Interactive Reticle

- Describe your experience of the work:

- Consider the interactive reticle in installation 1 - how would you rate this experience?

  (10 positive - 1 negative)



- How did the interactive reticle impact your experience of the work?

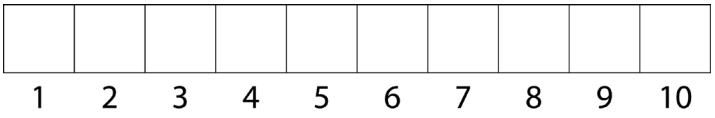
- What led to you ending the experience when you did?

Installation 2 - Interactive Cue Mark

- Describe your experience of the work:

- Consider the interactive cue mark in installation 2 - how would you rate this experience?

  (10 positive - 1 negative)



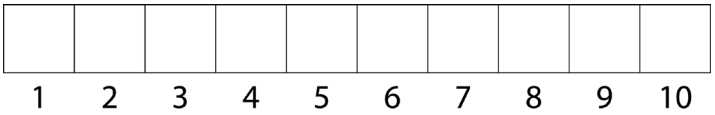
- How did the interactive cue mark impact your experience of the work?

- What led to you ending the experience when you did?

Installation 3 - Reticle

- Describe your experience of the work:
- Consider the reticle in installation 3 - how would you rate this experience?

  (10 positive - 1 negative)

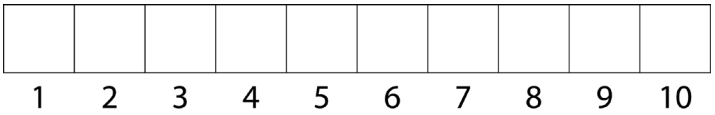


- How did the reticle impact your experience of the work?
- What led to you ending the experience when you did?

Installation 4 - No reticle

- Describe your experience of the work:
- Consider the lack of a reticle in installation 4 - how would you rate this experience?

  (10 positive - 1 negative)



- How did the absence of a reticle impact your experience of the work?
- What led to you ending the experience when you did?

After Installations 1 - 4

- Please number the installations in order of how immersive you found them:

  (1 being the least immersive and 4 being the most immersive)

Interactive Reticle	Interactive Cue Mark	Reticle	No Reticle

- Please number the installations in order of how interactive you found them:

  (1 being the least interactive and 4 being the most interactive)

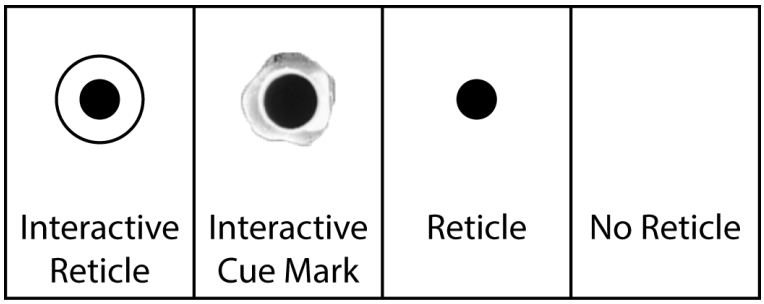
Interactive Reticle	Interactive Cue Mark	Reticle	No Reticle

- After using these four different VR reticles, which one do you think was the best overall approach to interactive 360 film?

- Additional thoughts - (space to improvise particular points raised by users)

Definition of a VR Reticle: **[2]**

Images such as fine lines, circles, dots, marks and cross hairs that are used to aim a user's simulated line of site in a virtual environment.



- **Interactive Reticle** - Point that activates when an interactive object is being looked at. In this example this is portrayed by a thin circle appearing outside of the main dot reticle.

- **Interactive Cue Mark** - Image of a cue mark that only appears when an interactive object is being looked at. Otherwise there is no image overlay visible at all.

- **Reticle** - There is a visible dot over the user's simulated line of sight, but it doesn't respond to interactive objects. Therefore the user must explore and build their own topography of the interactive landscape.

- **No Reticle** - The reticle has been removed from the installation. This promotes the fullest sense of immersion, but makes interactivity become quite an abstract process.

Navigation Survey 2

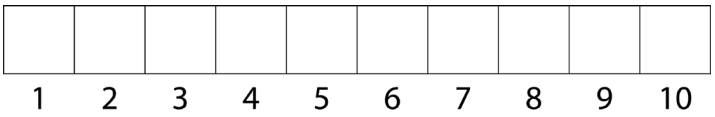
User #

Date:

Installation 1 - No reticle

- Describe your experience of the work:
- Consider the lack of a reticle in installation 1 - how would you rate this experience?

  (10 positive - 1 negative)

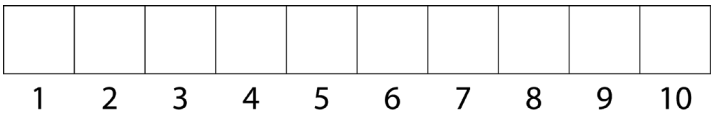


- How did the absence of a reticle impact your experience of the work?
- What led to you ending the experience when you did?

Installation 2 - Reticle

- Describe your experience of the work:
- Consider the reticle in installation 2 - how would you rate this experience?

  (10 positive - 1 negative)



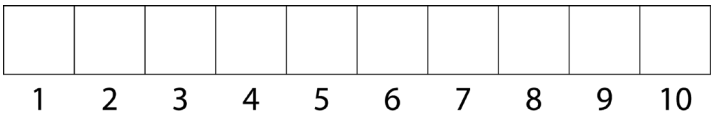
- How did the reticle impact your experience of the work?
- What led to you ending the experience when you did?

Installation 3 - Interactive Cue Mark

- Describe your experience of the work:

- Consider the interactive cue mark in installation 3 - how would you rate this experience?

  (10 positive - 1 negative)



- How did the interactive cue mark impact your experience of the work?

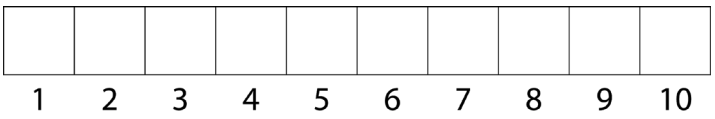
- What led to you ending the experience when you did?

Installation 4 - Interactive Reticle

- Describe your experience of the work:

- Consider the interactive reticle in installation 4 - how would you rate this experience?

  (10 positive - 1 negative)



- How did the interactive reticle impact your experience of the work?

- What led to you ending the experience when you did?

After Installations 1 - 4

- Please number the installations in order of how immersive you found them:

  (1 being the least immersive and 4 being the most immersive)

Interactive Reticle	Interactive Cue Mark	Reticle	No Reticle

- Please number the installations in order of how interactive you found them:

  (1 being the least interactive and 4 being the most interactive)

Interactive Reticle	Interactive Cue Mark	Reticle	No Reticle

- After using these four different VR reticles, which one do you think was the best overall approach to interactive 360 film?

- Additional thoughts - (space to improvise particular points raised by users)

9.8. Memory Stick with Website, Data Visualisation and Videos