The Future of Hybrid Animation: The Construction of Kaleidoscopic Narrative Structures within 360º 3D Animation

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Master of Arts in Digital Animation | Exegesis

The University of the Witwatersrand

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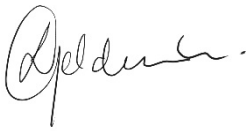
Declaration

I declare that this exegesis and abstract are my own unaided work. Proper accreditation has been given to all outside sources.

This report has not been submitted to another university or institution of higher learning. No part of this report has been published in any journals, as of 16 March 2020.



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Liezl Geldenhuis

479442

On 16 March 2020

This Exegesis is dedicated to my late grandfather

Lucas Hendrik Brits

21 June 1931 - 15 July 2018

In the garden of my life is you
standing out amongst the flowers

(ItzSakuraYT, 2018)

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This research project would not have been possible without the incredible support structure around me. The past three years have been an incredibly difficult, but ultimately rewarding time, and there are some people I would like to express my gratitude to.

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Ray Whitcher

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The Future of Hybrid Animation: The Construction of Kaleidoscopic Narrative Structures within 360º 3D Animation

Abstract

The main aim of this exegesis was to construct a kaleidoscopic narrative structure within a 360º 3D animation. The first objective of this aim was to create a 360º 3D animation. A parallel objective to the first was to consider the use of space and navigation within the animation, and how a constructed narrative of an animation would affect these two aspects of a 360º environment. The secondary objective was that of immersion. As this research revolves around animation, a subsequent secondary aim was that of applying the twelve principles of animation to the 360º 3D animation. The successes in terms of the creative practice animation having a kaleidoscopic narrative was seen in the way that smaller parts make a whole, and that different parts can be viewed separately as their own animations. One did not have to view the full animation to understand certain parts, or even watch the animation in the "correct sequence" to understand what was happening. The failure in creating a kaleidoscopic narrative in the animation, however, came forth in the fact that there was no true agency and that there was no interactivity (physically). For the animation to have truly be kaleidoscopic, one would have to have the ability to move around the space more freely.

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INTRODUCTION

In today's fast-moving Information Age, things such as virtual reality, augmented reality, and 360º videos are becoming more accessible and extremely popular, not only amongst the scientific community, but also in fields such as the humanities. Virtual reality, defined as "an artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment" and "the technology used to create or access a virtual reality" (Merriam-Webster, n.d.), is seemingly becoming not only very accessible, but becoming integrated into our everyday lives, from virtual tours, gaming, entertainment, marketing and advertising, to scientific experiments. "The Information Age is now. Every era from the Stone Age up to The Industrial Revolution has led to the world as we know it. Without the information, knowledge and discoveries of those from the past, we would not be where we are today. The past has shaped our present and will continue to shape our future" (Birkinshaw, n.d.).

Research Question

The research statement of this paper is as follows: "The Future of Hybrid Animation: The Construction of Kaleidoscopic Narrative Structures within 360º 3D Animation". This, however, is not a question that can be answered. This statement rather points to questions that make up what the research is all about. The first question, which is covered in this Introduction and in Chapter 2: *3D Animation in Virtual Reality*, is as follows: What is hybrid animation, and what is the future of hybrid animation? The second, and arguably the most important, question that comes from the research statement is as follows: Can the narrative I have created in the creative practice portion of this research be considered kaleidoscopic, and why? To answer these questions, a detailed look into the history of technology related to animation must first be explored, followed by an in-depth analysis of narrative and narrative structures within 360º 3D animation.

The New Information Age

The Information Age (also known as the Computer Age, Digital Age, or New Media Age), began around the late 1960s when the first video game console was developed by Ralph H. Baer in 1968 (Encyclopaedia Britannica, 2015). This revolutionary console video game system was initially called the Brown Box before being rebranded as the Magnavox Odyssey. This one invention ultimately led up to and inspired the creation of Microsoft's Xbox in 2002, and countless other console gaming systems since and in-between (see Figure 1 and Figure 2 below).

FIGURE 1: THE MAGNAVOX ODYSSEY, THE VERY FIRST VIDEO GAME CONSOLE, PHOTOGRAPHED BY EVAN AMOS, 2019.

FIGURE 2: THE XBOX, A SIXTH-GENERATION GAMING CONSOLE MADE BY MICROSOFT, PHOTOGRAPHED BY EVAN AMOS, 2014.

Since Baer's Odyssey gaming console, other ground-breaking digital technologies have been invented, most notably that of the creation of e-mail (in 1971 by Ray Tomlinson), Apple's first Macintosh personal computer (introduced in 1984), and the World Wide Web (in 1989 by Tim Berners-Lee). "Digital technologies have become the core building blocks of all modern information and communication systems" (Strader, 2011, p. 1). This can be seen in subsequent inventions and creations, such as broadband becoming readily available in homes in 1997, the creation of Google (founded by Larry Page and Sergey Brin) in 1998, the release of Blackberry in 1999, all the way to the launch of Facebook in 2007 (Encyclopaedia Britannica, 2015). Moore's Law states that "processor speeds, or overall processing power for computers will double every two years", however "though Moore's Law had said every two years, this rapid increase in technological production has lessened the period in the minds of technicians and users alike" (Investopedia, n.d.).

"Digital technologies are at the heart of all modern communication and information systems. The technologies have evolved from expensive component devices to current inexpensive systems used by everyone" (Strader, 2011, p. 1). Within the last few years things such as 3D printers have become more accessible and affordable to the general populace. "Progressively, over the past 30 years, new digital technologies have enabled to turn an increasing number of physical products into intangible digital content" (Rayna & Striukova, 2016, p. 214). 3D printers allow people to create three dimensional models of their own designs with a certain plastic filament that the printer heats up to a malleable consistency before it is dispensed through a nozzle that then builds the design from the bottom up. The plastic filament does not retain its heat for very long and so cools quickly as the layers are built up, resulting in a sturdy three-dimensional, tangible model of the initial concept. 3D printers are now also being used to create things such as tools, furniture, machinery parts, and even low-cost housing (see Figure 3 and Figure 4 below).

FIGURE 3: A MOBILE CONSTRUCTION 3D PRINTER IN THE PROCESS OF PRINTING A HOUSE BY APIS COR, 2017.

FIGURE 4: THE COMPLETED 3D PRINTED HOUSE BUILT IN 24 HOURS BY APIS CORE, 2017.

As the technology improved, it became possible to use 3D printers not only to prototype, but also to manufacture tools and moulds used for 'traditional' manufacturing. It then became possible and economical, in some cases, to entirely manufacture end-products with 3D printers. Finally, the advent of Personal 3D Printers has made it possible to directly manufacture at home, thereby bypassing the (physical) distribution stage. (Rayna & Striukova, 2016, p. 214)

And as this technology evolves, creating things such as housing will become cheaper and more efficient, helping to resolve real world problems such as providing homes for those who cannot afford it. This is just one example of how our society is moving away from two-dimensionality and opting instead for things that mimic our three-dimensional existence. The same can be said about previously expensive digital technology breakthroughs involving gaming, such as gaming in virtual reality, as technologies such as the HTC Vive and PlayStation VR are recently becoming the more popular options to play games through, seeing as they are more readily available at a more reasonable cost. Even though these virtual reality systems are extremely popular these days, these systems are not the first to break away from the two-dimensionality of the TV screen. Sony PlayStation's *EyeToy*, released in 2003 for the PlayStation 2, allowed the player to move around in front of the screen and interact with the virtual game being played through movements made by the player in the physical world that were captured through a camera setup linked with the console (see Figure 5 below).

FIGURE 5: PLAYSTATION EYETOY: A DIGITAL CAMERA THAT PROJECTS YOUR IMAGE ON SCREEN AND TRACKS YOUR MOVEMENTS, N.D.

"EyeToy uses a single camera along with special motion tracking software to place an image of your body in a game environment. It tracks your movements in 2-D… allowing you to manipulate objects in a game to score points" (Johnson, n.d.). This allowed the player to feel a greater sense of immersion and

have a sense of agency greater than that of just playing a game using a remote control. Instead, the player became the controller, and therefore the *EyeToy* can be considered to be one of the earlier examples of mixed reality, "an environment where users can interact with both real and virtual objects." (hemanthSK, et al., 2018). Sony PlayStation's *EyeToy* inevitably led to other, more sophisticated technology for mixed reality gaming, such as Microsoft's X-Box Kinect, which came out in 2010.

An example of augmented reality (defined as "the result of using technology to superimpose information - sounds, images and text - on the world we see" (Emspak, 2018), another (perhaps not so recent) digital technology, would be the very popular gaming app *Pokémon Go* (developed and published by Niantic in 2016) (see Figure 6 below).

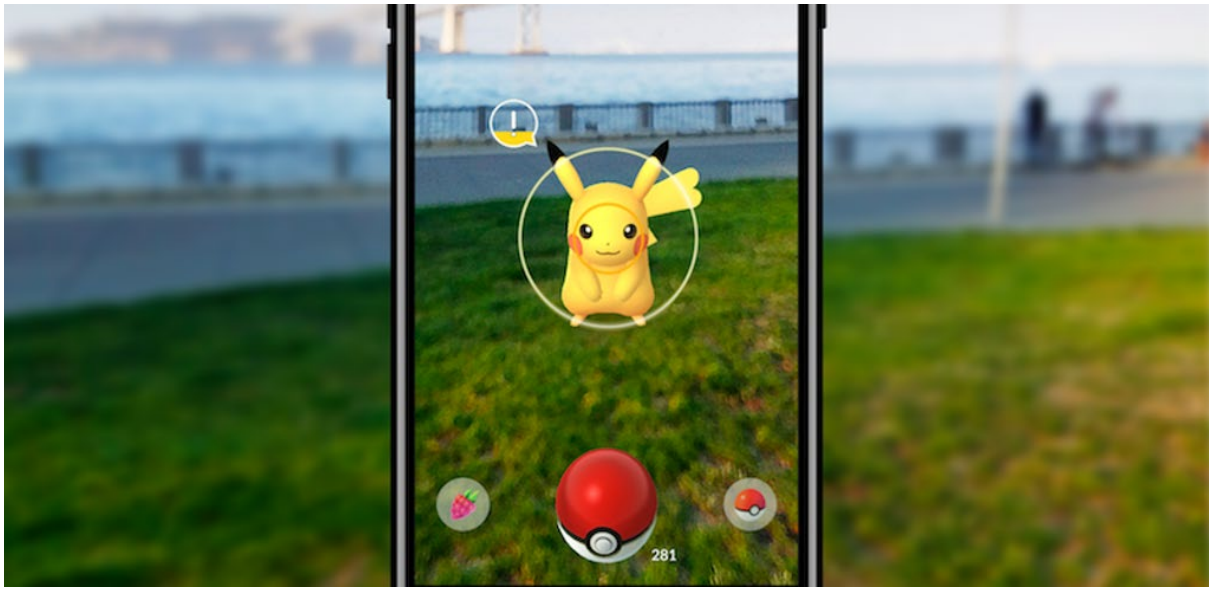

FIGURE 6: USING AUGMENTED REALITY ON A MOBILE PHONE TO PLAY POKÉMON GO, BY NIANTIC, N.D.

In this mobile game, players walk around the real world with their mobile devices searching for virtual creatures called *Pokémon*. The *Pokémon* appear on the screen of the mobile device but appears to be in the real world as the mobile device's camera is being utilised to generate the background of the game. By swiping their finger across their screen, the player throws a virtual *Pokéball* at the *Pokémon* to capture it. In this case the player does not become the controller, but instead the main character in the game, a *Pokémon Trainer*. Through these examples, one can see how society is shifting away from

the previous two-dimensionality of things such as gaming and the time-consuming nature of things such as creating furniture or building houses.

In the last decade even more advances have been made in terms of digital technology, including, but certainly not limited to, the evolution of cloud computing ("the delivery of computing services - servers, storage, databases, networking, software, analytics, intelligence and more - over the Internet ('the cloud') to offer faster innovation, flexible resources and economies of scale" (Microsoft Azure, n.d.)), digital currencies (such as cryptocurrencies like *Bitcoin*), optical head-mounted displays (such as *Google Glass*), immersive virtual reality (VR) (such as *HTC Vive* and *Oculus Rift*), augmented reality (AR) (such as *Pokémon Go*), and artificial intelligence (AI) (such as Amazon's *Alexa* and Microsoft's *Cortana*). The future of digital technologies is evidently open to many possibilities and is not likely to stop growing any time soon.

Virtual Reality and 360° 3D Animation

As technology advances in the fields of gaming and architecture (as in the examples previously mentioned), things such as film and animation must evolve to keep up. Innovations in the field of animation have become an interesting topic for debate and research, with much discussion around the seemingly natural hybrid nature of animation. 3D animation, made popular by Pixar's *Toy Story* (1995, released by Walt Disney Pictures), has subsequently led to incredible innovations in the field of 3D animation. 3D animation is now not only being used as stand-alone entertainment, but also as integral parts in live-action films, games, and simulations. Lately, a new hybrid form of 3D animation has surfaced and is becoming increasingly popular as new high-end virtual reality technologies are becoming readily available for commercial purchase and use – 360º 3D animation. Only a few years ago, if one had to search for 360° videos on YouTube, you would not find anything. But searching for it today there are tens of thousands of videos that are either 360° videos or tutorials on how to create your own. The same can be said about 360° animations on YouTube. Only three years ago there were very few 360° animations, and most were only created by individuals or rarely known small animation

companies. Nowadays there are also hundreds of 360° animations created by individuals, small animation companies, and large corporations alike. And as previously stated, this is because of the fast-paced nature of how technology evolves and becomes more accessible and user friendly. Nowadays one does not need to be rich, specially trained, or part of a company to create things such as 3D printed models or 360° videos, or play virtual reality games – one only needs to access the widely available and mostly affordable technology and follow a few "how to get started" YouTube videos, and you are ready to print a 3D model of your favourite Mario Brothers character, upload a 360° music video of your newly founded garage band, and play *Beat Sabre* on your HTC Vive to your heart's content.

There are many 3D animation programs that can be used to create a 360° 3D animation, such as Blender, Autodesk 3DS Max, and Autodesk Maya. There are, however, some other programs that must be used in conjunction with these 3D animation programs in order to create a 360° video, such as a 360° camera plugin application that is compatible with the 3D animation software, as well as a 360° spatial media metadata injector for compatibility with applications like YouTube. The process for creating a 3D 360° animation is much like creating any 3D animation, wherein one must model or source the 3D models, colour and texture the models, apply rigging (if necessary) and lighting, as well as animate the scene. The major difference between a traditional 3D animation and a 3D 360° animation is that of the camera. The camera, which must be set up to act as a 360° camera, needs to be placed in the middle of the scene (if the camera is to stay stationary for the duration of the animation) so that when the animation is viewed on a platform like YouTube, the viewer is able to look around at the entire scene when they move their head in whichever direction. If the camera must move around the scene, however, the animator must take into account what the viewer will be able to see when they move their head in any direction and ensure that the camera does not go through certain objects that might break the immersion or the illusion of the animation. With this said, the camera becomes one of the biggest challenges when creating a 3D 360° animation. It is therefore that I created

my creative practice animation with only a stationary 360° virtual camera, seeing as working with a moving 360° virtual camera would bring about more questions about 360° animations that could end up requiring a whole other exegesis.

As my main field of study is that of 3D animation, I will specifically be looking at 3D 360° animation within this exegesis. The other reason for focussing this research in the direction of 3D animation is because of not only the ease of creating 3D 360° animations, but also the appeal and tangibility that 3D animation can hold within a virtual reality space. One of the first and most successful recent 3D 360° animation is called *Invasion!* and was released on YouTube by Baobab Studios in 2016 (see Figure 7 below).

FIGURE 7: THE FIRST SCENE FROM BAOBAB'S 360° VIDEO INVASION!, 2016.

In this animation, you, as the viewer, are standing on a frozen lake. You can freely look around you either by using your phone, tablet, VR headset, or just by dragging your mouse across your computer scene. A curious bunny, named Chloe, hops up to you, and a little while later you and Chloe are both visited by aliens, named Mac and Cheez. Throughout the animation you are free to look wherever you please, whether to admire the beautiful winterscape around you or to watch the story unfold. *Invasion!* is a great example of what an appealing and engaging 3D 360° animation can be. One of the aspects

that stands out about a 360° animation such as *Invasion!* is not only the audio cues, but how the characters lead you, the viewer, around the screen by keeping your attention focussed on them. You are free to look around you at any time, yet you are curious to see what happens next. The foreseeable problem is that if you have seen the animation more than once, your attention might not be kept as it was during your first viewing and you might want to look around you to see if anything else was happening while the main scene was playing out. Unfortunately, in *Invasion!* there are no other actions or events to look at while the main scene takes place, and this leads to the thought that these types of animation might only be useful for one or two views, instead of something that can be viewed over and over again, like a film such as *Fight Club* (Fox 2000 Pictures, 1999) where one can go back and back again to see the relationship between Edward Norton's character and Brad Pitt's character, Tyler Durden, and wonder how you never figured out the twist ending that still surprises you every time you think about it.

As previously mentioned, if one searches for 360° animations on YouTube, you are presented with hundreds of different animations to choose from. Most are not as intriguing as *Invasion!*, but some, such as *Special Delivery* by Aardman Animations in 2015 (which will be explored in more detail in Chapter 3), include things such as the multiple viewing aspect that *Invasion!* seems to lack. Even though this is an example of a 2D 360° animation, it is a great example of how to keep a viewer's attention over multiple views of the animation.

As an extension of this exegesis I have created an accompanying animation that will explore and test the theories mentioned later in this report. This animation is a 360° 3D animation and will be explained and explored in detail in Chapter 4.

Risks Vs Rewards

As with any new or evolving piece of technology, certain problems are likely to surface. Within 360º animation, specifically when viewed through a VR headset such as Google Cardboard or the HTC Vive,

problems may arise in the form of health issues, such as seizures, nausea, dizziness, and motion sickness within virtual environments (more commonly referred to as VR- or cybersickness) (Meeri, 2019). When developing films for this medium, one also needs to take other issues into account, such as certain phobias that can be triggered because of the immersive qualities of some virtual environments or using virtual reality headsets. People with claustrophobia (an "abnormal dread of being in closed or narrow spaces" (Merriam-Webster, n.d.)), for instance, might react negatively to a virtual environment that is simulating a small and cramped space. This could lead to a multitude of negative side effects, including seizures or fainting spells. Additional risks to be aware of when participating in a VR experience is that of eye strain and potential hearing loss (if pairing your experience with sound at damaging levels) – "our eyes always focus on a fixed point while trying to converge or diverge toward objects that can appear either nearby or distant. This mismatch is known as the vergence-accommodation conflict, and it's the reason many people experience visual discomfort when using a VR" (Crawly, 2015).

Even though VR might have quite a few negative aspects regarding health issues, there are quite a few benefits as well. For example, exposure in VR for the treatment of phobias has proven mostly successful, especially in terms of arachnophobia (the fear of spiders). Back in 2005 a woman with arachnophobia was exposed to such a treatment with moderate success. The immersive experience was conducted gradually over a period of three months, and, after therapy, "the participant's scores on different cognitive and behavioural measures were significantly reduced. She could even take a live tarantula in her hands and keep her anxiety to a tolerable level" (Bouchard, et al., 2006, p. 20). Even though there are still some flaws with regards to treating phobias in VR, such as adapting the VR experiences to the needs of individual patients, advanced in this area are constantly being made. Other benefits of VR would include things such as letting "users exercise their built-in capacity for understanding stereopsis and motion parallax… a higher level of immersion can lead to greater spatial understanding, which can result in greater effectiveness for many applications such as scientific

visualization, design review, and virtual prototyping" (Bowman & McMahan, 2007, p. 39). Many health studies have also been done in terms of utilising VR for invasive surgery training, mental and physical therapy, and aiding education, amongst many other examples.

To conclude, when moving into a virtual space from the real world for the first time, one should do it gradually and not rush into something too immersive or intense, to see how your body and mind will react to certain events with a virtual reality space. Once you are aware of the potential risks and feel comfortable in whichever virtual space you would like to occupy and be immersed into, one could experience several benefits or just enjoy the experience of being in a virtual world.

Narrative and Digital Storytelling

Looking again at animation, an important aspect that this exegesis will consider is that of narrative. Mieke Bal, in her book *Narratology: Introduction to The Theory of Narrative* defines a narrative text as "a text in which an agent relates ('tells') a story in a particular medium, such as language, imagery, sound, buildings, or a combination thereof" (Bal, 1997, p. 5). The way a story is told, especially in terms of animation, is very important, seeing as different types of animation can tell the same story in different ways. For example, experiencing a story told through 2D animation might be vastly different when the same story is told through 360° 3D animation, as spatial differences might alter how you view the story. This is not only true for the medium of the narrative, but also the kind of narrative used.

In close relation to narrative, storytelling (and specifically digital storytelling for the purposes of this exegesis) will also be discussed and explored in relation to 360° 3D animation. Digital storytelling is "telling stories with digital technologies. Digital stories are narratives built from the stuff of cyberculture" (Alexander, 2011, p. 3), emphasising that the two are intrinsically linked. Both narrative and digital storytelling will be discussed in detail, specifically in relation to 360° 3D animation, in Chapter 3.

The importance narrative and digital storytelling have to this research is because of the new form of animation (360° 3D animation) that is being researched throughout this paper. However, many

types of narratives and digital storytelling techniques could be explored when looking at 360° 3D animation, especially when also looking at aspects such as virtual reality. Therefore, through research explained later in Chapter 3, the focus will be placed on kaleidoscopic narrative structures.

Rationalisation and Conceptualisation

The main aim of this exegesis is to construct a kaleidoscopic narrative structure within a 360º 3D animation. The first objective of this aim is to create a 360º 3D animation in conjunction with the theoretical framework discussed later in this introduction. A parallel objective to the first will be to consider the use of space and navigation within the animation, and how a constructed narrative of an animation will affect these two aspects of a 360º environment. The secondary objective is that of immersion. This, however, is a topic that could yield its own exegesis. For this reason, I aim to discuss immersion only in terms of immersive narratives within a digital environment and in creating an immersive storyline for my animation, by following the existing theories and practices set out in the relevant literature.

As this research revolves around animation, a subsequent secondary aim is that of applying the twelve principles of animation to the 360º 3D animation. Through my research so far, I have not come across any academic papers written on the principles of animation within a 360º animation, so it will therefore be interesting to see whether these principles still apply within a 360º environment. Only four of the twelve animation principles will be considered, namely anticipation, staging, timing, and appeal. The reason for concentrating on these four principles is to keep the scope of the research focussed on 360º animation (as well as within the scope of an MA exegesis), as anticipation, staging, timing, and appeal are more relevant principles when considering a 360º environment. As John Lasseter points out in his 1987 article on the *Principles of Traditional Animation Applied to 3D Computer Animation* “the application of some of these principles mean the same regardless of the medium of animation”, but with principles such as anticipation, staging, timing, and appeal “their application changes due to the difference in medium” (Lasseter, 1987, p. 36). When conducting

research into a new form of animation, such as 3D animation and 360º videos, it is inevitable that one must, at some point, consider the twelve principles of animation. These principles, as explained in detail by Frank Thomas and Ollie Johnston in their book *The Illusion of Life: Disney Animation* in 1995, are the foundation and rules that need to be applied to any animation (excluding things such as abstract or experimental animation). This will be explored further in Chapters 1 and 2. Although this aim, such as with the topic of immersion, can be a whole new exegesis on its own, it will only be prominent in the creation, observation, and documentation of the animation I have created and not have any significant impact on the main aim of constructing a viable narrative structure within a 360º 3D animation.

The research that I am conducting in this exegesis is of a theoretical nature, as I aim to fill the gap in knowledge in the field of 360º 3D animation, as well as furthering and improving on constructing immersive narrative structures within a 360º environment. These knowledge gaps would include looking at narratives in a VR environment, kaleidoscopic narrative structures, and the Principles of Animation, all specifically in relation to a 360º environment. The simple reason for looking at these concepts, specifically around 3D animation within a 360º environment, is that there are no published papers (at the time this research is being conducted for this exegesis) on 360º 3D animation specifically in terms of the principles of animation or narrative structures. There are, however, papers on that of narrative structures within virtual environments, and the principles of animation in 2D and 3D animation. These papers will help to discuss and examine 360º 3D animations specifically in terms of the principles of animation and narrative structures.

As previously mentioned, the research I have conducted for this paper is of a theoretical nature. As Niedderer and Roworth-Stokes explain in their 2007 conference paper entitled *The role and use of creative practice in research and its contributions to knowledge* there are several types of research that have been identified that deal with practice within research, such as practice-led research, practice-based research, investigative practice, research informed practice, research-led practice, and so forth. In this document they identify three categories of research, namely “research

involving practice", "critical inquiry", and "practice by reflection and/or research" (Niedderer & Roworth-Stokes, 2007, p. 10). As the research I aim to conduct falls within the "research involving practice" category, we move on to Niedderer and Roworth-Stokes' "matrix for analysis of the use of practice in research according to the different stages of research in relation to the three different criteria for rigour (objectivity, reliability, validity)" (Niedderer & Roworth-Stokes, 2007, p. 15). I will be using practice within research with regard to research method, or "practice as method and way of investigation to gain new knowledge and understanding", i.e. practice-led research (Niedderer & Roworth-Stokes, 2007, p. 15). As the research I am conducting aims to further the practical aspect of 360º 3D animation and provide new conceptual insights into the existing knowledge on narrative structures within digital environments, this research will be defined and conducted as practice-led research.

This research into kaleidoscopic narrative structures within 360º 3D animation that has been put forth aims to fill the knowledge gap in this specific branch of animation. Whatever the results of this study may yield, there will be potential to build upon the theories and discoveries made through this research. As previously stated, more research into, and an in-depth understanding of this new medium of animation could lead to advances in the technology surrounding it, new discoveries of animation techniques, and even the creation of new and innovative ways of viewing animation. This research will be able to be accessed by anyone who has access to the Wits Online Catalogue, or if published in a journal, those who have access to it will have full access to my MA exegesis.

Lastly, I would like to discuss why this research is important to me as a researcher in the field of digital animation. Since a young age I have been privileged to experience all kinds of forms of technology first hand, through my father, who is an acoustic engineer and sound consultant, and avid collector of movies; and uncle, a self-proclaimed audiophile, who has always been extremely passionate about music and art. I grew up around the latest innovations in audio, visual, and cinematic technologies, and had access to an extensive range of live action and animated films. I have also always felt that innovating and creating new technologies, especially in the field of cinematic

entertainment, would benefit society in many ways, such as the health benefits, job creation, and educational aspects that cinema can provide. My passion for animation and innovations in cinematic technologies stems from this, and has always been a fundamental part of my life, and is the reason behind my choice to study marketing and multimedia design for my undergraduate degree, and digital animation for my Honours and Master's degrees. I also aim to complete my PhD in digital animation – a life goal since an early age – by continuing my research proposed in this paper for my Master's exegesis. This research will therefore benefit my future studies, as well as my aspirations to seek a career as a 3D animator or modelling artist, 3D visual development artist, or animation director.

As with any academic research, ethical considerations must also be discussed and acquired (if necessary). Once the proposal for this research was handed in to the university, I sought ethical clearance. I approached the Human Research Ethics Committee (Non-Medical) at the university with my proposal and was granted a waiver letter stating that I did not require ethical clearance, based on what I had submitted and which was evaluated by the Chairs and Deputy Chairs of the committee. The main reason for this is because I did not need to involve any people in any process of creating this exegesis. This ethical waiver was granted to me on the 16th of March 2020 (please see Appendix 1: Human Research Ethics Committee (Non-Medical) Waiver Letter). Although the university deemed that ethical consideration was unnecessary regarding my research, other factors also had to be considered, namely that of uploading a virtual reality video to a public platform (YouTube). This would include adding warnings if there is any violence, nudity, sexual content, flashing lights, etc. before a video starts. With YouTube, one can add age restrictions on certain videos, and before uploading any video, must state whether the video is made for children or not. Giving warnings to those who have problems with epilepsy because of flashing lights is also crucial. The final uploads of my videos (processes and final videos) did not require any such warnings, and, as part of the upload process to YouTube, it was made clear that these videos were not specifically made for children.

Before moving on to the chapter outline, I would briefly like to call attention to some purposeful omittances and limited research within this exegesis. As this research is for my Master's exegesis, the scope of the research should reflect it, and therefore the topics of immersion and the Principles of Animation will only be briefly explored. Specific focus on digital storytelling and kaleidoscopic narratives will be given for the same reason, and this research will not be focussing on other alternate topics in these areas. Lastly, in terms of the creative practice portion of this exegesis, and as previously mentioned, only a stationary 360° virtual camera has been used.

Chapter Outline

This exegesis consists of four chapters, namely *Chapter 1: The Illusion of Movement and the Development of 3D Animation, Chapter 2: Virtual Reality and 3D Animation, Chapter 3: Narrative and Digital Storytelling,* and *Chapter 4: Creative Practice*, and a *Conclusion*.

Chapter 1: The Illusion of Movement and the Development of 3D Animation is divided into four sections. Section 1, *A Brief History of Animation*, will give a quick overview of the history of animation, specifically focussing on western and 2D animation. Section 2, *The Development of The Principles of Animation*, will focus on the book *The Illusion of Life: Disney Animation* by Frank Thomas and Ollie Johnston. The four main principles that will be explored will be that of anticipation, staging, timing, and appeal. Section 3, *The Principles as Applied to 3D Animation*, will be a quick study of John Lasseter's 1987 article *Principles of Traditional Animation Applied to 3D Computer Animation,* with specific focus given to anticipation, staging, timing, and appeal in relation to 3D computer animation. Section 4, *The Principles Applied to Virtual Reality Animation,* will be a prediction for how the above-mentioned principles might be applied to 360° 3D animation.

Chapter 2: Virtual Reality and 3D Animation is divided up into three sections. Section 1, *Hybrid Animation*, will look at early and recent forms of hybrid animation, as well as what the future might hold for hybrid animation. Section 2, *Virtual Reality*, will look at some definitions for virtual reality, and the

differences between virtual reality and things such as artificial reality, augmented reality, and artificial intelligence. Furthermore, a more in-depth study of the defining features of virtual reality will done. Section 3, *3D Animation in VR*, will be a more in-depth look at the history of 3D animation in virtual reality, followed by some examples of more recent 3D animations in virtual reality.

Chapter 3: Narrative and Digital Storytelling, the longest and most important chapter within this exegesis, is divided up into seven sections, two of which are case studies. Section 1, *Narrative*, will look at defining narrative. Firstly, in general terms then in relation to animation. Section 2, *Digital Storytelling*, looks at the definition of digital storytelling, as well as how digital storytelling works within virtual reality, followed by a brief look at other digital storytelling innovations. Section 4, *Space and Navigation*, will deal with the definitions of space and navigation, followed by a look at space and navigation within virtual reality and 360° 3D animation. Section 5, *"Invasion!" Case Study*, will look at the creation of Baobab Studios, followed by a case study of the animation *Invasion!.* Narrative and digital storytelling, as well as space and navigation, will be the focus areas of the case study. Section 6, *Kaleidoscopic Narrative*, focusses on defining kaleidoscopic narratives, looking specifically at Janet H. Murray's book *Hamlet on the Holodeck*. Kaleidoscopic narratives will also be discussed in terms of gaming (briefly) and film and animation. Section 7, *"Special Delivery" Case Study*, is the final case study in this exegesis. A brief history of Aardman Animations, the creators of *Special Delivery*, will be looked at before looking at kaleidoscopic narrative structures, digital storytelling, and the use of space and navigation within the animation. The final section of this chapter, *The Rube Goldberg Machine*, will introduce the basis for my creative practice. First, the history of the Rube Goldberg Machine will be looked at, followed by real world examples and their limitations versus animated examples and their potential. This section will be concluded with a look at kaleidoscopic narrative structures within a Rube Goldberg Machine.

Chapter 4: Creative Practice is the final chapter before the conclusion of this exegesis. This chapter is divided up into three sections. Section 1, *Introduction to the Animation and Justifications*, will

be the full description of my creative practice animation, and also explores how the animation was created, looking at both hardware and software, followed by the reasoning behind the hardware and software used, as well as the reasoning behind the created scene and scenery elements. Section 3, *The Narrative*, explains the narrative of the creative practice animation, as well as reasonings for why the narrative can be kaleidoscopic in nature. This section will include looking at the successes and failures of the animation in terms of creating a kaleidoscopic narrative structure within a 360° 3D animation. Section 4, *The Application of The Principles of Animation*, will be the brief conclusion to this chapter. The predictions made in Chapter 1, section 5, will be reviewed, before finally looking at how these principles really applied to 360° 3D animation.

Finally, the conclusion to this exegesis. This final part to the exegesis is divided up into three sections. Section 1, *Summary of the Exegesis*, sums up the exegesis and creative practice. Following this will be the final analysis of the research question *The Future of Hybrid Animation: The Construction of Kaleidoscopic Narrative Structures within 360º 3D Animation.* Section 2, *Limitations*, will look at the limitations that this research and creative practice put forth in terms of hybrid animation, kaleidoscopic narrative structures, and 360° 3D animation. Section 3, *Recommendations*, will include what research was lacking in the exegesis and creative practice, and what future research would entail.

CHAPTER 1:

THE ILLUSION OF MOVEMENT AND THE DEVELOPMENT OF 3D ANIMATION

1.1 A Brief History of Animation

This exegesis has its focus in the field of animation, and therefore the history and the principles of animation should be explained and understood before moving on to narrative and storytelling within animation. "The theory of the animated cartoon preceded the invention of the cinema by half a century" (Encyclopaedia Britannica, 1998) with the first notable and commercially successful invention of the phenakistoscope by Joseph Plateau in 1832, "a spinning cardboard disk that created the illusion of movement when viewed in a mirror" (Encyclopaedia Britannica, 1998) (see Figure 8 below).

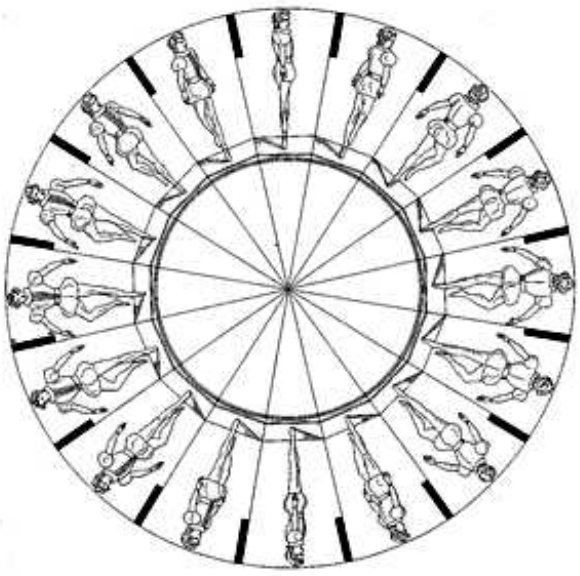

FIGURE 8: JOSEPH PLATEAU'S PHENAKISTOSCOPE, 1832.

This was preceded by William George Horner's zoetrope, "a rotating drum lined by a band of pictures that could be changed" (Kehr, 2005) two years later (see Figure 9 below).

FIGURE 9: WILLIAM GEORGE HORNER'S ZOETROPE, 1834.

Almost 80 years after the invention of the zoetrope, Winsor McCay presented *Little Nemo*, his hand-drawn short film, to the world in 1911, but it was McCay's *Gertie the Dinosaur* in 1914 that transformed the art of animation (see Figure 10 below).

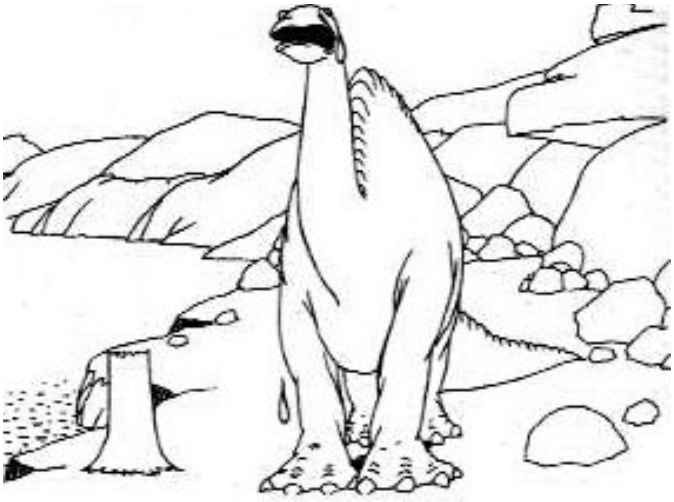

FIGURE 10: A FRAME FROM WINSOR MCCAY'S GERTIE THE DINOSAUR, 1914.

This iconic performance sees McCay standing on stage in front of a screen and proclaims to the audience in the room that "Gertie… will come out of that cave and do everything I tell her to do" (Encyclopaedia Britannica, 1998). Moments later Gertie, a hand drawn dinosaur, shyly exits her cave

and comes to greet the audience, stopping occasionally along the way to eat a rock and a large tree. This was a major turning point in animation and inspired iconic animators and cartoonists, Dave and Max Fleischer (also known as the Fleischer Brothers), to invent the rotoscoping process, in which live action film can be traced over and redrawn as cartoons. “The Fleischers exploited this technique in their pioneering series *Out of the Inkwell* (1919–29) with its lively interaction between human and drawn figures” (Encyclopaedia Britannica, 1998). in 1928 it was Walt Disney’s turn to stun the world with the novelty of synchronised sound, with his animation *Steamboat Willie*, another iconic animation and one of the first animations starring Mickey Mouse (see Figure 11 below).

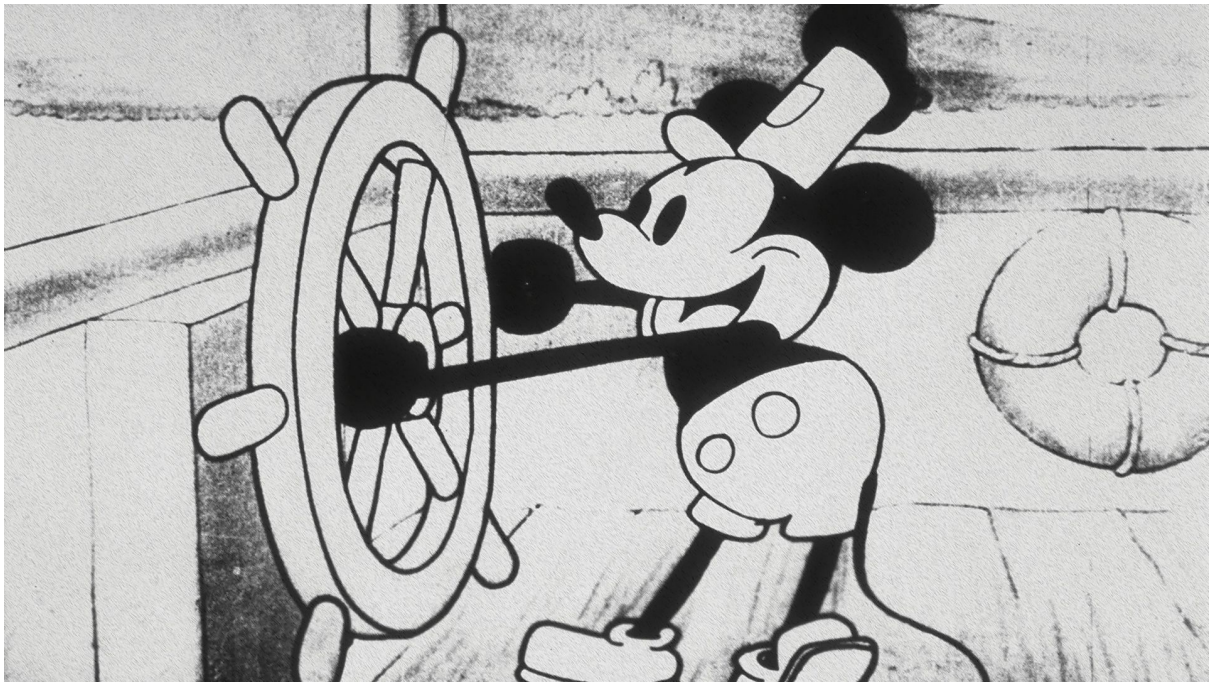

FIGURE 11: SCREENSHOT OF MICKEY MOUSE FROM THE FILM STEAMBOAT WILLIE BY WALT DISNEY, 1928.

Disney later went on to “add carefully synchronized music (*The Skeleton Dance*, 1929), three-strip Technicolor (*Flowers and Trees*, 1932), and the illusion of depth with his multiplane camera (*The Old Mill*, 1937)” (Encyclopaedia Britannica, 1998). In 1933, Warner Bros. Cartoons was founded by three Disney veterans, Rudolph Ising, Hugh Harmon, and Friz Freleng, and gave rise to the iconic and beloved *Looney Tunes* characters such as Bugs Bunny, Daffy Duck, Porky Pig, Tweety and Sylvester,

Road Runner, and Wile E. Coyote, beginning with the introduction of Bugs Bunny in Tex Avery's *A Wild Hare* in 1940 (Encyclopaedia Britannica, 1998).

Years later in 1986, with the integration of computer techniques in animated film, John Lasseter's experimental short *Luxo, Jr.* was released by Pixar Animation Studios (see Figure 12 below).

FIGURE 12: SCREENSHOT OF LUXO JR. AND DAD FROM THE FILM LUXO JR., BY JOHN LASSETER, 1986.

Although this was not the very first iteration of computer animation, it was a breakthrough in computer animation technique that led to the creation of *Toy Story* in 1995 (also by Pixar), the first feature length film to be fully computer animated. Computer animation techniques are now commonly incorporated into traditional animations and live action film, from Disney's *Mulan* (1998) and DreamWorks's *The Road to El Dorado* (2000), to films such as *The Matrix* (1999) and *Star Wars: Episode One* (1999). The next step in the animation evolution was that of computer-generated imagery (or CGI). A notable film that makes use of CGI is that of James Cameron's *Avatar* in 2009, where one marvels at the realism of the planet Pandora's inhabitants, the *Na'vi*, as well as the incredible world building and scenery within the film. A more recent example, partially written and produced by James Cameron, is Robert Rodriguez's 2019 film *Alita: Battle Angel*. *Alita: Battle Angel* is a cyberpunk film based on the manga

series *Gunnm* by Yukito Kishiro and is widely praised for its visual effects. Both *Avatar* and *Alita: Battle Angel* make use of CGI, as well as facial performance capture and the Fusion Camera System (a system developed by James Cameron to shoot films in stereoscopic 3D) (see Figure 13 below).

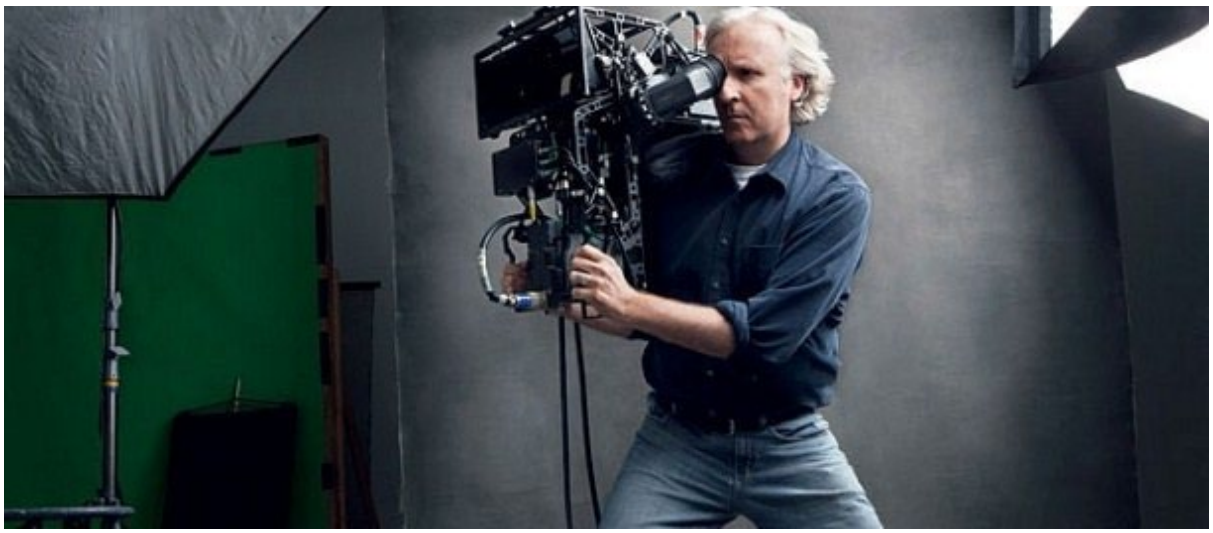

FIGURE 13: DIRECTOR JAMES CAMERON WITH HIS FUSION CAMERA SYSTEM, PHOTOGRAPHED BY ANNIE LEIBOVITZ, 2010.

As can be seen from the brief history above, animation is constantly evolving into new and sometimes unimaginable directions. The history also shows how animation has a tendency towards hybridity (which will be explored in more detail later in this chapter). Seemingly, animation is now also being reborn in a different space, that of virtual reality, and as such, should be explored and expanded upon, as experimentation with new forms of animation have proven to lead to even greater discoveries in the field.

1.2 The Development of The Principles of Animation

As explained in *Narrative and Digital Storytelling* in the introduction to this exegesis and *A Brief History of Animation* (the previous section in this chapter), it is imperative to look at the Principles of Animation when doing research on animation. The Principles of Animation were developed by Walt Disney Studios and introduced in Frank Thomas and Ollie Johnston in their book *The Illusion of Life: Disney*

Animation in 1981 and are still upheld as the basis for starting any animation, whether hand-drawn or computer-generated. Cases where the Principles would not apply would be, for instance, in experimental or abstract animation. Thomas and Johnston explain how the Principles were initially just new jargon heard around the studio and not set rules created by anyone in particular.

> The animators continued to search for better methods of relating drawings to each other and had found a few ways that seemed to produce a predictable result. They could not expect success every time, but these special techniques of drawing a character in motion did offer some security. As each of these processes acquired a name, it was analysed and perfected and talked about, and when new artists joined the staff they were taught these practices as if they were the rules of the trade… they became the fundamental principles of animation. (Thomas & Johnston, 1995, p. 48)

The Principles of Animation are as follows:

1. Squash and Stretch
2. Anticipation
3. Staging
4. Straight Ahead Action and Pose to Pose
5. Follow Through and Overlapping Action
6. Slow In and Slow Out
7. Arcs
8. Secondary Action
9. Timing
10. Exaggeration
11. Solid Drawing
12. Appeal

As previously mentioned, these principles are the cornerstones to creating any animation and each principle plays an important role in creating believable and appealing animations. For the purposes of this exegesis that focusses on 360° 3D animation, not all these principles will be defined in detail. Therefor this section will only focus on the definition and application of these four principles in traditional animation.

Anticipation is defined by Thomas and Johnston as: "… a planned sequence of actions that leads [the audience] clearly from one activity to the next… This is achieved by preceding each major action with a specific move that anticipates for the audience what is about to happen" (Thomas & Johnston, 1995, p. 52) (see Figure 14 below).

FIGURE 14: DONALD DUCK DEMONSTRATING THE PRINCIPLE OF ANTICIPATION, BY WALT DISNEY, 1981.

This principle, as like all the others, can be represented easier in a visual manner, such as in the video series *12 Principles of Animation* by AlanBeckerTutorials on YouTube. Becker started these tutorials on the 12 Principles of Animation back in 2015, starting with the first principle, Squash and Stretch, on the 16th of January 2015, and ends with the last principle, Appeal, on the 7th of April of the same year. On 30 May, in 2017, Becker complied all these videos into a single tutorial video, entitled *12 Principles of Animation*, which is where all the images related to Anticipation, Staging, Timing, and Appeal (Becker, 2017) that follows next have been sourced from. Anticipation, as further explained by Thomas and

Johnston, is the “oldest device of theatre” (Thomas & Johnston, 1995, p. 53) and is one of the most vital principles when creating animations. It is all about aiming the audience’s attention to the action that is about to take place. For instance, if a character is punching another character, the character doing the punching should pull back their arm and hand intended for the punch before throwing their arm forward. Therefore, as the punch lands, the impact is much clearer, and the audience has a sense of action before it has happened. In contrast, if this same character does not “anticipate” the next move, the scene and action will be less impactful.

Staging is defined by Thomas and Johnston as: “the presentation of any idea so that it is completely and unmistakeably clear. An action is staged so that it is understood, a personality so that it is recognisable, an expression so that it can be seen, a mood so that it will affect the audience” (Thomas & Johnston, 1995, p. 54) (see Figure 15 below).

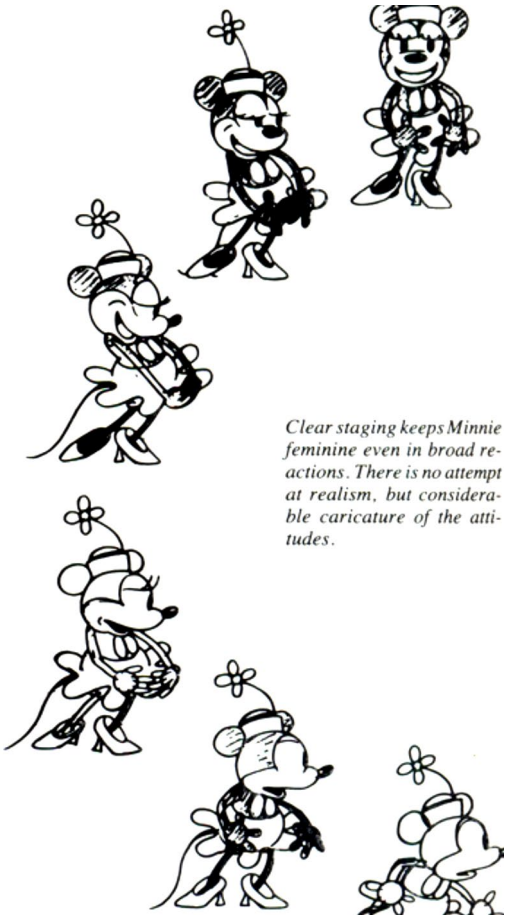

FIGURE 15: MINNIE MOUSE DEMONSTRATING THE PRINCIPLE OF STAGING, BY WALT DISNEY, 1981.

This principle is quite broad in the fact that it covers many areas of animations, especially acting, timing, camera angle and position, and setting, and therefore the animator needs to be in full control of where the audience is looking so that characters and events do not have to compete for stage presence. This principle is also important in terms of camera position, for instance, a wide-angle shot would be better for bigger action scenes, whereas close-up shots would be ideal for showing expressions (Becker, 2017).

Timing is defined by Thomas and Johnston as: "The number of drawings used in any move determines the amount of time that action will take on screen… and the varying speed of those movements determined whether the character was lethargic, excited, nervous, relaxed" (Thomas & Johnston, 1995, p. 65) (see Figure 16 below).

No inbetweens	THE CHARACTER has been hit by a tremendous force. His head is nearly snapped off.
One inbetween	. . . has been hit by a brick, rolling pin, frying pan.
Two inbetweens	. . . has a nervous tic, a muscle spasm, an uncontrollable twitch.
Three inbetweens	. . . is dodging the brick, rolling pin, frying pan.
Four inbetweens	. . . is giving a crisp order, ''Get going!'' ''Move it!''
Five inbetweens	. . . is more friendly, ''Over here.'' ''Come on—hurry!''
Six inbetweens	. . . sees a good-looking girl, or the sports car he has always wanted.
Seven inbetweens	. . . tries to get a better look at something.
Eight inbetweens	. . . searches for the peanut butter on the kitchen shelf.
Nine inbetweens	. . . appraises, considering thoughtfully.
Ten inbetweens	. . . stretches a sore muscle.

FIGURE 16: THE EXPLANATION OF IN-BETWEENS, BY WALT DISNEY, 1981.

For example, when wanting to draw a slow-moving object, one would place more drawings closer together between the two main poses, whereas placing fewer drawings further apart between the two main poses would mean the object is moving much faster. Timing is very important for conveying things such as actions or emotions towards certain things, for example a slower move of the head is required for searching for an object on a shelf, whereas a fast movement of the head can convey being hit in the head by an object (Becker, 2017).

Appeal is defined by Thomas and Johnston as: "… anything that a person likes to see, a quality of charm, pleasing design, simplicity, communication, and magnetism. Your eye is drawn to the figure that has appeal, and, once there, it is held while you appreciate what you are seeing" (Thomas & Johnston, 1995, p. 69) (see Figure 17 below).

FIGURE 17: AN EXAMPLE OF AN APPEALING CHARACTER FROM THE DISNEY FILM LADY AND THE TRAMP (1955), BY JOHN LOUNSBERY, 1981.

One of the trickier principles to work with when creating an animation, seeing as everyone has a different standing for what is appealing to them. Appeal does not also only mean good looking,

however, but can also mean that the character is interesting to look at. This is true not only for the hero of the story, but also the villain and all other characters in between. One effective way of creating appeal would be in creating dynamic designs for characters, specifically when focussing on using a variety of shapes and proportions, and by keeping the designs simple (Becker, 2017).

Even though this exegesis only focusses on the abovementioned principles, all 12 Principles of Animation have some sort of link or overlap with the other principles, such as staging having an overlap and connection with timing. The next section in this chapter will look at how these principles change when used within a different form of animation, namely 3D computer animation, but the link between the principles will still remain evident.

1.3 The Principles as Applied to 3D Animation

As mentioned in the previous section of this chapter, The Principles of Animation are a fundamental part in creating all kinds of animations, including 3D computer animation. The question, however, is whether the principles change in their application to animation other than traditional 2D animation. Pixar's John Lasseter, in 1987, posed this question in his paper entitled *Principles of Traditional Animation Applied to 3D Computer Animation.* Throughout this paper Lasseter first looks at the principles as applied to traditional animation before addressing their meaning and application to 3D computer animation. As Lasseter points out "the application of some of these principles mean the same regardless of the medium of animation", such as anticipation, staging, timing, and appeal. For other principles "their application changes due to the difference in medium" (Lasseter, 1987, p. 36). This is the main reason for only focussing on these four principles, in order to verify if the application of these principles stay the same regardless of the medium (3D 360° animation), and their application to traditional 2D animation (in the previous section of this chapter), 3D computer animation (in this section), and within virtual reality (in the final section in this chapter). It is also important to discuss if and how these principles change and affect different kinds of animation, because "understanding these

principles of traditional animation is essential to producing good computer animation" (Lasseter, 1987, p. 36) as well as all other kinds of animation, such as 360° 3D animation.

Anticipation is "the preparation or anatomic provision for an action" (Lasseter, 1987, p. 38). When applying this principle to 3D computer animation, many of its applications stay the same, seeing as "without anticipation many actions are abrupt, stiff and unnatural" (Lasseter, 1987, p. 38). Anticipation is a device to catch the audience's eye and to direct the audience's attention at the right moment and to the correct part of the screen. Lasseter also explains that anticipation emphasises things such as weight, and that, for example, picking up a heavy object, will be anticipated by the audience when the character struggles to lift it (Lasseter, 1987, p. 38). This aspect of anticipation is important when creating 3D animation, as weights of objects and characters need to be clearly shown. For instance, if a bowling ball rolls off a table, it cannot bounce like a rubber ball when it hits the floor (unless when making use of the "surprise gag", which is when the audience expects one thing to happen, but something entirely different happens (Thomas & Johnston, 1995, p. 53). Therefore, when animating a 3D animation, one needs to be fully aware of the weights that the objects and characters possess, so that the animation will become more believable and actions will be able to be anticipated correctly.

Staging is "presenting an idea so that it is unmistakably clear" (Lasseter, 1987, p. 38). This principle, as well as most other principles, has a relationship with other principles, such as anticipation and timing, as they are all essential to directing the eye. For example, "a well-timed anticipation will be wasted if it is not staged clearly" (Lasseter, 1987, p. 39). The principle of staging in relation to 3D computer animation is as important to that of traditional 2D animation, seeing as "each idea or action must be staged in the strongest and simplest way before going on to the next idea or action" (Lasseter, 1987, p. 39) (see Figure 18 below).

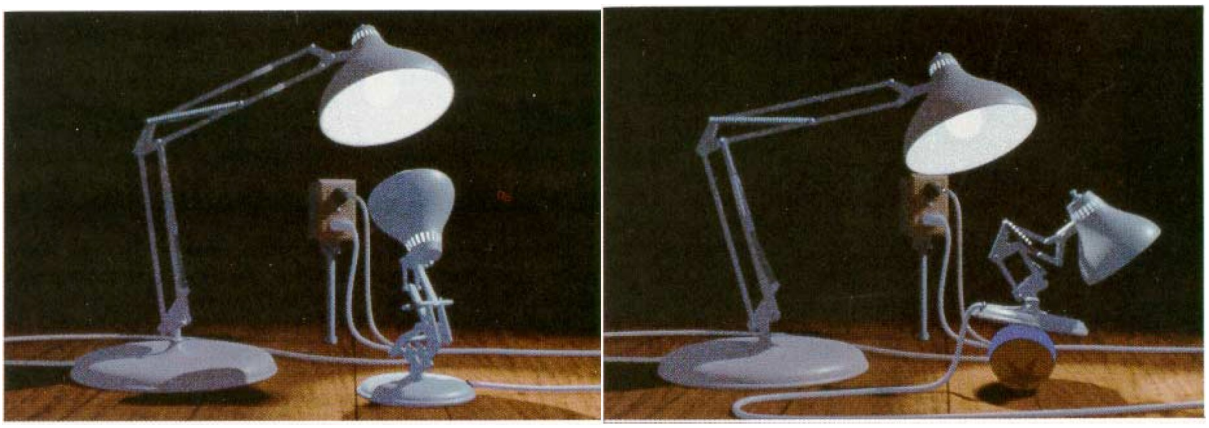

FIGURE 18: SCREENSHOT OF LUXO JR. AND DAD FROM THE FILM LUXO JR, BY JOHN LASSETER, 1986.

If more than one action is happening at a time, the audience might not be watching the right part of the screen at the right time and might end up missing a vital piece of information related to the animation. The main idea of the action should therefore not be upstaged so that it will not be overlooked. When thinking about staging when creating a 3D animation, one should be aware of the other actions taking place around the main scene and ensure that those actions are subtler and secondary to that of the main action.

Timing is "spacing actions to define the weights and size of objects and the personality of characters" (Lasseter, 1987, p. 37). For traditional animation, timing is sometimes referred to as a character or action being animated on "twos" or "threes". This simply means that, if an animation is created at 24 frames per second (FPS), every frame of the animation is drawn on every second or third frame respectively. With 3D animation, the same is meant by animating on "twos" and "threes", but is just done on digital frames, called the "time slider", such as seen in Autodesk Maya. As previously explained when looking at timing for traditional animation, when one wants to represent a slow-moving object, more frames are drawn closer together (between the two main poses), perhaps being animated on ones or twos, whereas when one wants to represent a fast-moving object, less frames are drawn further apart (between the two main poses), perhaps animated on fives or sixes. When looking at timing, considering how many in-betweens there are between two main poses are also important, as it

can convey certain emotions or meanings behind certain actions. This is explained better when reading about timing in *Principles of Traditional Animation Applied to 3D Computer Animation:*

> Just two drawings of a head, the first showing it leaning toward the right shoulder and the second with it over on the left and its chin slightly raised, can be made to communicate a multitude of ideas, depending entirely on the Timing used. Each in-between drawing added between these two "extremes" gives a new meaning to the action.
>
> NO in-betweens - The Character has been hit by a tremendous force. His head is nearly snapped off.
>
> ONE in-between - The Character has been hit by a brick, rolling pin, frying pan.
>
> TWO in-betweens - The Character has a nervous tic, a muscle spasm, an uncontrollable twitch.
>
> THREE in-betweens - The Character is dodging a brick, rolling pin, frying pan.
>
> FOUR in-betweens - The Character is giving a crisp order, "Get going!" "Move it!"
>
> FIVE in-betweens - The Character is more friendly, "Over here." "Come on-hurry!"
>
> SIX in-betweens - The Character sees a good looking girl, or the sports car he has always wanted.
>
> SEVEN in-betweens - The Character tries to get a better look at something.
>
> (Lasseter, 1987, p. 37)

This principle therefore “gives meaning to movement – the speed of an action defines how well the idea behind the action will read to an audience. It reflects the weight and size of an object and can even carry emotional meaning” (Lasseter, 1987, p. 37).

Appeal is “creating a design or an action that the audience enjoys watching” (Lasseter, 1987, p. 42). Again, this principle remains relatively the same when looking at 3D animation. One thing to pay

attention to, however, is that of “twinning”, which is basically creating symmetry in character poses. When animating in 3D, it can be easier just to mirror the poses a character makes across the horizontal centre line of the character, as this is much less time consuming than creating different poses for both arms and legs, for example. However, “if each part of the body varies in some way from its corresponding part, the character will look more natural and more appealing” (Lasseter, 1987, p. 42) (see Figure 19 below).

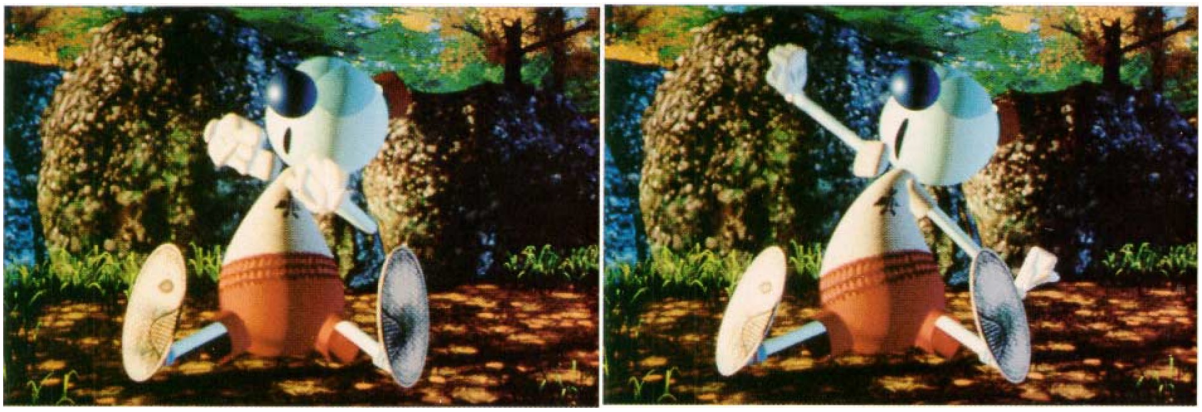

FIGURE 19: SCREENSHOT OF ANDRE FROM THE ADVENTURES OF ANDRE AND WALLY B, BY JOHN LASSETER, 1986.

From the above explanations of the principles as applied to 3D computer animation above, one can see, again, just how intertwined these principles are, whether looking at 2D or 3D animation. Another observation would be that these principles stay relatively the same, whether applied to 2D or 3D animation, but with a slight change on *how* the principles are applied within a 3D space. The principles of anticipation, staging, and timing are most important when creating a 3D animation, as these principles convey weight, size, and emotions of characters and objects. Appeal, whether looking at 2D or 3D animation, will also always be fundamental, as it is the appeal of characters and actions that draws the audience’s attention.

1.4 The Principles Applied to Virtual Reality Animation

As this paper revolves around animation within virtual reality, it is important to note how the animation principles should be applied to, and how they will be affected within, a 360° space. As the previous section in this chapter looked at how the principles are applied to 3D animation, this section will focus on how the Principles of Animation could be applied in virtual reality, and therefore a 360° space. The main reason for discussing these principles in this space, is because of the "interactivity" the viewer will have within the space, namely being able to look around at any given point throughout the animation. The space in a virtual 360° environment is not just a space viewed on a stationary screen where the camera has already been manipulated to show certain scenes (and is unmovable to the viewer), such as with standard 2D or 3D animations being viewed on a screen, but a dynamic space that can be explored and viewed from multiple angles. This "space" adds a whole new dimension to the animation and can be a more immersive experience to the audience, especially when viewed through head-mounted displays, such as *Google Cardboard* or the *Oculus Rift*. The principles discussed in this section will be the same as the previous two sections, namely the principles of anticipation, staging, timing, and appeal.

Anticipation (the preparation for an action) will be important in conveying weight in a 360° 3D animation, just as it shows weight in 2D and 3D animation. Just as in any animation, physics play a part in creating a more realistic and believable feel for the audience when they watch a performance. In a 360° animation, weight will be shown through things such as objects falling off surfaces, characters lifting objects, or even just characters and objects moving through the space. The biggest importance of anticipation in a 360° animation, however, will be that of creating anticipation for a certain action or event that occurs in a specific point in the animation. If the viewer is, for instance, looking at the scene in front of them, while an important action is happening behind them, the scene or action will not have been anticipated, and will most likely be missed by the viewer. This could lead to the animation either not being fully understood or even not being enjoyed, as an important part of the animation has been

missed. The audience's eye will have to be led through the 360° space to the event or action that needs to be viewed next, and in time for it to be viewed. Other distractions within the space will either have to be minimised or even stopped, while certain actions or events happen sequentially in order to lead the viewer to the correct viewpoint. The main action, in turn, will also have to be anticipated before it happens so that the viewer does not miss or misinterpret it.

Staging (presenting a clear and unmistakable idea) will most likely also have a great impact on the anticipation of actions or events, as "a well-timed anticipation will be wasted if it is not staged clearly" (Lasseter, 1987, p. 39). This leads back to the same potential problem as with anticipation – how to lead the viewer around the 360° space for the main action or event to be viewed at the correct time. Within a 360° space, the scene will most likely have to be set up in such a way that the viewer will be able to pick up on queues that will lead them around the space. A space such as this will still have to be interesting and appealing enough to the audience, but not so much that it will distract from the queues given by the animation leading to the next main action or event.

Timing (spacing actions to define weight, size, and personality), as with 2D and 3D animation, will show whether objects or characters are moving fast or slow, or what their emotions are towards, or because of, certain events or actions. This principle, again, will most likely be important in leading the viewer around the 360° space. Objects or characters in motion should lead the viewer's attention to where the next main scene or action is happening. An example could be when, in a 360° space, the audience is viewing a character running around the space. As the character, for instance, skids to an abrupt halt, the viewer should anticipate a reason for this happening and should stop their visual journey around the space to view what will happen next or be presented with a reason for the stop, such as piano falling from the ceiling right in front of the character. If a character is, for example, wandering around the space slowly and looking around them casually, the audience might not have a reason to stop continuing looking around the space if the character slowly stops, as there is no reason to suspect that something important is about to happen. A problem would occur if the viewer has

passed the character (and the main action scene is no longer in frame) and something happens, such as an ACME safe falling from the ceiling and narrowly missing the character. Therefore, the principle of timing seems to have the same kind of importance as that of anticipation and staging.

Appeal (creating a design or action that the audience will enjoy watching) within a 360° space will likely remain the same as when applying it to 2D or 3D animation, such as the appeal of characters and objects. One potential difference with this principle, as predicted with the principle of staging within a 360° space, could be that a too interesting and appealing environment might distract the viewer from moving around the space as visual cues lead the viewer to the main action or event. Seeing as we are dealing with animation and not a 360° scene comprising of stationary objects and no movement, such as a visual representation of an art exhibit for example, the main action or event taking place in the 360° animation at any time should be the most appealing to watch.

As can be seen from the examples given above, the principles of anticipation, staging, timing, and appeal will most likely be affected the most by the 360° space, as this addition of “space” gives the audience more to focus on, as well as giving the animator more space to work with. Specific attention will have to be paid to how the space is utilised within the animation, as well as proper planning done beforehand regarding how to lead the audience’s attention to the main actions or events that take place throughout the animation.

CHAPTER 2:

3D ANIMATION IN VIRTUAL REALITY

2.1 Hybrid Animation

Throughout this exegesis, hybrid animation has been mentioned quite often. Hybrid animation can be difficult to define, as it can encompass a wide range of definitions, seeing as there are so many forms of existing animation techniques – from traditional hand-drawn animation, to 3D animation, stop-motion animation, CGI animation etc. Hybrid animation can be simply merging two forms of animation, such as using 3D animation in traditional 2D animation, or merging traditional animation in live-action films, or the combination of multiple forms of animation in a single animated production or live-action film. "…Most of these methods were born from animation and have animation DNA – mixed with DNA from other media" (Manovich, 2006, p. 43). Animation having a tendency towards hybridity is not a standalone concept, however, seeing as, in today's modern society, people are used to viewing and interacting with a multitude of things on a daily basis that consists of varying materials or technologies – billboards driven past on the way to work are presented traditionally as well as digitally; taking notes in the boardroom depends whether your notepad and pen or tablet and smart pencil are closer at hand, etc. Hybrid animation is also not a recent form of animation, as animation, since its earliest forms, has always involved some other form of entertainment, whether animated or live-action, and continues to evolve.

> If we consider this multiplicity, it is possible to come to a conclusion that 'animation' as a separate medium in fact hardly exists anymore. At the same time, the general principles and techniques of putting objects and images into motion developed in 19th and 20th century animation are used much more frequently now than before computerisation. But they are hardly ever used in isolation – they are usually combined with other techniques drawn from live action cinematography and computer graphics (Manovich, 2006, p. 35).

Early on in animation history Winsor McCay presented *Gerty the Dinosaur* in 1914 to a live audience and "interacted" with the dinosaur as if she was standing right beside him, alive in the real world. This is one of the earliest examples of how animation can be mixed with another form of entertainment, in this case a live performance, to create a whole new form of entertainment. Another example of early hybrid animation would include the *Out of the Inkwell* series by the Fleischer brothers, who created films wherein, for example, Koko the Clown (one of the brothers' most well-known characters) would "interact" with a live human on screen. This was done through rotoscoping (a process explained previously in this chapter) – a lengthy process, but ultimately one of the best examples of early animation/live-action hybrid animation (see Figure 20 below).

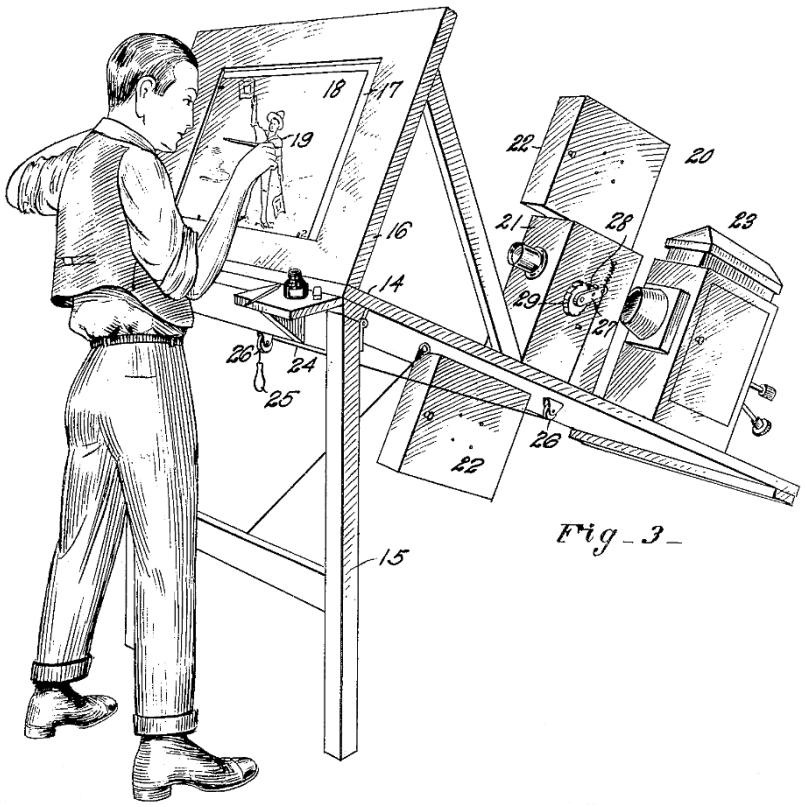

FIGURE 20: PATENT DRAWING FOR MAX FLEISCHER'S ORIGINAL ROTOSCOPE, 1915.

This trend of merging animation with other forms of entertainment has since continued. More notable examples would include that of the stop-motion animation scene in *Star Wars: A New Hope* (1977) where Chewbacca plays a holographic game (or "holochess") called *Dejarik* on the star ship, the

Millennium Falcon, or the multiple instances of the utilisation of CGI and 3D animation in Disney animations in the past, such as with *Mulan* (1998) and *Beauty and the Beast* (1991).

Today hybrid animation can be seen throughout most live action films, where animated scenes or certain events are animated in post-production or overlaid onto greenscreens that were strategically placed during the filming of the movie. "Today the techniques of traditional animation, cinematography, and computer graphics are often used in combination to create new hybrid moving image forms" (Manovich, 2006, p. 25). Examples of these types of scenes or events would include things such as the war scenes in the *Lord of the Rings* trilogy (2001 – 2003) (The Battle for Helm's Deep etc.), or the explosions in various Michael Bay movies. "… The simulated physical media for moving and still image production (cinematography, animation, graphic design, typography), new computer media (3D animation), and new computer techniques (compositing, multiple levels of transparency) started to interact within a single computing environment… The result was the emergence of a new hybrid aesthetic that quickly became the norm" (Manovich, 2006, p. 26). Things such as performance capture, previously referred to as motion capture, is yet another example of hybrid animation, especially considering the use of computers to produce animations and films. Performance capture is "the process of recording the movements of an actor, used for example in film-making and video games" (Cambridge Dictionary, n.d.). The reason why motion capture is now referred to as performance capture is because this technique is not just a way to capture mechanical movements, but a way to capture an actor's portrayal of a certain character as realistically as possible, including gestures and facial expressions, just as in any other live action film. Only with performance capture, the actor is transformed into something other than him/herself, such as Andy Serkis as *Ceasar* in the *War for the Planet of the Apes* (2017) (see Figure 21 below), or Olivia Cooke as *Art3mis* in *Ready Player One* (2018).

FIGURE 21: LEFT, ANDY SERKIS ON THE SET OF TWENTIETH CENTURY FOX'S WAR FOR THE PLANET OF THE APES. RIGHT, ANDY SERKIS STARS AS CAESAR IN WAR FOR THE PLANET OF THE APES, 2017.

Motion capture suggests that only raw mechanical movement is captured. Performance capture is giving credit to the actor. "…Animation has become a set of principles and techniques that animators and filmmakers employ today to create new methods and new visual styles" (Manovich, 2006, p. 43).

"…'Animation in an extended field' is a more productive way to think about animation today, especially if we want our reflections to be relevant for everybody concerned with contemporary visual and media cultures" (Manovich, 2006, p. 43). Animation continues to expand into other areas of technology as well, not just in the area of film, but also in fields such as advertising, and adding dynamic elements to websites. As can be seen from the multiple examples above, animation has an inherent tendency towards hybridity, and it is therefore not unusual to see animation being taken into a virtual reality space.

2.2 Virtual Reality

This exegesis looks at animation within a virtual reality space, so therefore this section will focus on the definition of virtual reality (VR) before looking at animation within VR. This is to better understand the nature and evolution of VR, before jumping to a more recent use of VR - 360° 3D animation.

> … Virtual reality can initially be defined as the intersecting fluctuation of two performances: (1) the performance of a human user connected to various 'immersive' prostheses such as a head-mounted display, a dataglove and/or a force display, and positional sensors; and (2) the performance of an electric computer, whose digital computational system connects to these prostheses generating the visual, auditory, tactile, and haptic (force) displays of the electronically animated, virtual environment (McKenzie, 2005, p. 86).

VR often gets confused with other new virtual technology terms such as augmented reality (AR), mixed reality (MR), and artificial reality, so it is important to note the differences between them. VR is where "…the user is immersed in a synthetic world created by computer graphics. Such a virtual world may be inspired by the real world but it's also free to break the laws of physics that govern real-world interactions" (hemanthSK, et al., 2018). Whereas a possible definition for AR "has three characteristics: it combines real and virtual; it's interactive in real time; and it's registered in 3D. This definition is regardless of the display hardware. It applies equally well to visuals that are optical see-throughs or rendered on monitors. A movie such as *Jurassic Park* (Amblin Entertainment, 1993) is not AR since it's not interactive for viewers" (hemanthSK, et al., 2018). Examples of AR would be things such as the *Pokémon Go* app. "While AR experiences are rooted in the real world, VR experiences are rooted in the virtual world. In VR." (hemanthSK, et al., 2018). MR, on the other hand, "is an environment where users can interact with both real and virtual objects" (hemanthSK, et al., 2018), with notable examples being the PlayStation 2 *EyeToy* and Microsoft's Xbox *Kinect*. Artificial reality "perceives a participant's action in terms of the body's relationship to a graphic world and generates responses that maintain the illusion that his or her actions are taking place within that world" (Sherman & Craig, 2003, p. 16), and is actually

a term that was originally used before the term “virtual reality” was coined. In this exegesis only the term “virtual reality” will be used, as it is the most recent and commonly used term.

The history of virtual reality is quite a long and intricate one, much like the complex history of animation. In their 2003 book *Understanding Virtual Reality: Interface, Application, and Design*, William Sherman and Alan Craig create an in-depth timeline for the evolution of virtual reality. This timeline spans over 85 years, from 1916 to 2001, looking at every instance of importance to the development of virtual reality. Below is a shortened timeline of some of the more notable developments leading to the creation of VR and those that followed its development.

1946 - The first electronic digital computer, the *ENIAC*, developed at the University of Pennsylvania, is delivered to the U.S. Army.

1956 - Inspired by *Cinerarna* (a very wide screen motion picture format) Morton Heilig develops *Sensorama*. *Sensorama* is a multimodal experience display system. A single person would perceive the pre-recorded experience via sights, sound, smell, vibration, and wind.

1961 - Philco engineers Comeau and Bryan create an HMD (head mounted display) for use as a head-movement following remote video camera viewing system.

1963 - MIT Ph.D. student Ivan Sutherland introduces the world to interactive computer graphics with his sketchpad application. Sutherland's seminal work uses a light pen to perform selection and drawing interaction, in addition to keyboard input.

1964 - General Motors Corporation begins research on the *DAC* (design augmented by computer) system, an interactive package for automotive design.

1972 - Developed by Atari, *Pong* brings real time, multiperson interactive graphics to the public (Magnavox beat Atari to the home market with their *Odyssey* system, but Atari's coin-operated version of *Pong* was the game that started it all.)

1976 - Myron Krueger's *Videoplace* prototype is completed. *Videoplace* uses cameras and other input devices to create a virtual world controlled by the untethered motions of the participant.

1976 - Commodore, Radio Shack, and Apple introduce personal computers for off-the-shelf use at home.

1981 - Silicon Graphics, Inc. is founded by Stanford professor and former Sutherland student Jim Clark and six of his students to produce high-speed, cost-effective graphics workstations used in many VR facilities today.

1981 - At MIT, the stereoscopic workspace project team begins work on an early augmented reality display that allows users to explore subject matter such as 3D drawing, architectural visualization, and 3D layout of computer chips. The device uses a half-silvered mirror to superimpose a computer image over the real hands and other body parts of the user.

1989 - On June 6, VPL announces a complete Virtual Reality system, *RB-2* (Reality Built for 2), introducing the phrase virtual reality.

1989 - Also on June 6, Autodesk, Inc. announces their *CyberSpace* project, a 3D world creation program for the PC.

1991 - The SIGGRAPH computer graphics conference introduces a new venue, *Tomorrow's Realities*, that demonstrates significant progress in the application and technology of virtual reality. A public demonstration of the *UNC Pixel Planes 5* graphics hardware and room-size ceiling tracker is held.

1992 - Projection VR is introduced as an alternative to the head-based paradigm at the SIGGRAPH '92 computer graphics conference in Chicago. The main attraction of the Showcase '92 venue at SIGGRAPH is the *CAVE*, developed by the Electronic Visualization

Lab at the University of Illinois at Chicago with a variety of scientific and artistic applications demonstrating the technology.

1997 - Virtual Technologies, Inc. introduces their *CyberGrasp* hand-based force feed-back device. This display allows the VR system to restrict the ability of the wearer to close individual fingers, enhancing the sense of touching and grasping in a virtual world.

1998 - Disney opens the first of their *DisneyQuest* family arcade centres, which feature numerous VR attractions using both HMD and projection-based visual displays

(Sherman & Craig, 2003, pp. 24-36).

From the timeline shown above, one can see how all the technological developments eventually became more and more accessible to the public for personal use. Since 1998, even more research and developments have been made in the field of VR, making VR even more available for public consumption at a reasonable price. The most recent developments in the field would include Japan Display Inc.'s development of a 3 ¼ inch LCD featuring 1001 PPI (pixels per inch) for VR headsets (the highest pixel-dense display that will have been made for VR) to be released in the first quarter of 2019 (see Figure 22 below).

FIGURE 22: COMPARISON OF PIXEL DENSITY BY JAPAN DISPLAY INC., 2018.

Other developments include Google Chrome's *Daydream* headset (a technology that brings AR and VR experiences through the web browser), Google's VR *Tour Creator,* and Facebook's in-development VR camera (Marlon, 2018).

To date, thousands of papers have been written on the development of VR, but what are some of the most important aspects when considering creating or experiencing VR? "The key elements in experiencing virtual reality--or any reality for that matter—are a virtual world, immersion, sensory feedback (responding to user input), and interactivity" (Sherman & Craig, 2003, p. 6).

> A virtual world is the content of a given medium. It may exist solely in the mind of its originator or be broadcast in such a way that it can be shared with others. A virtual world can exist without being displayed in a virtual reality system (i.e., an integrated collection of hardware, software, and content assembled for producing virtual reality experiences) - much like play or film scripts exist independently of specific instances of their performance. (Sherman & Craig, 2003, p. 6)

Virtual worlds can be seen in many examples throughout our everyday lives, for example when playing *God of War* on your PlayStation 4, when exploring a virtual tour of a house you are wanting to buy, exploring Google Earth for hidden secrets, or watching the Gorillaz 2017 360° music video, *Saturnz Barz*, on YouTube.

Immersion is the sensation of being in an environment and can be a purely mental state or accomplished through physical means. Physical immersion is "a defining characteristic of virtual reality", while mental immersion is the "state of being deeply engaged", the "suspension of disbelief", and "involvement" (Sherman & Craig, 2003, p. 9). The term "presence" is also commonly used when referring to immersion, "probably because of prior use of the term telepresence", especially in terms of VR (Sherman & Craig, 2003, p. 9). Immersion therefore does not really mean interactivity, as many might believe, but rather a feeling of engagement with the virtual environment.

Sensory feedback is “an ingredient essential to virtual reality. The VR system provides direct sensory feedback to the participants based on their physical position” (Sherman & Craig, 2003, p. 10). “Unlike more traditional media, VR allows participants to select their vantage point by positioning their body and to affect events in the virtual world” (Sherman & Craig, 2003, p. 10). Sensory feedback therefore does not solely mean haptic feedback (resistance and pressure), but rather an engagement with your other senses as well, sight and hearing in particular.

Interactivity, as explained by Sherman and Craig, “comes more readily with the addition of the computer to the equation” and is “the ability to change one's viewpoint within a world” (Sherman & Craig, 2003, pp. 10-11). Interactivity is quite a physical thing within VR environments, and can either be physically interacting with objects within the virtual space, such as when playing *Beat Sabre* or creating art with *Tilt Brush* by using VR hand-held controls, or just being able to move around the virtual environment, whether moving physically forward or backward within the space, or by just turning your head to view the environment.

From the explanations above, the defining features of VR would be as follows: “it is a medium of communication; it requires physical immersion; it provides synthetic sensory stimulation; it can mentally immerse the user; and it is interactive” (Sherman & Craig, 2003, p. 36).

2.3 3D Animation in VR

The topic of VR has been associated more with things such as gaming than animation, especially because of the immersive and interactive qualities that gaming possesses over that of animation. looking back to the defining features of VR, physical and mental immersion and interactivity are three of the key features, which are easier to create within VR gaming than VR animation. even though this is true, VR animation is becoming a more popular form of animation to explore among animation creators, as things such as digital storytelling evolve with the form. Google Spotlight Stories was one of the first companies to create animations for VR and has made around thirteen 360° animations to date. “Google

Spotlight Stories means storytelling for VR. We are artists and technologists making immersive stories for mobile 360, mobile VR and room-scale VR headsets, and building the innovative tech that makes it possible" (Google ATAP, n.d.). Google Spotlight Stories' first 360° VR animation was *Special Delivery*, a 2D Christmas-inspired short film made by Academy Award-winning studio Aardman Animations (the creators of *Wallace and Gromit* (1989 - present) and *Shaun the Sheep* (2007 - present)) in 2015. This short film paved the way for other great animations to be released by Google Spotlight Stories, such as *Pearl*, a 2D 360° animation, released in May 2016, that won the 2017 Emmy Award for *Outstanding Innovation in Interactive Storytelling*, as well as being nominated at the 2017 Oscar Awards for *Best Animated Short Film*. The next notable VR animation was Baobab Studios' 360° 3D animated short film *Invasion!*. This short film was released on 21 December in 2016 and is yet another Emmy Award winner for VR animation. Baobab Studios has since created three more award-winning VR animations. Just a month after the release of *Invasion!*, Oculus, through their new studio, The Oculus Story Studio, released their first VR "animated experience", *Dear Angelica*, in January of 2017. *Dear Angelica* is a very emotional and moving VR experience, revolving around a "narrative of grief, loss, and love" (oculus.com). "The scenes construct themselves around you as individual strokes are rendered in real-time for an interactive viewing experience unlike anything you've ever seen" (Oculus Story Studio Blog, 2017) (see Fig 23 below).

FIGURE 23: A FRAME FROM THE VR ANIMATED EXPERIENCE DEAR ANGELICA, BY WESLEY ALLSBROOK, 2017.

This animation comprises of a variety of different characters, sets, and props, painted solely by Art Director Wesley Allsbrook, and is “a significant moment for animation, whether based in VR or otherwise, as the field heavily relies on increasingly large teams of concept and production artists” (Oculus Story Studio Blog, 2017). This new leap into VR animations has not stopped with animations studios, however, but is also utilised for music videos, such as Gorillaz’s 2017 music video, *Saturnz Barz*. Their 360° music video has since amassed over sixteen million views on YouTube and was produced by Passion Pictures Animation in collaboration with Google Spotlight Stories.

The above-mentioned VR animations are just a few examples of VR animations that are available today. On YouTube, thousands of VR animations can be watched (with more being uploaded every day), and with many more being made exclusively for things such as the Oculus Rift. Digital storytelling has evolved with the creation of VR animation, which leads us to the next chapter in this exegesis, *Narrative and Digital Storytelling*.

CHAPTER 3:

NARRATIVE AND DIGITAL STORYTELLING

3.1 Narrative

The core aim of this exegesis is to investigate the construction of an immersive narrative structure within a 360º animation and is based upon the hybrid nature of animation (discussed in Chapter 2). Lev Manovich, in his 2007 paper *Image Future*, looks at different forms of animation hybrids (predominantly focussing on motion capture systems) and concludes (regarding incorporating animation with live action films, motion graphics, music videos etc.) that "these methods were born from animation and have animation DNA – mixed with DNA from other media" (Manovich, 2006, p. 43). Manovich's paper is just one example among many others recently written on the potential and realised futures of animation, with most of these papers focussing on or relating to 3D animation. Also, within the subject of "the future", are all the papers and books written about virtual reality and 360º videos. It would seem natural then that these two forms, 3D animation and VR, would come together to form a new medium in animation, especially because of the inherently hybrid nature of animation. A few innovative VR animations have already been created and have been highly praised, such as *Special Delivery*, *Invasion!*, and *Dear Angelica*, as discussed in Chapter 2. Considering this, an element that then seems to be missing from the research on the future of animation is that of the application of the narrative structure of a 3D animation within a VR space. The value that a study regarding this subject could have is potentially significant, as more research into, and an in-depth understanding of this new medium of animation could lead to advances in the technology surrounding it, new discoveries of animation techniques, and even the creation of new and innovative ways of viewing animation.

Narrative naturally plays an essential role when investigating a new medium of storytelling, with this new medium being a 360º digital environment (as experienced through various VR devices). In her 2001 book *Hamlet on The Holodeck: The Future of Narrative in Cyberspace*, Janet H. Murray, an iconic

author in the fields of digital media, expressive narrative forms, and gaming, writes that “we bring our own cognitive, cultural, and psychological templates to every story as we assess the characters and anticipate the way the story is likely to go” (Murray, 2001, p. 110), which she also refers to as “the active creation of belief”. This active creation of belief is an important aspect in narrative as “immersive stories invite our participation by offering us many things to keep track of and by rewarding our attention with a consistency of imagination” (Murray, 2001, p. 111). Murray’s views on the topic of narrative within digital environments is also a significant reason for me, as a research student in the field of animation, for choosing narrative as the core focus of my exegesis. She states that “the creation and refinement of narrative formulas are the necessary preconditions for the creation of any great work of art” (Murray, 2001, p. 278), which, to me, is an aspirational and motivational goal for anyone wanting to create great animations through immersive and compelling stories.

Before moving to a more in-depth study of narratives within VR animation, a definition of narrative first needs to be established. Narratology is the theory of narratives and is an all-encompassing term for the study of narratives. It is the theory of narratives, but also “narrative texts, images, spectacles, events; cultural artefacts that ‘tell a story’. Such a theory helps to understand, analyse, and evaluate narratives” (Bal, 1997, p. 3). One of the most important parts of narratology would be the narrative text:

> A narrative text is a text in which an agent relates (‘tells’) a story in a particular medium, such as language, imagery, sound, buildings, or a combination thereof. A story is a fabula that is presented in a certain manner. A fabula is a series of logically and chronologically related events that are caused or experienced by actors. An event is the transition from one state to another state. Actors are agents that perform actions. To act is defined here as to cause or to experience an event. (Bal, 1997, p. 5)

As can be seen from the quote above, Bal shows us the interconnectedness of things such as story, fabula, event, and actors, and explains that the fabula, "understood as material or content that is worked into a story, has been defined as a series of events. This series is constructed according to certain rules. We call this the logic of events" (Bal, 1997, p. 7). Bal refers to events, actors, time, and location as "elements", which are organised in a certain way in a story, with their purpose being "to make possible a description of the way content material comes across in the story" (Bal, 1997, p. 8). Bal's principles of ordering are broken up into six parts. The results of these processes are "a specific story which is distinct from other stories", and are as follows:

1. The events are arranged in a sequence which can differ from the chronological sequence;
2. The amount of time which is allotted in the story to the various elements of the fabula is determined with respect to the amount of time which these elements take up in the fabula;
3. The actors are provided with distinct traits. In this manner, they are individualised and transformed into characters;
4. The locations where events occur are also given distinct characteristics and are thus transformed into specific places;
5. In addition to the necessary relationships among actors, events, locations, and time, all of which were already describable in the layer of the fabula, other relationships (symbolic, allusive, traditional, etc.) may exist among the various elements;
6. A choice is made from among the various 'points of view' from which the elements can be presented. The resulting focalisation, the relation between 'who perceives' and what is perceived, 'colours' the story with subjectivity. (Bal, 1997, pp. 7-8)

A narrative is therefore not the actual story that is being told, but rather the *way* a story is told – the methods used to create the story – how events are arranged; how much time is given to certain events; how actors or characters are given personalities and certain distinguishable traits; and how choices are made for the progression of the story.

Another important aspect of narrative is that of the plot. The plot, as described by Seymour Benjamin Chatman in his 1978 book *Story and Discourse: Narrative Structure in Fiction and Film*, is an arrangement of incidents that make up a story, wherein the events of a story are "turned into a plot by its discourse, the modus of presentation" (Chatman, 1978, p. 43).

> Its function is to emphasize or de-emphasize certain story-events, to interpret some and to leave others to inference, to show or to tell, to comment or to remain silent, to focus on this or that aspect of an event or character. The author can arrange the incidents in a story in a great many ways. He can treat some in detail and barely mention or even omit others, as Sophocles omits everything that happened to Oedipus before the plague in Thebes. He can observe chronological sequence, he can distort it, he can use messengers or flashbacks, and so forth. Each arrangement produces a different plot, and a great many plots can be made from the same story. (Chatman, 1978, p. 43)

The plot is therefore important in how the story gets told. It is up to the author to decide whether to tell the audience certain truths or omit them for the story to evolve in a certain manner. A plot can be either mostly linear, with a clear and chronological beginning, middle, and end. However, "few films or novels are absolutely linear; most make use of some forms of back story which is revealed gradually as we move through the narrative action" (Jenkins, 2005, p. 9). Other times a plot can jump between different times within the story, for example to only make certain events previously seen understood later in the story for suspense or other specific purposes – "as they move through the film, spectators test and reformulate their mental maps of the narrative action and the story space" (Jenkins, 2005, p. 9). The plot will become an important topic for discussion when looking at VR animation, as the plot needs to be understood in the manner the author creates it for the story to be understood.

Narrative, though not wholly defined by the medium in which it comes forth, can have different properties when considering it within interactive media, for instance in gaming. Henry Jenkins, in his

2004 paper *Game Design as Narrative Architecture*, considers four possible modes for the integration of interactivity and narrative, namely evocative modes, enacted modes, embedded modes, and emergent modes of narrative. The evocative mode describes narratives that reference previous stories in other media, such as a *Star Wars* game (EA's 2018 title *Battlefront 2,* as an example) that refers to the Disney / Lucasarts *Star Wars* film franchise (1977 – present). The enactive mode allows the user to act out specific roles within an existing universe, such as the career of a *Star Wars* fighter pilot. The embedded mode conveys information by means of "spatially distributed narrative-infused encounters", such as represented in the game *Myst* (Cyan Inc., 1993). The emergent mode refers to rule-based and/or simulation games such as *The Sims* (Electronic Arts, 2000 – present), where the narrative appears unstructured, but the players are given tools to create their own narratives (Jenkins, 2005, pp. 3-13). Even though these interactive media properties for narrative are targeted towards gaming, they remain the same when looking at VR animation, as VR animation can defined as interactive media.

3.2 Digital Storytelling

"Stories do not require us to do anything except to pay attention as they are told" (Murray, 2001, p. 140). Digital stories are, simply put, telling stories with digital technologies – "digital stories are narratives built from the stuff of cyberculture" (Alexander, 2011, p. 3). In Bryan Alexander's 2011 book, *The New Digital Storytelling: Creating Narratives with New Media*, Alexander explains digital storytelling with a five-part definition, namely that digital stories:

1. Include a compelling narration of a story;
2. Provide a meaningful context for understanding the story being told;
3. Use images to capture and/or expand upon emotions found in the narrative;
4. Employ music and other sound effects to reinforce ideas; and
5. Invite thoughtful reflection from their audience(s) (Alexander, 2011, p. 27)

As can be seen form this definition, digital storytelling is quite similar in comparison to traditional storytelling, which is simply defined as the act of writing, telling, and or communicating a story (Olenski, 2018). With digital storytelling, the difference is the digital technology that becomes the medium through which the story is told, compared to, for instance, oral storytelling, reading a book, or watching a play. Digital storytelling is not a new concept, however, since "we've been telling stories with digital tools since the first computer networks linked nodes", and therefore "it is vital for practitioners and audiences alike to think historically on this topic, rather than viewing digital storytelling as something utterly new, alien, or freshly emergent" (Alexander, 2011, p. 17).

In Janet H. Murray's 1997 book *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (updated in 2016 and again released under the same title in 2017), Murray revisits "the journey story", which dates back to traditional oral storytelling, but in a digital technology context. She states that "the navigational space of the computer also makes it particularly suitable for journey stories, which are related to mazes but offer additional opportunities for exercising agency", making it "a universal archetype recognizable across all the variations of culture, author, and medium" (Murray, 2001, p. 138). She further explains that navigation is emphasised by the journey story on digital technology platforms, which differs from how navigation is viewed in traditional storytelling mediums, such as oral storytelling or reading a book. However, "one of the consistent pleasures of the journey story in every time and every medium is the unfolding of solutions to seemingly impossible situation" (Murray, 2001, p. 139). Murray, looking at the future of digital narratives, examines the transformative power of the computer even further, by explaining that "one way to understand the new narrative environment is through the metaphor of the kaleidoscope" (Murray, 2001, p. 154). This aspect of digital storytelling is what this exegesis focusses on and will be discussed in depth later in this chapter.

Before going into a more in-depth look at interactive digital storytelling, I would briefly like to look at digital storytelling in animation. As animation, in most forms, is viewed and created digitally (even hand-drawn animation, as it is edited and compiled digitally), storytelling in animation (in most

cases) is therefore digital storytelling. By telling stories through animation, one is presented with a multitude of different genres and topics that can be explored, as the constraints of "the real world" need not apply. One can create fantastical creatures that can fly without wings, create new worlds where the laws of physics do not apply, or embark on a journey through Arnold's digestive system with Miss Frizzle on her *Magic School Bus* (PBS, 1994 - 2017). The realms of possibility are endless and are only limited by our imaginations. In the same sense, storytelling within animation is then also seemingly limitless in terms of the stories we can tell. But what of the digital aspect of digital storytelling within animation? Digital technologies used in the creation of animations can have a significant impact on the animation's story. For example, a story created for a traditional 2D animation might have a completely different impact on the audience if the same story was created with hyper-realistic CGI animation methods. The 2D animation's story could be perceived as less believable if compared to a hyper-realistic render of the exact same story, and elements created with different animation techniques could have a different impact on the audience's perception of it. Different kinds of animations, for example a traditionally hand-drawn 2D animation compared to a CGI animation, will speak to the aesthetic preferences of people, and the decision to watch either (or both) will come down to what a person enjoys watching most – a 2D hand-drawn animation or a more realistic or detailed CGI animation.

> Animated worlds do not need to depict fantasy or science fiction, but when addressing aesthetic experience, they have tended to depict processes of becoming, of transformation, and of the failure of epistemological mastery. That is, not only do they depict the experience of learning the rules of an environment, or of a community (e.g., what to eat and what not to eat); they also depict moments in which characters discover that they have been wrong about what they thought the rules were. (Herhuth, 2017, p. 15)

Animated worlds, as described above, don't have to then necessarily focus on a specific genre, but rather the focus becomes how the world is explored by the characters and the journey that must be taken. The "experience" of the characters within the animated world mentioned in the quote above

becomes the story that the audience follows. Many animations also make use of a multitude of different animation styles, with many 2D animations making use of 3D technology and vice versa. “As animation and cinema technologies conflate in the digital age, storytelling conventions become more significant as guiding elements for audience expectations and evaluations” (Herhuth, 2017, p. 8). Simply put, storytelling is becoming even more important when watching an animation and can have a greater impact on a person’s decision to watch an animation than the actual animation method used. Digital storytelling in animation is therefore just as important as any other type of storytelling, as the story is one of the more important things that the audience will remember.

“There has always been an audience that has hungered for interaction” (DeFranco, 2019). Recently there has been a lot more media coverage and debate around interactive storytelling, especially after the release of *Black Mirror: Bandersnatch* in December 2018, an episode of Netflix’s sci-fi anthology series. *Black Mirror: Bandersnatch* was widely interacted with and opened a much bigger discussion in terms of past interactive storytelling devices, as well as how interactive storytelling can benefit society today. In 2015 Variety released an online article entitled *Interactive Video: A Gamechanger for the Medium or Just Another Gimmick?* wherein Todd Spangler (Variety’s New York Digital Editor) discusses what interactive video is, and what the benefits and drawbacks of interactive video are. Spangler states that “for creative types, the technology opens up a panoply of possibilities, letting users dictate the action in a movie, TV show or musicvideo [sic] with multifaceted, immersive content that rewards repeat visits”, and explains that if a video is made interactive, it could lead to a more emotionally invested audience, which turns them into active participants, and ultimately this “translates into digital dollars” (Spangler, 2015). One cannot have good without the bad, however, and Spangler also points out that “TV is still the biggest and most popular screen in the house for watching video, but a fragmented hodgepodge of interactive TV devices, services and platforms make it a logistical nightmare to run large-scale campaigns” (Spangler, 2015). Although there is some scepticism around whether interactive television will (or can) become mainstream, the tone of the article suggests

that interactive video is on the rise and gaining more popularity by the day, seeing as interactive videos have been around for quite some time.

"To be sure, forms of interactive video have existed for years. More than a decade ago, DVRs let TV viewers easily record, play back, rewind and fast-forward programs… Videogames evolved into sophisticated, interactive narratives with stunningly realistic graphics and live-action sequences, and virtual reality moves the ball forward into a 3D realm" (Spangler, 2015). In terms of past interactive storytelling devices, it is logical to view things such as *Dungeons and Dragons* (a tabletop fantasy role-playing game by TSR Inc., and Wizards of the Coast, 1974 - present) and *Choose Your Own Adventure* books (or *Secret Path Books*, by Bantam Books, 1979 – 1998 (original series)) as the original ways to interact with stories. Both these devices, even though they were not digital, persist to this day. *Dungeons and Dragons* is also becoming more popular again, while *Choose Your Own Adventure* books have evolved into much more than just short stories with a few alternative endings. The mechanics of *Choose Your Own Adventure* books are implemented in a variety of different ways, including gaming in which players can choose where they want to go or which path they want to follow in the story. A great example of a video game developer that implements the *Choose Your Own Adventure* mechanic into their games would be Quantic Dream, a French video game company based in Paris. Some of their most recognised games would include *Fahrenheit* (2005), *Heavy Rain* (2010), *Beyond Two Souls* (2013), and *Detroit: Become Human* (2018) wherein, in all three games, you, as the main character, have to make real-time decisions about events that take place within the game. Once a decision is made it cannot be undone (unless one plays the game again or reloads from a previous save point) and this decision impacts the game going forward. *Choose Your Own Adventure* mechanics do not just come forth in games, however, but also in online videos and, more prominently, in film and television, such as Netflix's *Black Mirror: Bandersnatch*.

Throughout *Black Mirror: Bandersnatch* you, as the viewer, are given options to choose from via your television or mobile device, depending on which platform you are using the Netflix app on (see Figure 24 below).

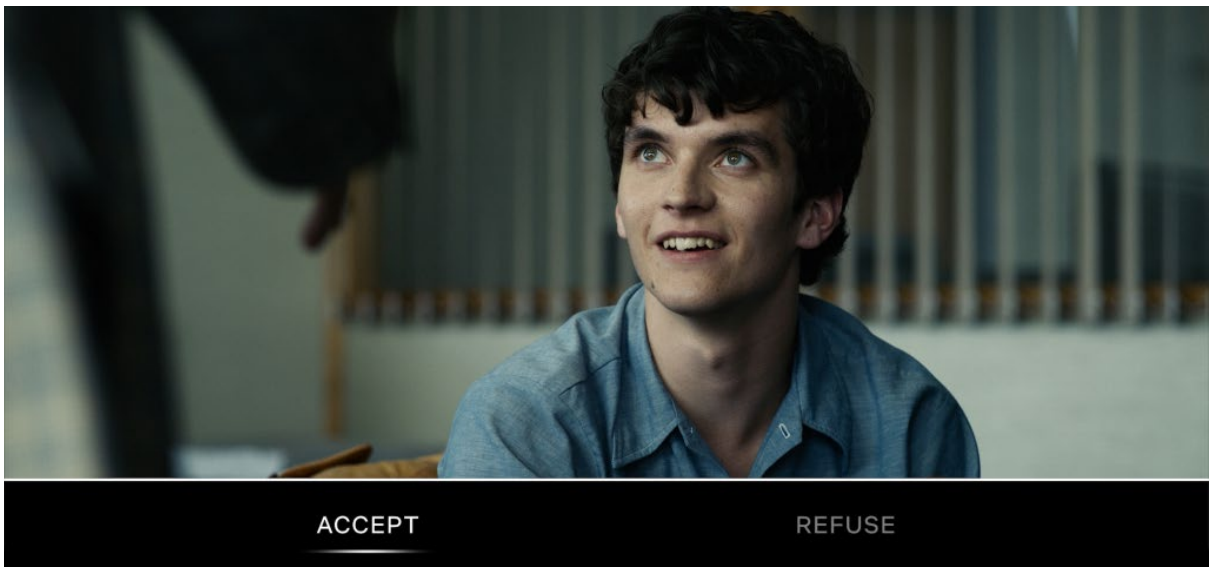

FIGURE 24: A FRAME FROM BLACK MIRROR: BANDERSNATCH, BY NETFLIX, 2018.

These choices change the path of the story, which leads to the film having multiple endings, and wherein the viewer can go back and replay the film and choose different options to see how the story changes. These choices within the episode led to a massive branching narrative that became very difficult to manage and edit, and this ultimately led to Netflix develop an entirely new software "to account for the non-linear nature" of the episode, which they called "Branch Manager" (see Figure 25 below).

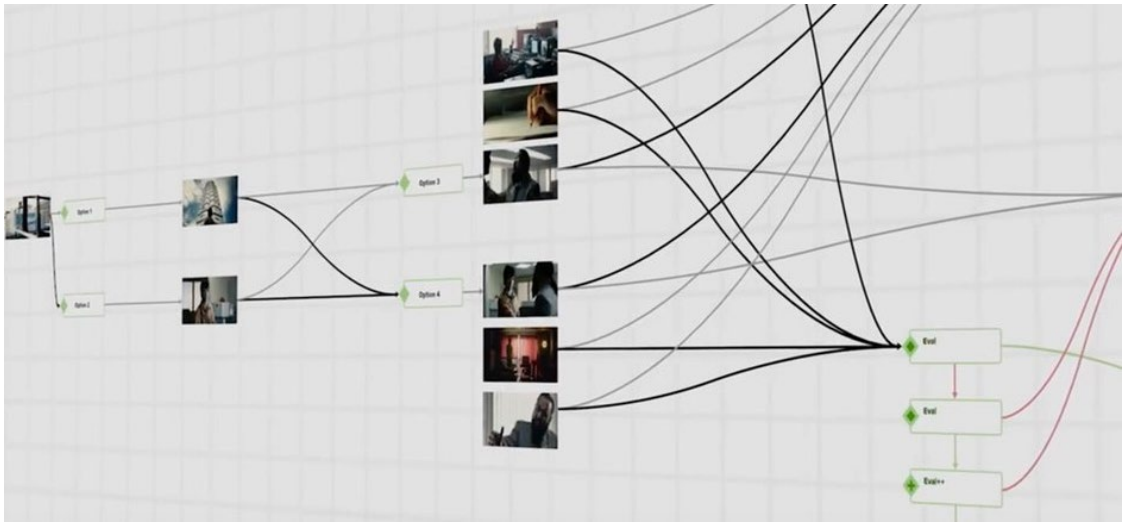

FIGURE 25: AN EXAMPLE OF THE VARIOUS STORYLINE LAYOUTS USED IN BLACK MIRROR: BANDERSNATCH, BY NETFLIX, 2018.

This new technology is now being used in upcoming Netflix series, such as *You vs. Wild with Bear Grylls* (2019), wherein you as the viewer make survival decisions for Grylls. “Interactive Cinema now has a secure history—what the future holds is a branching narrative that has yet to be traversed” (Hales, 2015, p. 47). Besides the new technology that had to be created to ensure the success of *Black Mirror: Bandersnatch*, there were other issues that also had to be resolved, such as creating cohesion among the multitude of endings and consistency with the characters. The biggest challenge, however, was the concern around people believing that this episode would look like a game or think it was just a gimmick. Charlie Brooker, the creator and writer of the Black Mirror series, told the Hollywood Reporter (in an article written by Jackie Strause) that “if people were being drawn into the story and into the character so much that they were then totally shattered that they couldn’t fix his life, that was evidence that they were absorbed and were buying it and were engaged” (Strause, 2019).

> Bandersnatch might signal the beginning of a new film genre. It might even be, if it has any influence, a brand new visual medium. Although it calls itself an “interactive film,” it is really an artwork containing branching story pathways. You could experience just one pathway, or you

> could go through all the pathways, trying to conceive of the entire set of story possibilities as a whole. It is somewhere between a movie and a videogame! (Matthews, 2019)

Another topic for debate around interactive television, specifically concerning things like *Black Mirror: Bandersnatch*, is whether the episode gave you real agency, or whether it was just an illusion of choice. Even though you, as the viewer, can choose different options that lead the story in another direction, these options have still been planned out ahead of time and all result in endings that, even though your decisions led you there, was still scripted and directed by someone else. "The Netflix producers borrowed from game designers, and the classic *Choose Your Own Adventure* book series, to give viewers the illusion of choices when really the alternatives were limited" (Schwartz, 2019).

Digital storytelling, as can be seen from the above, is an evolution of storytelling brought on by the evolution of digital technologies, and as such, there are a multitude of digital technologies that can be used to communicate stories. The most recognisable vehicles for digital storytelling would be things such as gaming and film, as previously mentioned, with things such as mobile devices likely becoming "the ultimate digital storytelling device" (Alexander, 2011, p. 139), seeing as "the amount of content we generate and consume is accelerated by the presence of mobile phones" (Alexander, 2011, p. 142). Other popular digital storytelling technologies would, of course, be that of web stories. The internet is a place where millions of people can consume almost any type of information at a touch of a button, and as such, websites such as YouTube (and other web video services such as Vimeo) "have amassed an astonishingly diverse realm of content" (Alexander, 2011, p. 83). On a platform such as YouTube, the storytelling practices used are also quite varied, ranging from "oral storytelling delivered via webcam to rich multimedia presentations, political appeals to raucous stunts, gameplay captures to archival republications" (Alexander, 2011, p. 84), and are created by amateurs and professionals alike. YouTube has also become a platform where the lines between "audience", "creator", and "uploader" have become blurred, because of the complex mix of the "roles" assigned to these terms on the platform. Storytelling on the YouTube platform is also evolving in terms of hyperlinked branching films,

an homage to early text adventure games. “The functions of early text adventure games—virtual worlds, user generated content, hypertext, multilinear storytelling—have migrated to other platforms, making IF [interactive fiction] a new media ancestor. Interactive fiction has also worked its way into cyberculture deeply enough that it can be repurposed to serve other functions” (Alexander, 2011, p. 105). More and more creator channels on YouTube, such as *Markiplier* (a popular gaming, comedy sketches, and animated parodies channel) and *Draw with Jazza* (now just *Jazza* as of late 2019, another popular channel dedicated to art tutorials, speed paintings, and a wide variety of art related content), are creating their own interactive hyperlinked videos, with Markiplier’s *A Date with Markiplier* (14 February 2017) and Jazza’s *Choose your Own Adventure: Draw The Bandersnatch* (15 January 2019) interactive video series. “An interactive film is no longer the recognisably distinct item that it once was. It has blended into a wider range of phenomena and now requires a much broader definition, which includes personalisation and collaboration. Audiences have the potential to contribute to the filmic content itself, not just how it is finally manipulated” (Hales, 2015, p. 46).

With the popularity of interactive videos on YouTube, YouTube has recently started to develop choose-your-own-adventure-style shows that explore this new storytelling format “that could increase viewers and ad sales for the world’s largest video website” (AdAge, 2019). With the new advancements in technology, this way of telling stories has become more feasible for platform such as YouTube to explore. “YouTube has already experimented with interactive advertisements. But interactive programming — with multiple storylines — requires a far larger investment to ensure choices load without buffering” (AdAge, 2019), and thus YouTube is still in the process of exploring interactive videos, and it might still be a while before we see this as a mainstream storytelling format. Some YouTube creators, such as Markiplier, are already exploring interactive videos further, regardless of YouTube’s ongoing developments in interactive video, with his new interactive video series “A Heist with Markiplier”. In a video interview with Philip DeFranco, a popular YouTube daily news show that covers internet and pop culture news, Markiplier stated that he does not “want people to know how

deep the rabbit hole goes" with *A Heist with Markiplier* (DeFranco, 2019). Furthermore, on the future of interactive content, Markiplier explains how, "in this day and age", interactive videos could become very popular, seeing as there is so much interactivity going on around us daily – "there is so much more interactive media going on, there's so much more consumption on a personal level for stuff like this… There is a craving for this and there is a right way to go about this and there is definitely a market to be had for it. And I think it will kind of be a little bit in the gimmicky area, but that's fun" (DeFranco, 2019).

As previously mentioned, places like YouTube and things such as games are not the only ways that interactive content is being created. Eko is a company that creates interactive videos and interactive music videos; an "interactive storytelling platform that lets you control the story" (eko, n.d.). Much like Markiplier and Jazza's interactive videos, and *Black Mirror: Bandersnatch*, Eko's interactive video series *That Moment When* gives the viewer options to choose from at certain points in the video that lead the story in a new direction. The difference between *That Moment When* and an interactive video such as *Black Mirror: Bandersnatch*, is that the viewer needs to pay more attention to the visual cues within the video. For example, in episode 3, #*TMW You Meet Your Potential Roommate*, visual clues are shown on screen and this leads you to make the more "correct" choice when choosing options in order to complete the episode with the most pleasant ending (see Figure 26 below).

FIGURE 26: A SCREENSHOT FROM EKO'S #TMW YOU MEET YOUR POTENTIAL ROOMMATE VIDEO WHERE VISUAL CUES ARE GIVEN IN ORDER TO CHOOSE A MORE "CORRECT" ANSWER, N.D.

This is just one of a few different mechanics the series uses to engage the audience more, in comparison to other interactive videos, such as *Black Mirror: Bandersnatch*. As with all interactive video creators mentioned so far, Eko also had some issues to overcome. Chief Creative Officer for Eko, Alon Benari, told The Philip Defranco Show that the biggest challenge is getting writers and directors used to telling stories in radically different ways. "Many of the film makers and the storytellers that we know, including myself… have grown up in linear, traditional video… and all you do there is maintain the control and hold the viewer by the hand. So, telling a story where you give the viewer some level of agency is something that is very different than what many film makers and storytellers are used to" (DeFranco, 2019). Looking at Eko's interactive music videos, their first creations in terms of interactive video, one can see the benefits of interactive videos when looking at some of the statistics around audience retention rates. In these music videos, one can "choose" different channels (like one would do when watching television at home) and on every channel one specific song is playing, seemingly sung by the people on the screen. The fun part about this is that all the "channels" are from real television shows and the syncing of the music matches almost perfectly with how the people are speaking on

screen. Eko audience retention rates for their music videos are two and a half to almost three times higher than that of other music videos on other platforms such as YouTube, where statistics indicate that videos are not even watched to completion the first time (DeFranco, 2019) (see Figure 27 and Figure 28 below, and follow the link to watch and interact with the music video).

FIGURE 27: A SCREENSHOT FROM EKO'S BOB DYLAN – LIKE A ROLLING STONE INTERACTIVE MUSIC VIDEO, N.D.

FIGURE 28: A SCREENSHOT FROM EKO'S BOB DYLAN – LIKE A ROLLING STONE INTERACTIVE MUSIC VIDEO, N.D.

Dan Garraway, the co-founder of Wirewax (a video technology company that provides interactive tools for brands such as Nike, Microsoft, and Disney), on the effectiveness of interactive advertising (a 2017 study conducted by IPG Media Lab), summarised that "there's a 32% lift on the memorability – the recall. So, people were more likely to remember the content because they had physically touched something in the video... There's a lot of cognitive research around this now to do with touching a physical moment relating to a more impressionable thought" (DeFranco, 2019) interactivity will bridge the gap between advertising and content.

VR can also be a great vehicle for creating interactive digital content, as "people can feel the same kind of attachment to virtual worlds as they do to the real world" (Ryan, 2015, p. 133). Interaction within a VR setting can therefore be more appealing to people, as they might feel a familiarity with the digital environment as it can closely resemble the real world. This can also be explained as "emotional space", which will be discussed in more depth later in this chapter. With the popularisation of VR (because of things such as VR gaming in particular), more and more innovations are being made with this technology, especially that of telling stories within VR – not just for VR gaming, but also as a standalone art form. Throughout this chapter, a lot of focus has been given to interactive video and media in terms of digital storytelling. Although VR is another platform for digital storytelling, how would 360° videos (or animations) work as interactive videos? Or rather, would they work at all? In 2016, Voices of VR, a podcast that features "the pioneering artists, storytellers, and technologists driving the resurgence of virtual and augmented reality", interviewed the founders of Baobab Studios, Eric Darnell and Maureen Fan, about storytelling in VR (the transcripts of the interview hosted by Kent Bye is available on Voices of VR's website, voicesofvr.com, and is *titled Episode #209 – Storytelling in VR and The Tradeoffs [sic] of Empathy & Interactivity*). Baobab Studios is well known for their 360° 3D animation series *Invasion!*, and is one of the leading studios in 360° 3D animation (Bye, 2016). In the interview, Darnell is cautious about how interactivity will impact how much the viewer empathises with the characters, stating that "if you have to make a choice in an experience as to how to console a

character who's in pain, then does it turn into more of a video game experience where your intention is to achieve a specific goal? Can you still completely witness the character without your ego getting worried about whether or not you're taking the right course of action?" (Bye, 2016). Darnell suspects that "a more passive experience of watching someone's story unfold is more likely to cultivate empathy than if you're somehow dynamically interactive with that character within their story" (Bye, 2016), but believes that more research should still be conducted around immersive storyboards or new ways to "choreograph the action within a 360-degree landscape" (Bye, 2016). On the potential future of storytelling in VR, Darnell is positive of its success:

> It is going to be the dominate artform of the 21st century… the ultimate potential of storytelling in VR is that we'll be able to live out the stories that we could previously only read, listen to or watch. Technology is progressing a lot faster than many of us realize, and he (Darnell) does believe that we'll at some point have our own holodeck-like technologies where we won't be able to really distinguish between reality and virtual reality (Bye, 2016).

3.3 Space and Navigation

As this research focusses on narrative within a digital 360º environment, I will firstly be considering Murray's *Four Essential Properties of Digital Environments*, namely that digital environments are procedural, participatory, spatial, and encyclopaedic. "The first two properties make up most of what we mean by the vaguely used word interactive; the remaining two properties help to make digital creations seem as explorable and extensive as the actual world, making up much of what we mean when we say that cyberspace is immersive" (Murray, 2001, p. 71). The fourth property of digital environments being encyclopaedic will only be briefly discussed under the Kaleidoscopic Narrative section of this chapter, as this points to a far larger scale narrative project as "it offers writers the opportunity to tell stories from multiple vantage points and to offer intersecting stories that form a dense and wide-spreading web" (p. 84). The first and second properties, namely that digital environments are procedural and participatory, will not be discussed, as these properties generally discussed as one property, and will also change the

scope of this exegesis. However, as the proposed research considers space and navigation within a 360º environment and the impact that narrative has on these elements of a digital environment, the third property, that digital environments are spatial, will be the most appropriate property to apply to my research and creative practice. “The new digital environments are characterized by their power to represent navigable space. Linear media such as books and films can portray space, either by verbal description or image, but only digital environments can present space that we can move through” (Murray, 2001, p. 79). Here Murray is not only referring to moving through space as a physical activity, such as a player in a video game walking through a dungeon, but as an experience that is only possible within a digital environment created by the computer, and “the computer’s spatial quality is created by the interactive process of navigation” (Murray, 2001, p. 80). Here, again, interactive does not necessarily mean physical interaction with a digital environment, but rather that navigation, or moving through a space, is inherently an interactive experience or an experience of agency.

> The experience of agency by the interactor is the key design value for all digital artefacts. It requires two kinds of scripting—coding the actions of the digital system, and cueing the actions of the interactor. When these two scripts are well matched, the interactor feels the satisfaction of agency. When the action is motivated by something in the story, by an anticipation of some story event or action or revelation, and when the response rewards that anticipation in some appropriate way, then the interactor experiences dramatic agency. Dramatic agency should be the goal of design for interactive narrative in any form. (Murray, 2001, p. 153)

Agency, especially in terms of gaming, points to a few things. Firstly, a person playing a character in a game has control over their own character’s decisions and actions. For example, when playing an RPG (Role Playing Game) on the computer, the player controlling the onscreen character will feel agency when choosing whether to follow the right or left path within the game. Secondly, the decisions and actions that a player has control over can have consequences within the game itself, for example, if you, as the player, made your character follow the right path, something might happen that

will disallow the character from turning back and following the left path. Lastly, you as the player should be able to anticipate the consequences mentioned above – perhaps you know you should choose the left path first, because of a sign or earlier conversation with an NPC (a non-player character). Agency, more specifically in terms of virtual space, is a bit different from a game character's agency. Within a virtual space, agency could mean feeling in control of the space around you – perhaps being able to move in any direction you choose or moving the camera around you to see in different directions.

> Spatial navigation is a characteristic of digital environments and is also a form of agency.
>
> The ability to move through virtual landscapes can be pleasurable in itself, independent of the content of the spaces… Construing space and moving through it in an exploratory way (when done for its own sake and not in order to find the dentist's office or the right airport gate) is a satisfying activity regardless of whether the space is real or virtual. (Murray, 2001, p. 129)

This form of agency is therefore important when considering being within a virtual environment. One does not necessarily have to have a goal within the environment, but one should still be able to explore that which is around you. Spatial navigation points towards exploration, discovery, and ultimately (hopefully), satisfaction. This can be true if one is only standing within a virtual space (using VR for example) and visually navigating the space around you, or whether you are physically moving through the virtual space (in VR or within a non-VR computer game) and have to navigate around obstacles, make decisions about which paths to take, etc.

Spatial navigation and orienteering within electronic environments also have links with narrative. "Electronic environments offer the pleasure of orienteering in two very different configurations, each of which carries its own narrative power: the solvable maze and the tangled rhizome." (Murray, 2001, p. 129). Basically, the narrative of the solvable maze and the narrative of the "tangled rhizome", or unsolvable maze. The narrative of the solvable maze, or "adventure maze" as Murray sometimes refers to it, is the story of the character working their way through a maze-like

situation (either physical or metaphorical) and finding treasure or some kind of ultimate reward at the centre of the maze. Whether it is a simple or complex maze, "it is particularly suited to the digital environment because the story is tied to the navigation of space" (Murray, 2001, p. 130). The narrative of the unsolvable maze, or "tangled rhizome", holds promise as an expressive structure, meaning that one can feel a sense of loss or anxiety from not finding a way out, or the realisation that there are no exits, but also feeling a sense of thrill or excitement at being enticed into different directions or where the story is more reassuring than finding an exit – "the fact that the plot will not resolve means that no irreparable loss will be suffered" (Murray, 2001, p. 131).

Navigating or interacting within a digital environment, such as a 360° VR space for example, also leads to another kind of space – emotional space. Emotional space is best defined by Marie-Laure Ryan (in her section of the book *Interactive Digital Narrative: History, Theory and Practice*, entitled *Emotional and Strategic Conceptions of Space in Digital Narratives*) as the following:

> The term of emotional space speaks for itself: it is an experience of space associated with affective reactions. These reactions can be either positive, such as a sense of belonging, of security, of being home, or negative, such as repulsion, fear, or a sense of being lost. Emotional space is best represented by pictures taken from a horizontal perspective—an elevation view— because this perspective captures the perception of the human body, and therefore comes closest to the lived, embodied experience that produces emotions. In emotional space we relate to space—or to certain places within space—not in a utilitarian way, not to get somewhere, but rather for the sake of what it evokes in the imagination. Emotional space has a special affinity with stories and with memories—it is because it is linked to stories that it matters to us, either positively or negatively. (Ryan, 2015, p. 123)

This "emotional space" does therefore not only come from hyper-realistic VR environments, but rather the way in which an environment is set up – the horizontal perspective in particular – and a person's

emotional or sentimental attachment to the environment. Therefore, an animation in a VR setting, for example, can have the same "emotional space" effect on a person as a live-action film in the same VR space. An interactive digital narrative within a VR space will then also be affected by this "emotional space", as everyone has different experiences and memories when it comes to certain events or objects or environments.

As can be seen from the examples and definitions above, space and navigation are inherently linked. Digital environments, whether you are playing a 2D computer game with your mouse and keyboard or exploring a digital environment within a virtual reality world with an Oculus Rift, are spatial, spaces we can *move through*. Moving through these digital spaces can therefore be physical, metaphorical, or even emotional.

3.4 "Invasion" Case Study

Baobab Studios is a VR animation studio founded in 2015 by Eric Darnell. Since the company's founding, they have made some outstanding VR animations, including the very popular *Invasion!* VR animation, which can be watched for free on YouTube on the studios channel. Baobab Studios puts a lot of focus on storytelling and narrative, with interactivity coming second.

> For Eric and Baobab Studios, they're going to be focusing primarily on telling stories that can wash over you and really sink in. They're not as interested in creating highly interactive stories where your actions change the outcome of their story, but they're looking into how to create a sense of presence by embodying a character in a scene where you may have a little bit of interaction and small ways of flavoring your personal experience. (Bye, 2016)

This sense of presence in a virtual reality space can also give the person viewing the animation (especially through VR equipment) agency. One can still "interact" with the animation purely on a visual level, rather than moving through the space at your own will (for example, using controls to move your character around the space).

Throughout the entire animation you are only an observer. You are not invisible, however, as the main character, a bunny names Chloe, curiously comes closer to you (see Figure 29 below).

FIGURE 29: A SCREENSHOT OF CHLOE FROM BAOBAB STUDIO'S 360° VIDEO INVASION!, 2016.

This makes you feel as if you are part of the scene, like an actor in a stage play without any lines or direction, but still with purpose. Darnell, in the Voices of VR Podcast in 2016 said that "film is a medium where someone can share the story of an experience, whereas virtual reality is a medium where you can give someone an experience which they can generate their own stories from" (Bye, 2016).

With this animation one can see how a VR animation does not necessarily have to be interactive in the sense of moving one's character through the scene, or being able to interact with other characters or objects, but it can be interactive in a more visual exploratory way, and feeling that you are part of the story. And as Darnell said, the experience you have within a virtual reality space leads you to create your own story, which might be different from everyone else's stories who have watched the same animation – everyone takes away something different and has a different experience.

3.5 Kaleidoscopic Narrative

Kaleidoscopic narrative, as Murray aptly describes it, most compellingly creates "the ability to present simultaneous actions in multiple ways" (Murray, 2001, p. 157), among various other possibilities for narrative in digital environments. The importance of this theory is that humans are inherently inquisitive

and do not only focus on one aspect of life at a time. Today's modern society is filled with simultaneous complexities, such as being bombarded with thousands of advertisements on various platforms within a single day, multitasking at work or college while constantly being engaged with your computer, tablet, and phone, and balancing work, exercise, a healthy diet, and one's social life, and still having time to complete one more quest on *The Legend of Zelda* (Nintendo, 1986) before turning in for the night.

> The kaleidoscopic power of the computer allows us to tell stories that more truly reflect our turn-of-the-century sensibility. We no longer believe in a single reality, a single integrating view of the world, or even the reliability of a single angle of perception. Yet we retain the core human desire to fix reality on one canvas, to express all of what we see in an integrated and shapely manner. The solution is the kaleidoscopic canvas that can capture the world as it looks from many perspectives—complex and perhaps ultimately unknowable but still coherent (Murray, 2001, pp. 161-162).

Here, the computer that Murray is referring to are the digital devices that we all rely on daily. Even though this seemingly complex way of living is exhausting to think about, it comes naturally and easily as we are so used to this fast-paced way of living. Therefore, by creating a narrative structure within a digital environment that aligns more with the world we live in, a new form of digital storytelling, such as a 360º 3D animation, has the potential to be more immersive, and be more familiar.

Kaleidoscopic narratives is one branch under the umbrella term "interactive digital narratives", according to Murray (written in a 2018 article for Georgia Tech, Atlanta), where interactive digital narratives are non-linear, or rather, multisequential ("'multisequential' is a substitute for 'non-linear' that emphases the coherence of all of the paths through a story with variable parts" (Murray, 2018, p. 13)).

> "By moving storytelling from the unisequential [rather than non-linear] genres of print-based novels and conventional films and TV shows to the new digital medium capable of multiform and multisequential genres like procedural scenarios and branching narratives, we open up the

> possibility of expanding our understanding of the world and our cognitive capacity." (Murray, 2018, p. 12).

Murray, visualising accessing previously inaccessible environments in the twenty-first century through virtual reality, compares it to how "ancient Greek city dwellers enjoyed reciting verses about frolicking shepherds" (Murray, 2001, p. 263), and explains that we, as twenty-first-century citizens, will enjoy transforming our screens into "elfin groves, Victorian parks, or galactic fireworks displays" (Murray, 2001, p. 263). Kaleidoscopic narratives can also help with the replay value of games or films or animations, as variation and complexity within the story can provoke meaningful and thought-provoking feelings that would encourage you to play or watch a certain game or video again (Murray, 2018, p. 11).

Looking at narrative environments in a more modern way, that is in this multifaceted way of living previously described, Murray describes it through the metaphor of the kaleidoscope: "the communications media of the twentieth century are mosaic rather than linear in structure, as compared to the printed book (Murray, 2001, p. 155). This kaleidoscopic metaphor turns into a structure for narrative and can "present simultaneous actions in multiple ways", as opposed to consecutive (Murray, 2001, p. 157). The kaleidoscopic narrative is important as a new way of storytelling, as we are constantly creating new technologies for entertainment and so forth, "… we need the process of continuously expanding our means of storytelling, because it allows us to expand our ability to know who we are and to collectively reimagine who we might become" (Murray, 2001, p. 290).

Murray also refers to multistage narratives, which are closely related to kaleidoscopic narratives. Multistage narratives need to be structured in such a way that the reader (or viewer of an animation, for example) becomes curious and is therefore enticed to move between sets, or locations, or levels etc. (Murray, 2001, p. 158).

> Like earlier media forms that are made up of paragraphs or recorded scenes, my imagined kaleidoscopic story of the future is a composite made up of fragments. But the kaleidoscopic fragments have been organized into a larger, more coherent whole, analogous to the symmetrical patterns of the kaleidoscope. However, just like kaleidoscopic configurations, the symmetrical arrangement is not fixed. There is always the possibility of rearrangement of the same elements into different patterns, of switching from one pattern to another (Murray, 2001, p. 183).

Murray explains that the most ambitious promise of kaleidoscopic narratives is its potential for telling stories about entire systems, meaning things such as creating simulations in virtual worlds where one can "enter, manipulate, and observe in process" (Murray, 2001, p. 280). "Creating such kaleidoscopic story structures… could also foster greater flexibility of mind, by allowing us to see any set of circumstances as a scenario open to recontextualization and change" (Murray, 2018, p. 13).

3.6 "Special Delivery" Case Study

Aardman Animations is an Academy-Award-winning British animation studio founded in 1972 and has made many loved Claymation animations, such as *Wallace and Gromit* (1989 – present), *Shaun the Sheep* (2007 – present), and *Chicken Run* (2000 – present). In 2015 Aardman Animation started an animation collaboration with Google Spotlight Stories to create a 360° VR animation.

> Google Spotlight Stories is a new form of storytelling made specifically for mobile and VR. In these 360-degree, interactive stories, users' phones become a window to a world all around them. The sensors on users' phones allow the story to be interactive; when users move their phone to various scenes, they are able to unlock mini-stories within the story. Users will encounter 10 subplots, three potential ways to see the end, and 60+ moments where they can decide to follow the story in different ways (Wolfe, 2015).

The collaboration resulted in a Christmas themed 2D animation called *Special Delivery*, and as mentioned above in the quote, there is not only one story that one can follow throughout the animation, but multiple. You can choose whether you would like to follow the main animation, which follows "the adventures of a humble caretaker disturbed by a mysterious rooftop stranger who is always one step ahead...leaving behind a trail of gifts" (Wolfe, 2015), or you could instead look around and explore all the little side stories that inadvertently get influenced and affected by the main story characters. "Meanwhile, you're following the action at your own pace, from whatever angle you please—behind you, to your left, to your right, or in front of you. All on your mobile phone" (Wolfe, 2015) (see Figure 30 and 31 below).

FIGURE 30: A SCREENSHOT OF ONE OF THE MAIN CHARACTERS AND STORY FROM AARDMAN ANIMATIONS' SPECIAL DELIVERY, 2015.

FIGURE 31: A SCREENSHOT OF ONE OF THE SIDE CHARACTERS AND STORY FROM AARDMAN ANIMATIONS' SPECIAL DELIVERY, 2015.

Emphasis is put on the fact that you can watch this animation with your phone, therefore indicating that it is more accessible to people who cannot afford a VR device such as an Oculus Rift or an HTC Vive. This immersive VR experience, much like that that of *Invasion!*, can be viewed on multiple devices, such as cell phones, tablets, VR devices, Google Cardboard, or even on your home computer using your mouse to move your viewpoint in a 360° fashion around you.

Another aspect that stands out with *Special Delivery* is that there is more than one story that you can follow, making it more of a kaleidoscopic animation than *Invasion!*, which only follows a single storyline. This also gives *Special Delivery* rewatch value, as you can always come back to the animation after you have already viewed it to follow another short story embedded within the main animation, unlike "Invasion!" where, once you have viewed the story once, there is no need to watch it again in order to discover new aspects of the story. "You'll want to watch "Special Delivery" a few times to find all the surprises within the story. In the full interactive experience, you'll encounter 10 subplots,

three potential ways to view the ending, and 60+ moments where you can decide to follow the story in different ways" (Wolfe, 2015).

Kaleidoscopic narratives, like that in *Special Delivery*, is especially important in terms of things such as rewatch value. In this way there is also more engagement from the audience and a sense of discovery even when watching the animation for the n-th time.

3.7 The Rube Goldberg Machine

Rube Goldberg was a cartoonist that was famous for his signature and complex machines that he invented which he explained through his humorous cartoons. These machines were usually unnecessarily complex and over the top, some even completely absurd, that would consist of multiple intermediary operations that would ultimately succeed in performing a very simple task, such as buttering a piece of toast (Olsen & Nelson, 2017, p. 1) – "…the item earlier in the chain must cause an action that this item uses, in a sense, to complete its own action, which then leads to the next item down the chain" (Olsen & Nelson, 2017, p. 5) (see Figure 32 below).

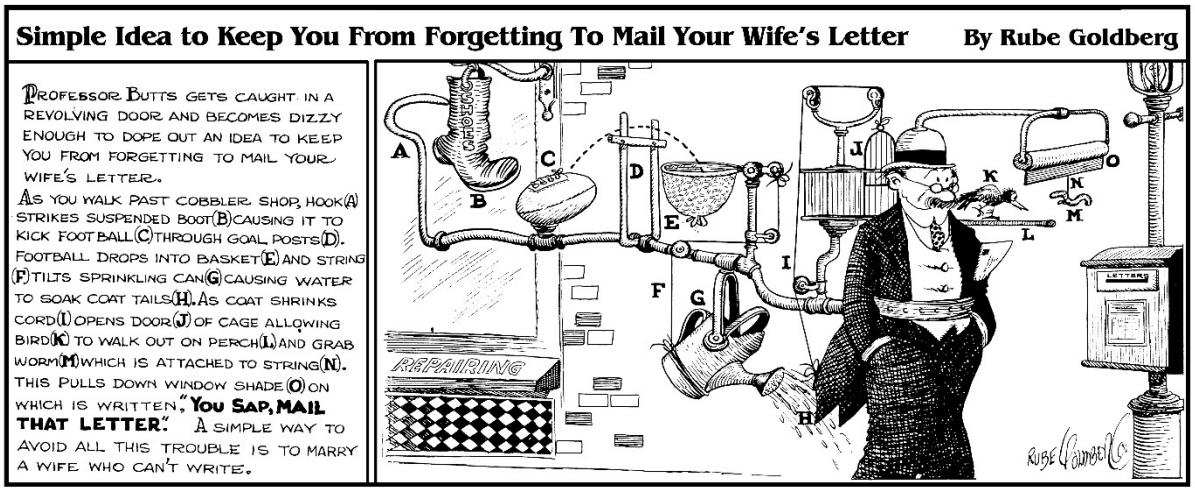

FIGURE 32: SIMPLE IDEA TO KEEP YOU FROM FORGETTING TO MAIL YOUR WIFE'S LETTER BY RUBE GOLDBERG, N.D.

"The steps are thus pairs of objects with actions gluing them together; the state of one object and action must fit with what the next object needs" (Olsen & Nelson, 2017, p. 5). Objects within a Rube Goldberg machine are generally selected because of their physical attributes, such as a round shape that can roll around or a magnet that can attract other magnetic objects (Olsen & Nelson, 2017, p. 8).

Every action within the machine needs a reason for it to occur, and the objects that cause these actions also need to be similarly motivated, and therefore every part of the machine is essential – no part of as Rube Goldberg machine is unnecessary (Olsen & Nelson, 2017, p. 10). The title could be considered the most important part of the whole machine, as it "provides a framework for the action in the world, explaining the practical goal that the invention is trying to accomplish". All the objects within the cartoon are also labelled and the text around the space describes what is going on at each moment within the machine, "i.e. the potential moves that link the objects labelled together to achieve the stated goal" (Olsen & Nelson, 2017, p. 4).

The objects within the machine are divided up into three sections, namely the initial object (the object that starts the process and which uses a "pre- determined state of the world to start the action" (Olsen & Nelson, 2017, p. 5)), the final object, and all the objects in between. "The final object is the final step achieving the goal" (Olsen & Nelson, 2017, p. 5) and is a key feature of the machine that explains its overall purpose. As with all the other objects within the machine, how the final object is used may be different from its general purpose, creating a twist expectation. The objects that make up the middle of the machine are less constrained than the beginning and end objects, and often seem random (Olsen & Nelson, 2017, p. 5). The only rule of a Rube Goldberg machine can be seen to be the use of single objects, wherein these objects perform actions that are somewhat realistic (or, rather, reasonable). For example, a round object has the tendency to roll and, if made from a hard and solid material, wont bounce like a rubber ball. Overall, however, when viewing all the objects performing actions as a whole, the machine still needs to have a complex or ridiculous feel to it (Olsen & Nelson, 2017, p. 6).

The concept of the Rube Goldberg machine has inspired many to recreate (or create their own) machines as real-world contraptions. This can be seen with the boardgame Mouse Trap (published by Ideal in 1963), where one constructs a Rube Goldberg-esque machine to capture the toy mouse. Other real-world examples can be seen all over the internet, on Facebook or YouTube, where people create and test their own Rube Goldberg inventions. These real-world examples are more akin to a domino show, however, seeing as real-world constraints and physics must apply. In a true Rube Goldberg machine, some laws of nature do not necessarily have to apply, as long as the machine is somewhat believable, and above all, absurd (Olsen & Nelson, 2017, p. 1). "People have however built physical machines often described as Rube Goldberg machines, and it is worth briefly looking at how they differ" (Olsen & Nelson, 2017, p. 3). Another real-world example would be the machines created by the Japanese television show *Pythagora Switch* (NHK, 2002). These are a series of narrative-driven domino-like machines where one object hits the next object and thus triggers that object to continue the sequence. This is not a true Rube Goldberg machine as the design is based on space and that all the components of the machine link each other in a physical chain of events (Olsen & Nelson, 2017, p. 3).

> In cartoon Rube Goldberg machines, by contrast, space is not really the primary concern. In a sense they are actually much simpler. There is a goal state, and the intervening steps are mostly there to be funny, not to contribute to an impressive feat of virtuosic machine-building, as in the physical examples (Olsen & Nelson, 2017, p. 3).

The most iconic feature of these machines (in the cartoon sense) is how the components of the machine are arranged in a certain way and this indicates how the machine is supposed to operate, without the need for explicitly showing how the machine works (in a physical manner) (Olsen & Nelson, 2017, p. 12). "Therefore in some respects the logic of (cartoon) Rube Goldberg machines is more similar to the internal logic of narrative structures, which require some degree of coherence but not strict fidelity to physics, than it is to the strictly mechanistic logic of real-world machines" (Olsen & Nelson, 2017, p. 3), "…it is an absurdist mechanical logic" (Olsen & Nelson, 2017, p. 3).

The cartoon machines usually include human or animal characters as machine components, and their implied operation heavily relies on readers being able to recognize stereotypical actions suited to, for example, mice or goats or stockbrokers. Often these machines would not actually work, based as they are on coincidences, but each component sufficiently matches those that come before and after it in the sequence that the reader can read what is supposed to happen. In that sense they have an internal narrative consistency (Olsen & Nelson, 2017, pp. 11-12).

CHAPTER 4:

CREATIVE PRACTICE

4.1 Introduction to the Animation and Justifications

For my creative practice animation, I decided to create a 1950s style diner, wherein the viewer of the animation would be able to stand in the middle of the kitchen and watch the animation in a 360° space. This would be achieved through watching the video on YouTube (as YouTube allows for 360° videos to be uploaded with ease and be viewed using their 360° technology). One can view the animation on one's smartphone or tablet (preferably a phone or tablet with gyroscopic technology build in) by moving the device around you at eyelevel in order to view the animation in a 360° view. The animation was also created to be stereoscopic, meaning one can view the animation through YouTube using Google Cardboard (with one's smartphone), or even VR devices such as the Oculus Rift. The animation can also be viewed directly on a computer or laptop monitor by using your mouse to hold and drag around the scene to view the full 360° animation.

The scene created for this animation consists of a retro-style diner kitchen that includes a few obvious kitchen appliances, such as a refrigerator, kitchen sink, microwave, stove, and cabinets. A few extra decorative elements are also scattered around the scene, such as plants, an unplugged toaster, a fan, plates, and boxes. Additional elements would include all the elements needed for the Rube Goldberg Machine to work, such as the rail systems, frying pan, bucket, apples, and spring-rigged stove tops. Each section can be viewed as its own animation and does not necessarily need the next or previous part of the whole animation to make it make sense. This "kaleidoscopic" narrative effect ensures that the viewer can move his/her around the space, and he/she chooses, but the viewer will still be able to piece together what is happening within the full animation in only a few moments.

The animation starts off with the viewer facing the “front” of the kitchen, where the refrigerator is to one’s left (and in view), and the sink is in front of you. A piece of bread moves from the open refrigerator down a rail and onto a frying pan (see Figure 33 below).

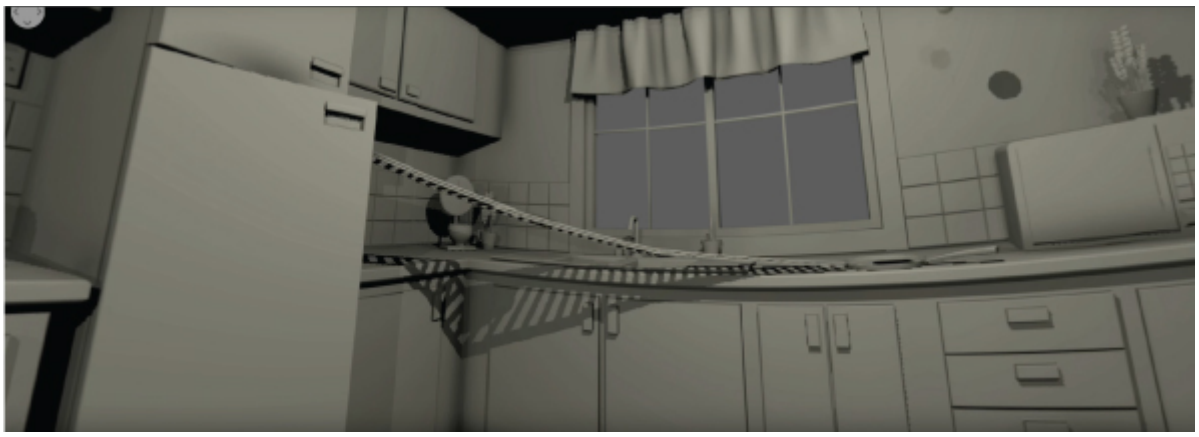

FIGURE 33: FRONT VIEW 1 OF FINAL ANIMATION BY LIEZL GELDENHUIS, 2020.

An apple falls out of a broken basket hanging overhead and bounces off the frying pan handle (and subsequently into a bucket on the floor near the counter in front of you), causing the frying pan to tilt up and shoot the piece of bread off to the right, over the microwave and onto the rail leaning against the old television (see Figure 34 and Figure 35 below).

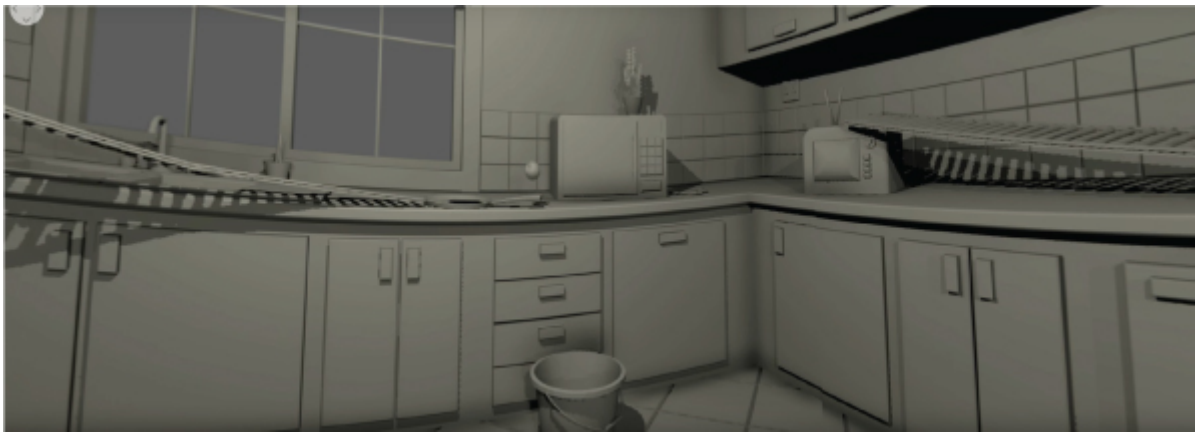

FIGURE 34: FRONT VIEW 2 OF FINAL ANIMATION BY LIEZL GELDENHUIS, 2020.

FIGURE 35: FRONT VIEW 3 OF FINAL ANIMATION BY LIEZL GELDENHUIS, 2020.

The piece of bread then proceeds to slide down this rail and onto a hot stove plate, which, once the bread has toasted on one side, shoots the bread over to the next stove plate by use of a spring attached to the plate (see Figure 36 below).

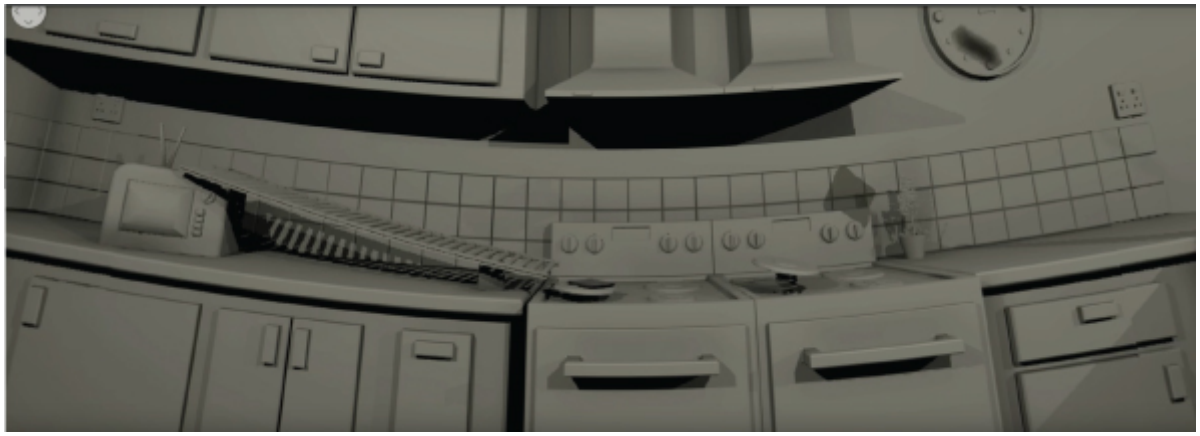

FIGURE 36: RIGHT VIEW 1 OF FINAL ANIMATION BY LIEZL GELDENHUIS, 2020.

The same procedure then occurs with the next stove plate and toasts the bread fully before shooting it off in a similar manner to a stack of plates waiting further to the right of the viewer. The force of the toast as it hits the plate causes the plate to slide onto the rail behind it and propel the toast and plate down this rail and out of the kitchen, through the server's exit just behind the refrigerator (see Figure 37 and Figure 38 below).

FIGURE 37: BACK VIEW 1 OF FINAL ANIMATION BY LIEZL GELDENHUIS, 2020.

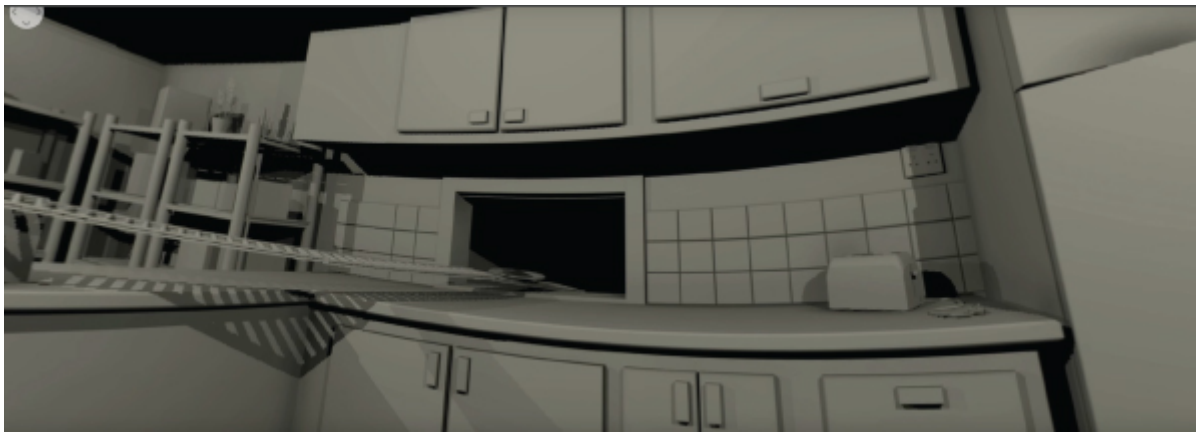

FIGURE 38: LEFT VIEW 1 OF FINAL ANIMATION BY LIEZL GELDENHUIS, 2020.

The animation of the bread/toast is copied a few times over within the scene and the scene is also loopable, meaning that one can view the animation on repeat, and it will flow smoothly as if it was one long animation.

The process to create this animation was quite laborious, as it consisted of a variety of additional steps not required in normal 3D animation. These additional steps would include things such as setting up omnidirectional/ spherical cameras, injecting 360° metadata, creating stereoscopic videos, etc. Below is a step-by-step process of the creation of my creative practice animation:

4.1.1 Conceptualisation

The first step in creating any animation is planning. I had to firstly determine what kind of setting would best suit the animation I was creating (a 360° 3D animation) and then use trial and error and peer feedback to determine the final setting for the animation. a kitchen setting seemed like the perfect fit for a 360° 3D Rube Goldberg Machine animation, as the scene could be created with the viewer standing directly in the middle of the scene. The kitchen could also provide all the necessary surfaces, models, and accessories for the Rube Goldberg Machine to function, without any element seeming out of place. A 1950s diner kitchen seemed like a fun way to model the scene, and would fit in with kitchen appliance advertisements from the 1950s showing how kitchen appliances would ensure that you had more free time (although target to women in quite a sexist manner; see Figure 39 below). This concept of "more free time" also fits in well with the concept of a Rube Goldberg Machine, which is essentially a contraption made to do something automatically so that you don't have to.

FIGURE 39: YOU'LL HAVE MORE FREE TIME WITH A MCCLARY KITCHEN ADVERTISEMENT BY MCCLARY, 1952.

4.1.2 Storyboarding and Animatic Creation

Firstly, I had to create a storyboard for my animation, which meant I had to create a scene and elements that would fit with my concept. I roughly sketched some spaces and kitchen elements (inspired by the image above and some other Google searched images of 1950s style kitchens and appliances) before creating six watercolour paintings of my final scene. These six paintings correspond with each view within a 360° space, namely the front view, right view, back view, left view, up view, and down view (I also included a seventh painting for the divider in the kitchen separating the entrance of the kitchen from the kitchen itself) (see Figure 40 to Figure 46 below).

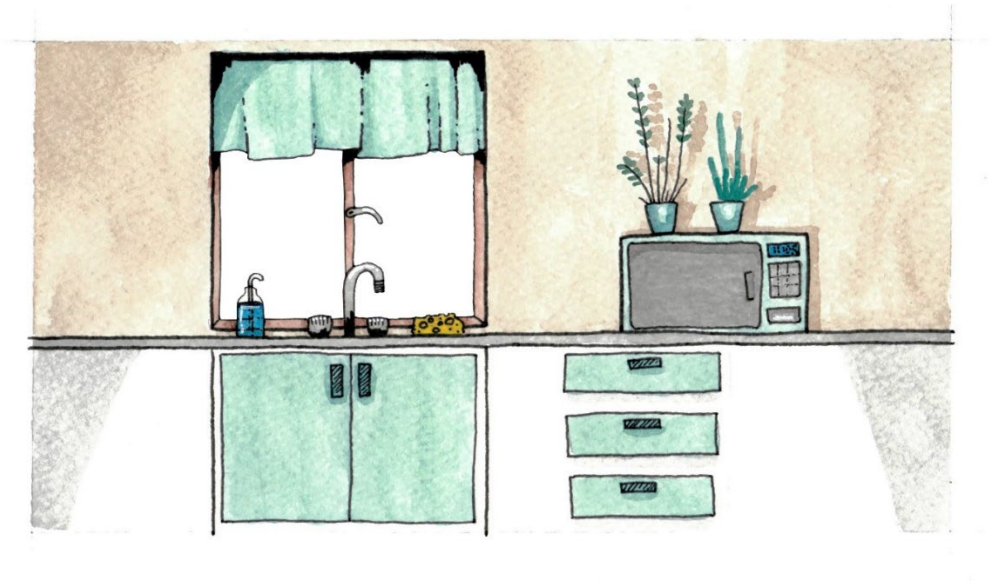

FIGURE 40: FRONT VIEW OF LIEZL GELDENHUIS' WATERCOLOUR PAINTING, 2018.

FIGURE 41: RIGHT VIEW OF LIEZL GELDENHUIS' WATERCOLOUR PAINTING, 2018.

FIGURE 42: BACK VIEW OF LIEZL GELDENHUIS' WATERCOLOUR PAINTING, 2018.

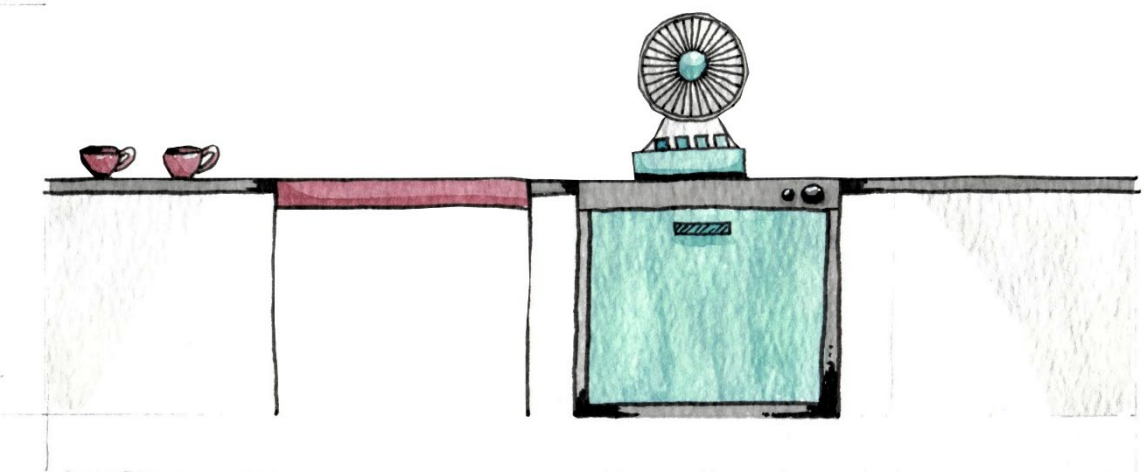

FIGURE 43: DIVIDER, LIEZL GELDENHUIS' WATERCOLOUR PAINTING, 2018.

FIGURE 44: LEFT VIEW OF LIEZL GELDENHUIS' WATERCOLOUR PAINTING, 2018.

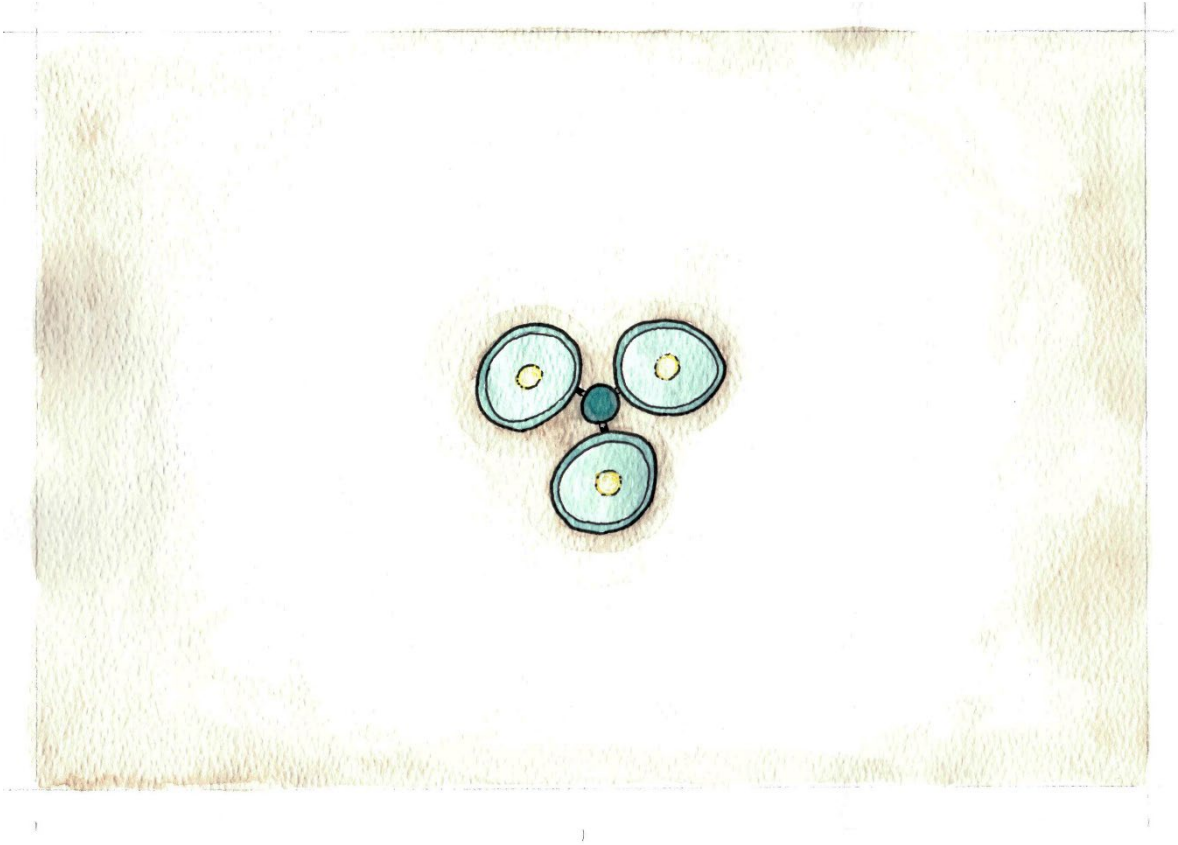

FIGURE 45: UP VIEW OF LIEZL GELDENHUIS' WATERCOLOUR PAINTING, 2018.

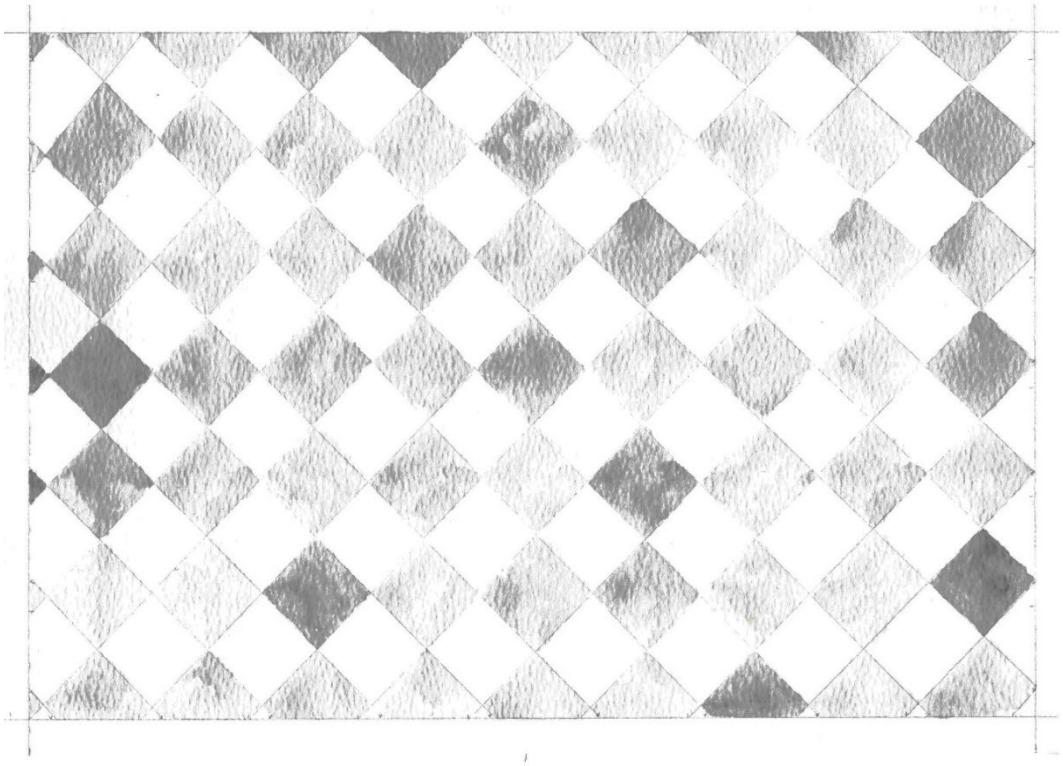

FIGURE 46: DOWN VIEW OF LIEZL GELDENHUIS' WATERCOLOUR PAINTING, 2018.

For the first test animatic of this initial watercolour storyboard I had to stitch all seven images together so that they formed a cube wherein an omnidirectional/spherical camera could be positioned in the centre of the cube. This was done in Autodesk Maya 2018, by placing image planes in a blank scene in the arrangement mentioned above, followed by rendering one frame. This image was then imported into Adobe Premiere Pro 2018 to change the length from one frame to one minute, and then saving it in an mp4 format. Thereafter I used a program called Spatial Media Metadata Injector (which was released online on GitHub on 14 June 2016) to inject the video with 360° metadata for the video to be uploaded to YouTube as a 360° video. The final video can be found here: https://www.youtube.com/watch?v=9sJgWLTQ31M (the video is entitled "First Test Animatic | Watercolour Storyboard", and was uploaded by me on 10 March 2020, on my YouTube channel "Liezl Geldenhuis" created specifically for this exegesis and creative practice). The original first animatic video can be found on YouTube using this link: https://www.youtube.com/watch?v=CNbb2lhRxX4 (the video is entitled "animatic frame1 v2 injected", and was uploaded by me on 26 June 2018 on a secondary

channel). The second test animatic was created similarly to the first. I used the build-in Arnold spherical camera, as well as inserted a 3D model of a conveyor belt and timecodes. The final video can be found here: https://www.youtube.com/watch?v=9JOEIryhm3w (the video is entitled "Second Test Animatic | Mixed Media Storyboard", and was uploaded by me on 10 March 2020, on my YouTube channel "Liezl Geldenhuis). The original second animatic can be found on YouTube using this link: https://www.youtube.com/watch?v=GwUcbj6pOuA (the video is entitled "full animatic v1 injected", and was uploaded by me on 4 July 2018 on a secondary channel).

4.1.3 3D Modelling, Texturing, and Lighting

After getting more comfortable with the process of creating 360° videos, it was time to create the 3D models for the animation. At first, I considered using premade models that could be accessed and downloaded for free from a website called TurboSquid. This website provides many free (and royalty free) and paid-for 3D models that can be downloaded in a variety of different formats, such as .obj (a general 3D model format recognised by most 3D software), .3ds (a 3D model format for Autodesk 3DS Max), .mb or .ma (a 3D model format for Autodesk Maya), and many more. I did decide against using free models, however, and rather spent time creating my own 3D models in Autodesk Maya 2018. The models I created were therefor in the style I wanted them to be, and I could easily modify or manipulate the models to suit my needs as the project continued and evolved. Although this required more time, I believe it added more authenticity to the final animation.

Initially, I used Pixar's student version of their rendering software, Renderman 21, to texture and add lighting to my scene within Maya. Renderman 21 (now updated to Renderman 23 as of January 2020) can be added easily as a plug-in for Autodesk Maya 2018 (or 2019, but not 2020 just yet) and comes with a variety of stunning realistic pre-made textures that are easily applied to any 3D model. The final video can be found here: https://www.youtube.com/watch?v=iJGuxMw-als (the video is entitled "Renderman 21 Texture and Lighting Test", and was uploaded by me on 10 March 2020, on my YouTube channel "Liezl Geldenhuis). The original 360° test video of the Renderman 21 texturing and

lighting of my scene can be found here: https://www.youtube.com/watch?v=nuWqvW5dFKE (the video is entitled “Kitchen Textured Lighting Test 2 | 4k”, and was uploaded by me on 18 Dec. 2019 on a secondary channel). Below are some screenshots of the 360° video (Figure 47 to Fig 49).

FIGURE 47: SCREENSHOT FROM RENDERMAN 21 TEXTURE AND LIGHTING TEST BY LIEZL GELDENHUIS, 2020.

FIGURE 48: SCREENSHOT FROM RENDERMAN 21 TEXTURE AND LIGHTING TEST BY LIEZL GELDENHUIS, 2020.

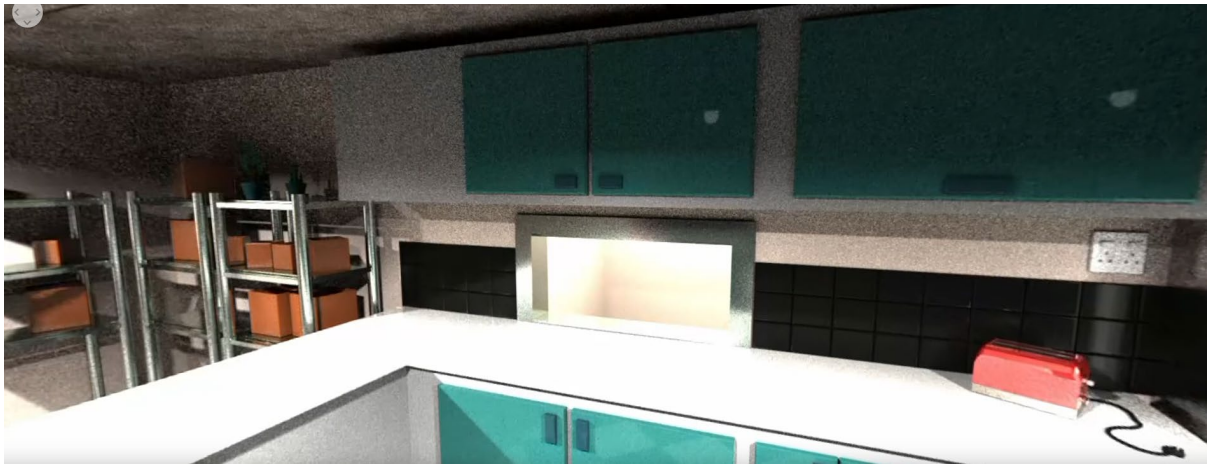

FIGURE 49: SCREENSHOT FROM RENDERMAN 21 TEXTURE AND LIGHTING TEST BY LIEZL GELDENHUIS, 2020.

As can be seen from the above images, the textures are quite realistic and create appealing reflections, especially when looking at the reflections of the floor on the refrigerator and stove doors. These textures also cause the space to seem more inviting and intimate, and it is more engaging because how one wants to move around the scene and observe all the different materials and how the lighting affects them.

There was, however, one major flaw in texturing and lighting my scene with Renderman 21, namely the render time. This video only consists of one frame of animation that was rendered through Renderman 21 for Autodesk Maya and extended to be one minute in Adobe Premiere Pro. The render time on my personal computer through Renderman was 11 hours and considering my animation would possibly be around 15 seconds long and would therefor consist of about 360 frames (at 24 frames per second), using the Renderman software would not be feasible. The reason for this incredibly lengthy render time is because of the resolution required for the upload of 360° videos, on any platform. The recommended resolution for a 360° video on YouTube is around 4K, meaning the pixel ratio of the video is 4 times more than a standard 1080p (1920 x 1080 pixels) video, and comes to 4096 x 2160 pixels. When viewing a 360° video on YouTube, for example, every view you see (front, right, back, left, up, or down) needs to be at least at a resolution of 1080p for optimal quality, meaning that the full

resolution of the video should preferably be 1080p times 6 views. Considering the resolution the animation had to be rendered at, and the fact that rendering high quality textures also adds to the render time, caused me to have to come up with a solution that would require less time to render (this solution will be explained in the next section – *Animation and Final Rendering)*.

4.1.4 Animation and Final Rendering

Before animating my scene, I created some updated storyboards to work from, showing the layout of the scene from a top view. These storyboards were comprised of three layers: the static layer; the Rube Goldberg elements layer; and the animation layer (see Figure 50 to Figure 52 below).

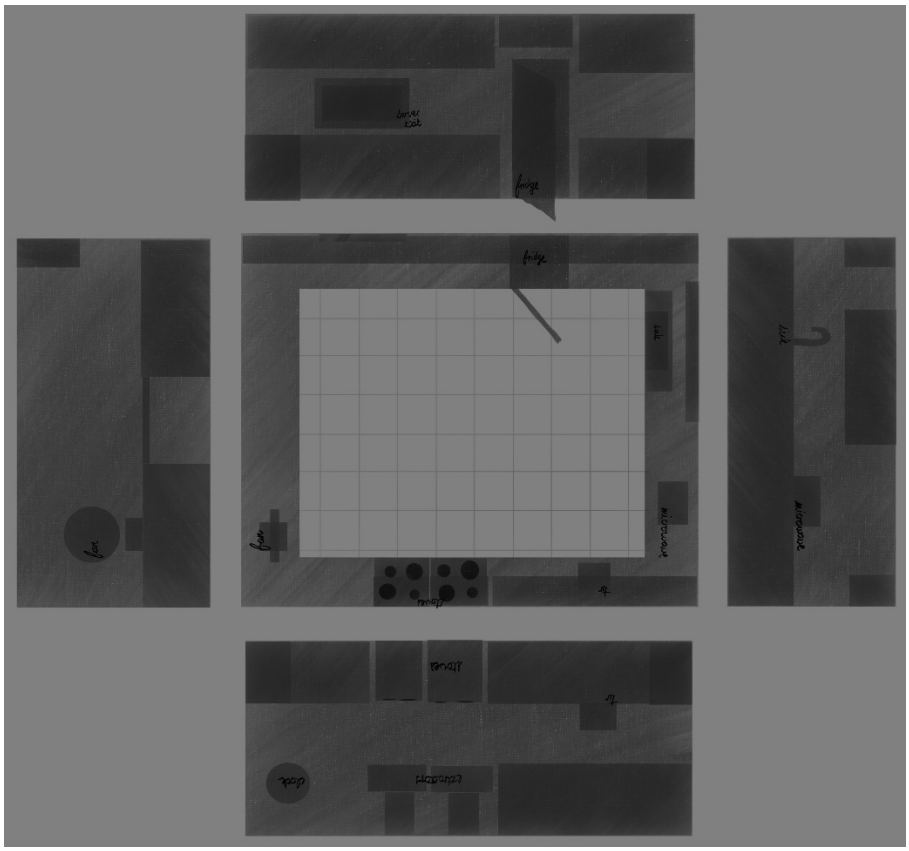

FIGURE 50: STATIC ELEMENTS BY LIEZL GELDENHUIS, 2020.

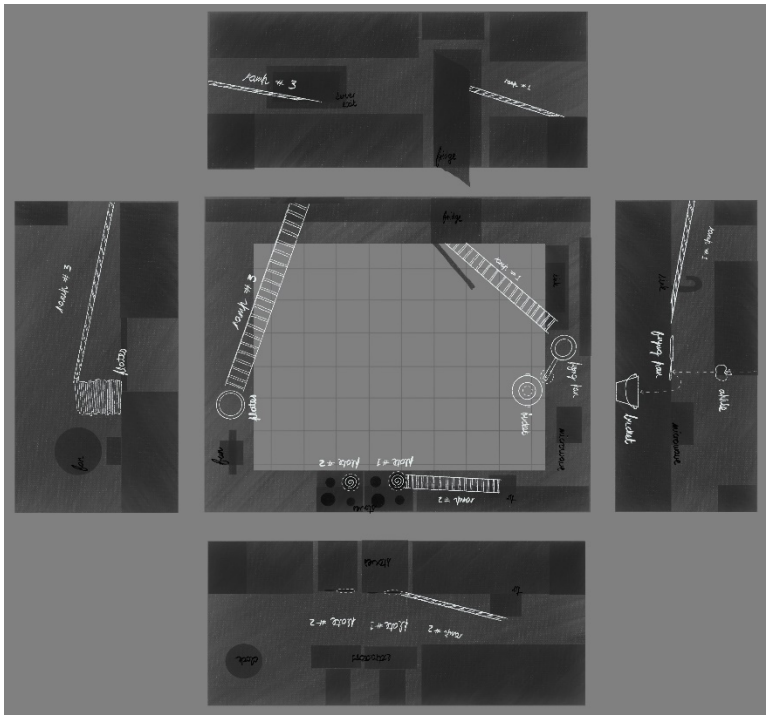

FIGURE 51: RUBE GOLDBERG ELEMENTS BY LIEZL GELDENHUIS, 2020.

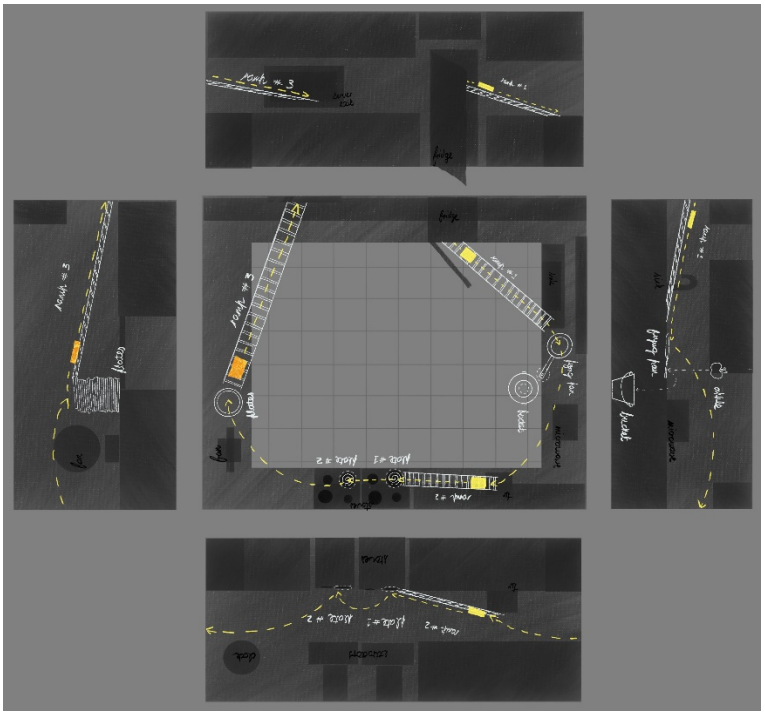

FIGURE 52: ANIMATION ELEMENTS BY LIEZL GELDENHUIS, 2020.

I animated my scene fully in Autodesk Maya (2018-2019), using the skills I have been taught through my lecturers and learned through online tutorials over the past few years. The animation,

however, was not the focus of this creative practice, and therefore less time was spent on animating the scene. The focus of this creative practice was in creating the actual 360° space, creating and using omnidirectional/spherical cameras, creating cubemaps and equirectangular videos (which will be explained later in this section), and, ultimately, creating a setting for a kaleidoscopic narrative within a 360° space. The animation is integral for this kaleidoscopic narrative to be viewed, but the animation itself does not necessarily have to be too realistic or detailed.

Once my scene was animated and all Renderman textures were removed and replaced with a standard Maya material (a plain grey lambert material), it was time to light and render the scene. I used build-in standard directional Arnold lighting to light the scene but was again faced with the problem of lengthy rendering times. Although I had decided to use one plain texture for all the models and only simplistic lighting, one frame of animation still took around 4 hours to render. This led me to think about other ways one could render out animations in Maya, namely “playblasting” an animation. “A Playblast is a quick preview that lets you make a ‘sketch’ of your animation, providing a realistic idea of your final render result without requiring the time needed for a formal render” (Autodesk, 2018). Playblasting an animation works fine when one is rendering out one camera view (and takes around double your animation time to render out instead of hours), but Maya does not yet support Playblasting omnidirectional/spherical cameras. In order to overcome this next problem, I created 6 standard Maya cameras all facing in different directions (front, right, back, left, up, or down), but all in the same position on the y, x, and z axis (see Figure 53 below), with their fields of view all set to 90°.

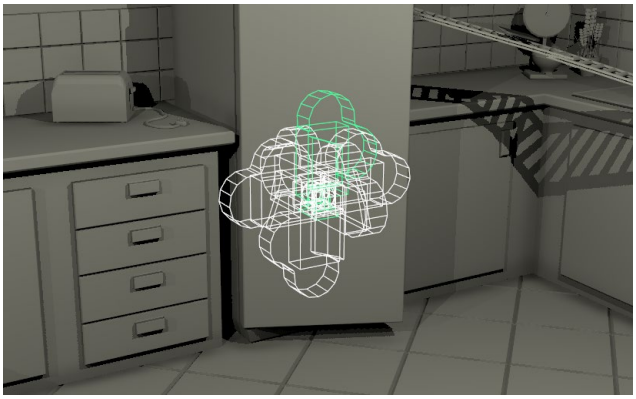

FIGURE 53: MAYA CAMERA SETUP FROM LIEZL GELDENHUIS' FINAL AUTODESK MAYA PROJECT, 2020.

This camera setup shown above let me recreate what I did with my original storyboards that I turned into a 360° video. For this being the final animation, however, a bit more effort and work had to be put into creating the final video. The optimal way to upload 360° videos to YouTube is to upload an equirectangular video or image that has been injected with 360° metadata. This is basically just a spherical video or image that has been spread out onto a flat rectangle, very similar to how we view maps of the world (see Figure 54 below).

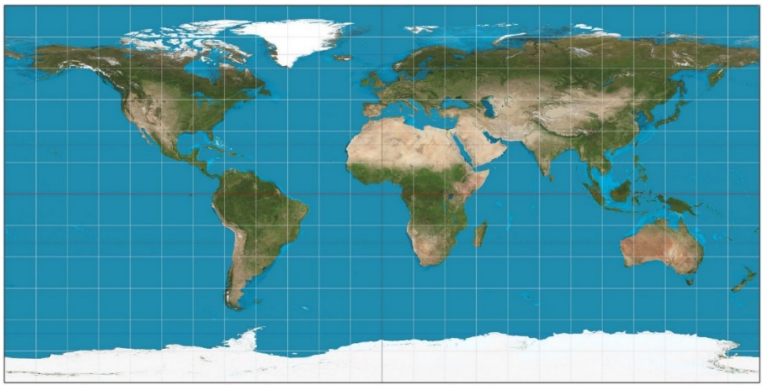

FIGURE 54: EQUIRECTANGULAR PROJECTION OF THE WORLD BY STREBE, 2011.

In order to create an equirectangular video with the 6 Playblasts I had created, I first had to create a cubemap (a flat layout of a cube on a 2D plane) of the videos in Adobe After Effects, before converting the cubemap into an equirectangular video in the same program (see Figure 55 and Figure 56 below).

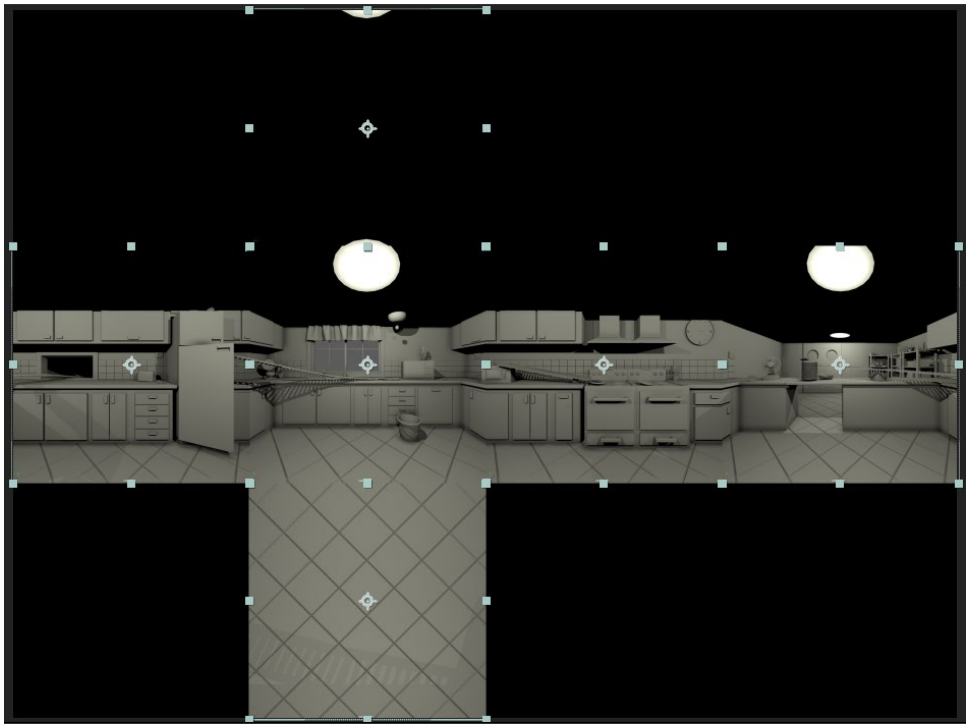

FIGURE 55: CUBEMAP FROM LIEZL GELDENHUIS' FINAL ADOBE AFTER EFFECTS PROJECT, 2020.

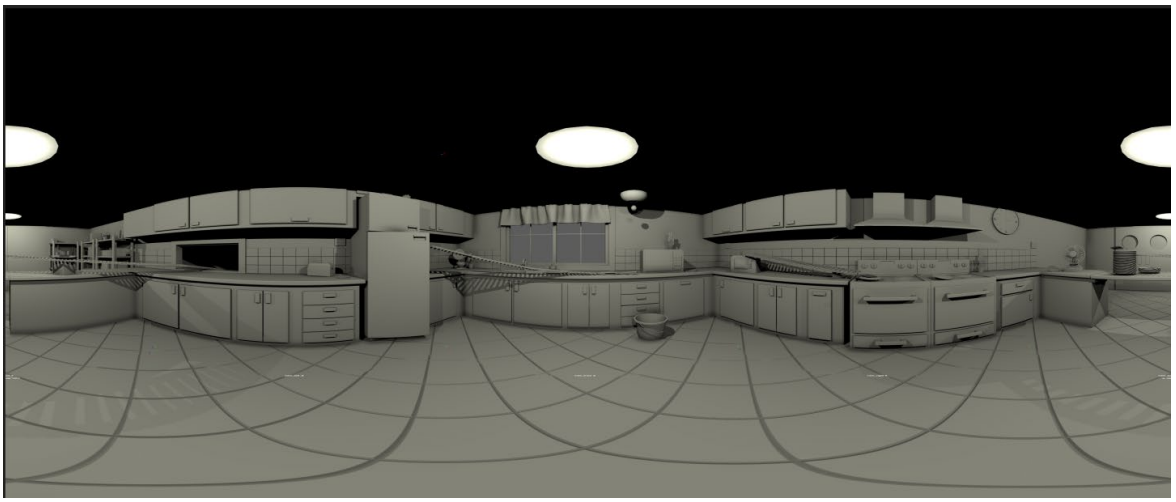

FIGURE 56: EQUIRECTANGULAR VIDEO SCREENSHOT FROM LIEZL GELDENHUIS' FINAL ADOBE AFTER EFFECTS PROJECT, 2020.

Afterwards, I took this equirectangular video into Adobe Premiere Pro and looped the animation 3 times, for the viewer to have more time to view the animation. To make the video stereoscopic, all that had to be done was copy the video and add it directly above the original video, creating a squarer video (see Figure 57 below).

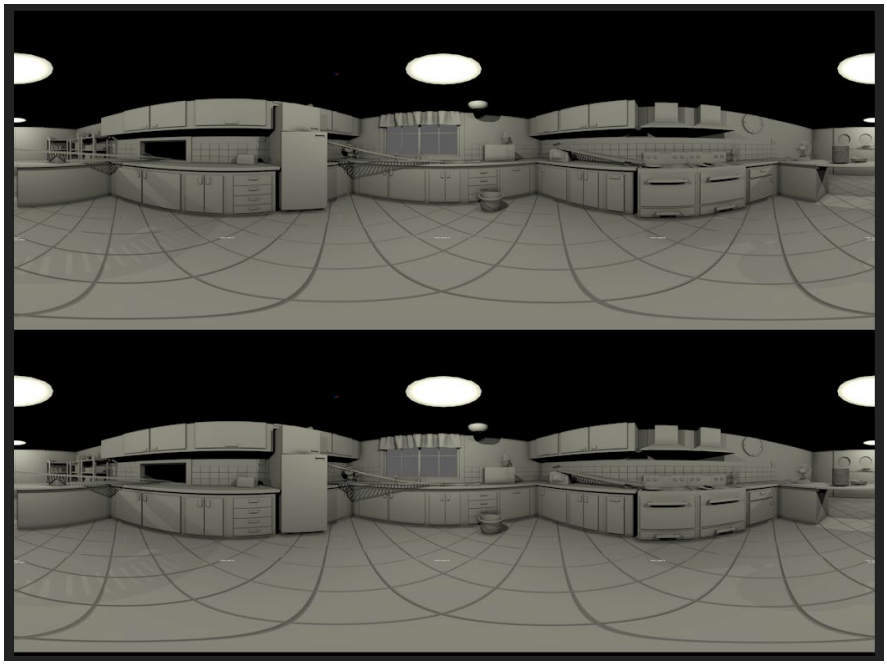

FIGURE 57: STEREOSCOPIC LAYOUT SCREENSHOT FROM LIEZL GELDENHUIS' FINAL ADOBE PREMIERE PRO PROJECT, 2020.

This process mentioned above consisted of a lot of trial and error, as there are no tutorials on how to quickly render out omnidirectional/spherical cameras in Maya for preview purposes. The final step before uploading the video to YouTube was to inject the video with 360° metadata with the Spatial Media Metadata Injector application. This application also allows the user to specify whether the video is stereoscopic, which then tells YouTube how to present the uploaded video as a 360° stereoscopic video. The final video can be found here: https://www.youtube.com/watch?v=alqbvKVjNUM (the video is entitled "Final Animation", and was uploaded by me on 10 March 2020, on my YouTube channel "Liezl Geldenhuis). The original final uploaded animation can be found here: https://www.youtube.com/watch?v=ogP2Mw-NdY8 (the video is entitled "equirectangular final injected", and was uploaded by me on 9 March 2020 on a secondary channel).

4.2 The Narrative

As discussed in Chapter 3, under the Narrative section, a narrative is not the actual story being told, but rather the way or how the story is told. This would include the methods used in creating the story,

namely how events are arranged; how much time is given to certain events; how actors or characters are given personalities and certain distinguishable traits; and how choices are made for the progression of the story.

For my creative practice animation, the events of the animation are arranged in such a way as to be loopable or repeating. The animation is divided up into certain segments or event sequences (the bread moving away from the refrigerator, the bread being toasted, the toast being delivered to the dining room etc.) that can either be viewed separately or as a whole. This is also closely related to how much time is given to each event (or sequence). Each sequence of events is not very long and only takes a few seconds to be completed before the action is repeated again. However, overall, the full animation (all events viewed in sequence) is around 15 seconds in length. As for how actors or characters are given personalities and certain distinguishable traits, this does not really come forth within my animation. The piece of toast can be seen as the main character, or rather the main focus of the animation, but as the piece of toast is not anthropomorphic in any way it does not have any kind of personality or characteristics. Personalities and traits can, however, be seen throughout the animation of the machine as a whole – like how the stove plates bounce up with springs in order to move the bread/toast to a new location. For the progression of the story one needs to follow the overarching sequence of events, but the story does not really progress as the story loops continuously. For the story to truly continue, one would have to follow the piece of toast into the next room to see what happens to it. The story that I have created with this animation is more of an open-ended story, where one can explore the space and watch the different sequences at your leisure, seeing this story as a smaller part of a bigger whole.

Looking back again at Digital Storytelling from Chapter 3, Bryan Alexander's 2011 book, *The New Digital Storytelling: Creating Narratives with New Media*, explains digital storytelling with a five-part definition, namely that digital stories:

1. Include a compelling narration of a story;
2. Provide a meaningful context for understanding the story being told;
3. Use images to capture and/or expand upon emotions found in the narrative;
4. Employ music and other sound effects to reinforce ideas; and
5. Invite thoughtful reflection from their audience(s) (Alexander, 2011, p. 27)

The animation that I have created for my creative practice, I believe, can tick three of the abovementioned points. The first point, that digital storytelling includes a compelling narrative for a story, has been met. Even though the story might not be complex and include mystery or deception or twists, is still compelling and interesting in the way you view the story – by looking around you and following the story how you see fit (whether in the "correct" sequence, or as smaller parts). The second and third points, to provide a meaningful context for understanding the story being told and using images to capture and/or expand upon emotions found in the narrative, I believe has also been met. The story that is being told through my creative practice animation is simple and understandable, and all part within the scene are easily recognisable. As for the fourth point, music and sound effects have not yet been employed to reinforce ideas, as sound is not a part of this study, but rather visuals. This point will be discussed more in the conclusion of this exegesis, as it is a limitation to the research and needs further attention in future research. The last point in Alexander's list can also only been discussed if an audience of a certain size has viewed the animation and the audience has had time to reflect on the animation before answering questions, such as what they thought of the animation and what, if any, thoughts or emotions it provoked.

As mentioned before, constructing a kaleidoscopic narrative structure within a 360° 3D animation has been the focus of this research. Kaleidoscopic narrative, as described earlier through a quote by Murray in Chapter 3, "most compellingly creates the ability to present simultaneous actions in multiple ways" (Murray, 2001, p. 157). The main question to answer when looking at my creative practice animation is: Can the narrative I have created be considered kaleidoscopic? Murray explains

that the most ambitious promise of kaleidoscopic narratives is its potential for telling stories about entire systems, meaning things such as creating simulations in virtual worlds where one can “enter, manipulate, and observe in process” (Murray, 2001, p. 280). The animation I have created for this research can be seen as telling a story about an entire system, only in this animation there is no manipulation involved, as it is not a physically interactive animation. one can, however, enter and observe the process of the animation. I believe that, with the animation being separate looping animations that make up a whole animation, and wherein each animation and the whole animation repeats infinitely, the animation can be seen as kaleidoscopic.

The successes in terms of my creative practice animation having a kaleidoscopic narrative is seen in the way that smaller parts make a whole, and that different parts can be viewed separately as their own animations. One does not have to view the full animation to understand certain parts, or even the animation in the “correct sequence” to understand what is happening. The failure in creating a kaleidoscopic narrative in the animation, however, comes forth in the fact that there is no true agency and that there is no interactivity (physically). For the animation to truly be kaleidoscopic, one would have to have the ability to move around the space more freely, instead of just being rooted to one spot in the middle of the scene. One can also not interact with any of the objects within the scene, which limits how long one would want to stay and visually interact with the animation. Animation is, however, not supposed to be for interaction, but rather for entertainment (in the context of animation in this exegesis).

4.3 The Application of the Principles of Animation

Anticipation is defined by Thomas and Johnston (developed by Walt Disney Studios and introduced in Frank Thomas and Ollie Johnston in their book *The Illusion of Life: Disney Animation* in 1981) as: “… a planned sequence of actions that leads [the audience] clearly from one activity to the next… This is achieved by preceding each major action with a specific move that anticipates for the audience what is about to happen” (Thomas & Johnston, 1995, p. 52). Anticipation was important in conveying weight in

my animation, just as it shows weight in 2D and 3D animation. Physics was one of the most important aspects of making the animation feel somewhat realistic and believable. The next important thing about creating anticipation within the animation was creating it in such a way that the audience viewing the animation did not miss key anticipation events. This was helped by enabling that the animation sequences were loopable and repeated as a whole, so if the viewer missed something, they could go back and watch the animation again (either as a sequence or the whole animation), in order to see what they missed the first time around. Other distractions within the animation were also kept to a minimal, so as the viewer can watch the animation in the "correct" sequence and be able to anticipate the actions that are to follow.

Staging is defined by Thomas and Johnston as: "the presentation of any idea so that it is completely and unmistakeably clear. An action is staged so that it is understood, a personality so that it is recognisable, an expression so that it can be seen, a mood so that it will affect the audience" (Thomas & Johnston, 1995, p. 54). Staging had a great impact on the anticipation of actions and events, as, as Lasseter puts it "a well-timed anticipation will be wasted if it is not staged clearly" (Lasseter, 1987, p. 39). The staging created for my animation was kept simplistic and laid out in such a way that whichever way the viewer turns, they will be able to see all parts of the scene, meaning nothing was hidden behind objects that were important to the story. In this way certain actions can be anticipated without it being hidden from view. This space also had to be created as to be somewhat appealing, but not as to distract the viewer from the visual cues.

Timing is defined by Thomas and Johnston as: "The number of drawings used in any move determines the amount of time that action will take on screen… and the varying speed of those movements determined whether the character was lethargic, excited, nervous, relaxed" (Thomas & Johnston, 1995, p. 65). Timing in my animation was created using slow- or fast-moving actions (looking specifically at the rules of physics as with the principle of anticipation). Timing was, once again,

important in leading the viewer around the virtual space, as objects or characters in motion should lead the viewer's attention to where the next main scene or action is happening.

Appeal is defined by Thomas and Johnston as: "… anything that a person likes to see, a quality of charm, pleasing design, simplicity, communication, and magnetism. Your eye is drawn to the figure that has appeal, and, once there, it is held while you appreciate what you are seeing" (Thomas & Johnston, 1995, p. 69). Appeal within my animation was kept to a minimal, meaning I did not use overly detailed models or any too-distracting colours. As previously mentioned in Chapter 2, we are dealing with animation and not a 360° scene comprising of stationary objects and no movement, and therefor the main action or event taking place in the 360° animation at any time should be the most appealing to watch, which was the ultimate goal for this animation when considering the principle of appeal. However, as mentioned previously in this chapter, the animation would have been more appealing had it been textured and lighted with Pixar's Renderman (or in a similar manner with realistic textures and lighting).

CONCLUSION

Summary of The Exegesis

The main aim of this exegesis was to construct a kaleidoscopic narrative structure within a 360º 3D animation. This aim consisted of two main objectives. Firstly, to construct a kaleidoscopic narrative structure within a 360º 3D animation by creating a 360º 3D non-interactive animation, while considering the use of space and navigation within the animation (and how a constructed narrative of an animation will affect these two aspects of a 360º environment), and briefly discussing immersion only in terms of immersive narratives within a digital environment. And secondly, applying four of the twelve principles of animation (namely anticipation, staging, timing, and appeal) to my 360º 3D animation, which is only be prominent in the creation, observation, and documentation of the animations and does not have any significant impact on the main aim. My theoretical framework consists of two theories – as my research does not allow for interaction or participation within the proposed animation, and purely considers a non-interacting viewer, theories on interaction and participation have been disregarded. The first theory I applied is Murray's third property in her Four Essential Properties of Digital Environments, namely that digital environments are spatial. Secondly, I applied Murray's views on kaleidoscopic narratives (which is the ability to present simultaneous actions in multiple ways) to my animation, and which led to my research topic: "The Future of Hybrid Animation: The Construction of Kaleidoscopic Narrative Structures within 360º 3D Animation". I also briefly observed what effect a 360º environment had on anticipation, staging, timing, and appeal. As previously stated, the principles of animation were only observed within the creation, observation, and documentation of the animation. Lastly, this practice-led exegesis's methodology focusses more on the link between my creative practice and my research. Within this section I considered problem analysis tools, achieving objectives, my research timeline, the resources and materials I used, and discussed possible outcomes of the research.

Limitations

Throughout this exegesis I have mentioned several topics that will not be covered, in order to keep the report within the scope of an MA exegesis. Firstly, looking at The Principles of Animation, only four principles were discussed, namely anticipation, staging, timing, and appeal, seeing as they are more relevant principles when considering a 360º environment. As John Lasseter points out in his 1987 article on the Principles of Traditional Animation Applied to 3D Computer Animation "the application of some of these principles mean the same regardless of the medium of animation", but with principles such as anticipation, staging, timing, and appeal "their application changes due to the difference in medium" (Lasseter, 1987, p. 36). Some other limited research within this exegesis includes the topic of immersion, with specific focus being more on digital storytelling and kaleidoscopic narratives. Looking at Murray's Four Essential Properties of Digital Environments (namely that digital environments are procedural, participatory, spatial, and encyclopaedic), which is a major part of the Space and Navigation portion of this exegesis in Chapter 3, only one of these properties was discussed within this report, namely that digital environments are spatial. The other three properties points to a far larger scale narrative project and would drastically change the scope of the exegesis. Lastly, I disregarded any research and literature on the topics of semiotics and interaction, as both are unnecessary when researching and creating a 360º 3D non-interactive animation.

The above-mentioned limitations were in terms of the scope of the exegesis, looking specifically at previous research and literature around the topic of 360° 3D animation, kaleidoscopic narratives, and digital storytelling. Within the practical aspect of this research there are also several limitations. These would include not having access to, or not having sufficient knowledge about certain 3D design elements, such as creating my own textures or materials for my 3D elements, and would also include having to keep the animation very short, as rendering times are much longer when rendering 360° videos (which should be rendered in 4K or higher to keep the quality at a high enough standard). Time was also affected by the fact that I was creating a 360° 3D animation and resulted in a

much simpler animation than originally planned. The animation is not as complex as even the cartoon Rube Goldberg machines are, as this would have taken a considerably much longer time to create and render. Many of these limitations are explored in Chapter 4, with simpler solutions and workarounds being explored to overcome some of these limitations.

Recommendations

For this exegesis, there are a few recommendations that I would make for future research. Firstly, that more focus be put on the 12 Principles of Animation in their entirety, meaning that all 12 principles should be looked at in the context of a 360° 3D animation. even though the principles of anticipation, staging, timing, and appeal are more crucial when studying 360° animation, the other principles might also tend to change in context when looking at a 360° environment. Secondly, instead of just observing these principles within a 360° environment, they should be studied in more depth and perhaps be individually experimented with within such a digital environment. Thirdly, Murray's Four Principles of Digital Environments should also be focussed on together, as they make up an entire theory. For this exegesis (and the scope thereof), only looking at the third property was adequate, but research into the remaining three properties would be more beneficial for studying 3D animation within a 360° digital environment.

A major recommendation would also be to consider the three papers that have been excluded from this research (mentioned in *Limitations*). All three papers will be vitally important to consider, as they were the first to be published specifically on narrative and animation within a 360° environment.

In terms of the creative practice portion of this research into kaleidoscopic narratives within a 360° 3D animation, creating a fully functioning Rube Goldberg machine would be highly beneficial in terms of researching the 12 Principles of Animation, especially when looking at anticipation, staging, timing, and appeal, and also for determining whether a kaleidoscopic narrative truly works within such an environment. A study with participants would therefor also help in determining its efficiency, as

feedback from an audience during different stages of the animation would lead to a greater understanding of things such as anticipation.

In conclusion, more research into, and an in-depth understanding of this new medium of animation could lead to advances in the technology surrounding it, new discoveries of animation techniques, and even the creation of new and innovative ways of viewing animation. “We are living in a time of immense creativity, with new opportunities for creators appearing nearly every day” (Alexander, 2011, p. 3).

APPENDIX

1. *Human Research Ethics Committee (Non-Medical) Waiver Letter*

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

Registration number: REC-101114-044

16 March 2020

Re: Ms. Liezl Geldenhuis (479442)
Waiver letter number: HRECNMW20/04/01

To whom it may concern,

Ms. Geldenhuis is currently registered as a Masters student at the School of Arts at the University of the Witwatersrand, Johannesburg. This letter is to confirm that, at the time of writing, Ms. Geldenhuis does not need ethical clearance for her Masters study entitled *'The Future of Hybrid Animation: The Construction of Kaleidoscopic Narrative Structures within 360º 3D Animation'*. This decision has been reached based upon a description of the project supplied by Ms. Geldenhuis to the University Human Research Ethics Committee (Non-Medical), which has been evaluated by the Chairs and Deputy Chairs. If, however, Ms. Geldenhuis changes the methods of data collection and analysis for this study, this decision may no longer be valid. If such changes take place, this should be communicated to the University Human Research Ethics Committee (Non-Medical) as soon as possible. This waiver letter is valid until 15 March 2023.

Please feel free to contact me should you require any further information.

Thank you.

Yours sincerely,
S Schoeman

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www.wits.ac.za/research/about-our-research/ethics-and-research-integrity/

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