Interactive Storytelling for Virtual Reality Medium by Real Walking Inside Virtual Story World

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Abstract

This PhD thesis delved into the innovative intersection of cinematic VR and narrative theory, drawing heavily on Gilles Deleuze's cinematic concepts to forge a new ontology for cinematic storytelling within immersive media. Through a blend of theoretical exploration and practical experimentation, the research investigated the unique perceptual and engagement dynamics of VR audiences. The creation and analysis of two VR simulations, "How Do You Teel It 2021" and "The Man Who Disoriented in Time 2022," served as empirical studies to understand and enhance narrative engagement in immersive environments.

Building on these foundations, the thesis introduced and exemplified the "Story-Without-End" narrative structure through the interactive VR movie "Déjà vu." This creative output not only demonstrated the practical application of the developed theoretical framework but also set a precedent for future narrative explorations in cinematic VR through offering original definitions and a novel narrative framework. This research significantly contributed to the discourse on interactive storytelling through real walking inside virtual story worlds, providing valuable insights for both academic scholars and practitioners in the field of cinematic VR.

Acknowledgement

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Lastly, I dedicate this work to my family: my beloved wife, Laleh, and my lovely daughter, Melodie. Their love, support, and sacrifice have been my greatest source of strength and inspiration. This thesis is a testament to their unwavering faith in me, and I am forever grateful for their presence in my life.

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List of Abbreviations and Acronyms

AI – Artificial Intelligence

AR – Augmented Reality

CMT - Conceptual (Cognitive) Metaphor Theory

CVR – Cinematic Virtual Reality

DoF- Degree of Freedom

ICVR – Interactive Cinematic Virtual Reality

LBE – Location-Based Experience

MR – Mixed Reality

MWI – Many World Interpretation

NFT – Non-Fungible Token

PW – Possible Worlds

SR – Substitutional Reality

VR – Virtual Reality

List of Publications and Public Presentations

Boock Chapter:

- Mazarei, M. (2023). Story-Without-End: A Narrative Structure for Open-World Cinematic VR. In: Holloway-Attaway, L., Murray, J.T. (eds) Interactive Storytelling. ICIDS 2023. Lecture Notes in Computer Science, vol 14383. Springer, Cham. https://doi.org/10.1007/978-3-031-47655-6_20

Poster:

- Mazarei, M (2021). *“Interactive Storytelling for Virtual reality Medium by Real Walking inside Virtual Story World”.* [Poster]. Beyond Conference. UK: Belfast, Oct 2021.
- Mazarei, M. (2021). *“How non-experienced audiences immerse in VR movies”.* [Poster]. Communities and communication conference, Staffordshire University. UK: Stoke-on-Trent. April 2021.

Conferences and Seminar Presentation

- Mazarei, M. (2023). *“Story without-end; a narrative structure for open-world cinema”,* ICIDS Conference. Japan: Kobe, Nov 2023.
- Mazarei, M. (2022). *“Story without-end; a narrative structure for open-world cinema”,* Media and Performance Symposium, Staffordshire University, UK, Jan 2022.
- Mazarei, M. (2021). *“Generic Elements for designing Interactive Cinematic VR (IcVR)”,* Beyond Conference, Belfast, Northern Ireland, Oct 2021.
- Mazarei, M. (2021). *Interactive Storytelling for VR Medium; A cinema without-camera”,* Media and Performance seminar, Staffordshire University, UK, May 2021.

Festival Attendance

- A demo of the movie “Déjà vu” officially selected and exhibited in Laval Virtual Exhibition, Student’s Demo Competition, in city of Laval in France, in April 2022.

Glossary of Terms

The terminology presented below reflects the specific perspectives and school of thought adopted in this research. It addresses the complexity of concepts related to immersive media, which are interpreted differently by various scholars.

Virtual Reality (VR): A digital environment that completely immerses the user, replacing the real-world surroundings with a simulated one, often accessed through a VR headset.

Augmented Reality (AR): Overlays virtual objects on the real-world environment, enhancing it with digital information visible through devices like smartphones or AR glasses.

Mixed Reality (MR): Combines elements of both real and virtual worlds to create new environments where physical and digital objects co-exist and interact in real-time.

Virtual Environment (VE): A digitally created space designed to simulate physical presence in places in the real or imagined worlds, often interactive and navigable.

Artificial Intelligence (AI): The simulation of human intelligence in machines that are programmed to think and learn like humans.

AI Foundation Model: Large AI models that provide a base layer of understanding and capabilities, which can be fine-tuned for specific tasks or applications.

Generative AI: A type of AI designed to create new content, ranging from text to images, music, and more, based on learning from a dataset.

Cryptocurrency: Digital or virtual currency that uses cryptography for security, enabling secure, anonymous transactions.

Non-Fungible Token (NFT): A unique digital identifier that cannot be copied, substituted, or subdivided, recorded in a blockchain, and used to certify ownership and authenticity of a digital asset.

Story-world: The universe or setting where various storylines unfold through a specific mechanism that wraps the narrative together. It includes a space-covered, characters, moving objects, and designated events that make up the story. The story-world is governed by rules that ensure the different storylines connect in a coherent and consistent manner.

Immersive Narrative: An event that crafted by a designer to represent a designated duration for the changes within the immersive environment, considering the agency of the designated avatar embodied by users to explore a verity of timelines dispersed inside a story-world.

Wanderer Audience: This term refers to viewers of an immersive cinematic experience who have the freedom to explore the entire story-world without restrictions on time and space. The ability of wandering grants the viewer to discover a unique temporal perspective over the story progression.

Temporal Perspective: The understanding of story's temporal succession by wanderer audiences that reflect the way they comprehend changes within the story-world. This understanding is shaped by their unique position and viewpoint, allowing them to see how things move and transform within the environment.

Open-World VR film: Open-world storytelling for VR film is defined as a non-linear story in which episodes are spatially dispersed within a 3D environment. The episodes are connected through narrative threads that establish the causality between the temporal and spatial coordination of episodes within 3D setting; thus, the design of open-world VR film provides audiences a real-time exploration of pre-recorded immersive narratives.

Immersion: Relies on the mediation of technology which provides a degree to which a user feels absorbed or engaged in a virtual environment, story, or activity.

Engagement: This term refers to the active exploration of an environment, indicating how involved, interactive, or emotionally invested a user is with a digital experience or narrative. It reflects the depth of the user's connection and participation with the content.

Presence: The feeling of being physically present in a non-physical world or environment.

Virtual Presence: The feeling of being in a virtual environment, as opposed to the physical world, facilitated by immersive technology (VR helmet, controller, etc.) and immersive contents (narratives, gaming, etc.).

Objective presence: The feeling of being present inside a non-physical environment mediated by immersive technology like VR, AR or MR.

Subjective presence: The feeling of being an integral part of the immersive environment like one of story's character which arises by level of engagement with narratives.

Interaction: In an open-world cinematic experience, interaction is the freedom to navigate the pre-designed story-world which results users to experience a psychological state of indetermination, an uncertainty in understanding the pre-set narratives within the whole of virtual environment.

Level of Agency: The degree to which a user can exert control or make choices that impact their understanding of virtual environment or interpretation of narrative outcome.

Degree of Interactivity: Refers to Crawford (2013) the extent and complexity of user interactions available within a digital experience, influencing the narrative or environment. Crawford evaluates the degree of interactivity of an interactive application based on the speed of response, the depth to which the user can influence the VR system through interaction, and the variety of choices available to the user.

Perception: The psychological process by which users identify, interpret and make sense of sensory information from the external world.

Sensation: The immediate physical response to environmental stimuli, such as sight or sound, which is sent to the brain as information about external world.

Feeling: A perception from the changes within virtual environment which reflects as emotional responses to external events.

Emotion: A complex psychological state involving thoughts, feelings, and physiological changes, often in response to a narrative or external incidents.

Emotional arousal: The level of physiological and emotional excitement or stimulation prompted by immersion in a virtual stimulus or facing an event in external environment.

Emotional contribution: The impact of emotional responses on user's engagement with narrative or virtual experience.

Memory-Retrieving Process: The memory-retrieving process involves recalling information from memory systems. There are typically two types of memory systems: a slow-learning system, which accumulates knowledge from repeated experiences and forms general representations, and a fast-learning system, which quickly forms episodic memories of specific events.

Association Processing: Association processing is a type of cognitive processing that relies on patterns of features built up over time in the slow-learning memory system. It operates quickly and automatically, retrieving information based on the similarity of current stimuli to past experiences. This type of processing often results in intuitive judgments and is reproductive, using available cues to retrieve existing representations from memory.

Rule-Based Processing: Rule-based processing is a more deliberate and effortful type of cognitive processing. It involves the use of symbolically represented rules and culturally transmitted knowledge to interpret information. This processing mode draws on both the slow-learning and fast-learning memory systems, utilizing explicit, symbolically encoded rules to guide thought processes. Rule-based processing is typically used when individuals have both the cognitive capacity and motivation to engage in deeper, more structured reasoning.

Room scale VR Experience: Allows physical movement within a designated area, mirroring user actions in the virtual environment for immersive interaction.

Seated VR Experience: Users experience VR from a seated position, using head tracking and controllers for interaction, suitable for stationary experiences.

Three Degrees of Freedom (3 DoF): Tracks rotational head movements only—pitch, yaw, and roll—suitable for static VR setups.

Six Degrees of Freedom (6 DoF): Tracks both rotational (yaw, pitch, roll) and translational in three axis (x, y, z) movements, offering a highly immersive VR experience with realistic user movement simulation.

Plot-centric Storytelling: Plot-centric storytelling emphasises a structured sequence of events driving the narrative. In VR, this approach ensures users follow a specific storyline, with interactive elements revealing the plot as they progress. The focus is on maintaining a cohesive, engaging narrative that keeps users immersed in the unfolding events.

Character-centric Storytelling: Character-centric storytelling centres on story's characters' development and interactions. In VR, this approach allows users to experience the world through the characters' perspectives, influencing the narrative through their choices. The emphasis is on creating a rich, immersive experience driven by characters' motivations and relationships.

Disorientation (in Virtual Environment): Disorientation in a VR environment occurs when users lose their sense of where their body is in relation to their surroundings. It results in losing dramatic elements because the brain struggles to process conflicting sensory information from the virtual world, leading to confusion about objects' position, motion, and orientation.

VR Motion Sickness: VR motion sickness happens when there is a mismatch between the visual movement perceived in the VR environment and the lack of corresponding physical movement. This sensory conflict can cause symptoms like dizziness, nausea, and discomfort.

Multiplicity: Multiplicity in Deleuze's ontology refers to a concept that describes the complex structure of reality. It denotes the various dimensions and layers that interact to form what we perceive as singular entities. Multiplicities are characterised by their non-linear organization, unclear causality, and non-fixed spatial arrangement, making them a foundational element in Deleuzian thought.

Rhizome: The rhizome is a metaphor used by Deleuze and Guattari to describe a non-hierarchical and non-centralised network of elements. Unlike trees or roots, which follow a linear progression path, rhizomes connect any point to any other point, representing a model of thought that is dynamic, interconnected, and constantly evolving. This concept opposes traditional, hierarchical structures and emphasises the fluidity and multiplicity of connections within any system.

Subjectivity: Subjectivity in Deleuze's ontology, influenced by Henri Bergson, refers to the dynamic and evolving process of forming personal identity and consciousness. Bergson emphasises duration (la durée), the continuous flow of internal time, and views perception as an active engagement where the mind selects and interprets sensory information based on past experiences and future actions. This process, characterised by a delay in reaction, a duration which allows individuals to create meaningful connections with their surroundings. Deleuze builds on this, seeing subjectivity as a fluid narrative shaped by continuous interactions with the world and internal cognitive processes, emphasising temporality and memory in personal identity formation.

Virtuality: Virtuality, in Deleuze's ontology influenced by Henri Bergson, contrasts with actuality and refers to the realm of potential experiences and states that are not yet actualised. Bergson views virtuality as integral to consciousness, where the mind continuously interacts with the material world to form virtual perceptions, actions, and memories. This concept underscores the dynamic and temporal nature of reality, where the virtual represents the potential for change and new forms of existence. In cinema and VR, virtuality involves the creation of immersive environments where representations are always virtual, allowing for an exploration of potentialities over actualities.

Introduction

1. Project overview

This PhD project investigates interactive storytelling methods in the realm of Cinematic Virtual Reality (CVR). Cinematic VR refers to the integration of cinematic storytelling techniques within immersive virtual reality environments. It combines the narrative theories and visual aesthetics of traditional cinema with the interactive and immersive capabilities of VR technology. In CVR, viewers are placed within a 360-degree virtual environment where they can explore and interact with the story from multiple perspectives. It can be a seated experience of 360 footages or room-scale navigation through an open-world setting. This approach allows for a non-linear narrative structure, where viewers can influence the unfolding of events, creating a personalised and participatory storytelling experience.

In this context, CVR enhances emotional and empathetic engagement by providing a sense of presence and realism that traditional cinema cannot achieve. Thus, CVR has the potential to immerse its audiences in the cinematic world like a real-life experience. It allows viewers to freely walk around the film set and explore the storylines dispersed in an immersive environment as they wish.

In parallel with such immersive experiences, live performances that employ immersive technologies also invite audiences to engage in real-time explorations of performances that may occur in distant or parallel spaces. Incorporating interactivity within these live performances to connect audiences and performers through shared, spontaneous exchanges recalls the improvisational nature of theatre practices, notably articulated by Augusto Boal in *Theatre of the Oppressed* (1979). Nevertheless, this research does not aim to recreate methods for live performance; rather, it seeks to develop a framework for interaction with pre-constructed narrative content distributed throughout a three-dimensional story-world. This content is made accessible to audiences through dedicated interaction tools and locomotion techniques that enable free exploration of the virtual environment. In this context, interaction and the process of constructing meaning through exploration of the story-world form the central focus of this research.

Thus, in this practice-led research project, the perception process for wandering audiences of Virtual Reality (VR) film is investigated to find elements that increase emotional contribution and narrative engagement in an immersive cinematic experience and to define locomotion techniques which reduce the negative effects raised by immersion in VR stimuli. This study contributes to existing knowledge of cinematic VR by proposing an original method for designing open-world cinematic VRs, titled "Story-Without-End." It also reconstitutes a terminology for interactive filmmaking within the medium of VR by examining Gilles Deleuze's ontology of cinema, articulated in the books *Cinema 1: Movement-Image* (1986) and *Cinema 2: Time-Image* (1989), through a creative practice titled "Déjà vu."

2. Aims and Objectives

The project's aims to:

i. Develop a thorough theory for analysing the engagement of wanderer audiences in cinematic VR narratives.
ii. Establish design principles for a storytelling framework that enhances narrative engagement and employs effective locomotion techniques to prevent disorientation within the story world.
iii. Design a creative practice that is unique to the VR medium and provides wanderer audiences with a cohesive cinematic experience.

To achieves this goal, the objectives of the project are:

a) Observing and analysing the perceptual process of VR audiences within virtual narrative worlds in real-time by conducting tests and utilising a constructive grounded theory to identify the type of emotional engagement for VR narrative experiences. (aim one)
b) Conducting experiment to investigate the impact of non-linear timelines and non-isomorphic durations in immersive environments on VR audiences' interactions and locomotion. (aim two)
c) Designing and examining a cohesive narrative structure through a creative practice that interlinks storylines dispersed across an open story-world, replicable to other interactive VR practices. (aim three)

3. Project contribution to knowledge

The proposed ontology for open-world cinema in this project, which is reviewed in Chapter One, considers VR audiences as participants in the creation of the cinematic narrative within an immersive medium. It views their interactions in following and responding to dramatic content as complementary actions that shape the cinematic experience.

In this context, the second chapter of this dissertation specifically explores the intersection of Gilles Deleuze's theories on cinematic narrative to devise a framework tailored to the unique capabilities of “wanderer audiences”, a term originally used in this research. The focus is on examining the conditions under which a "wanderer camera" (Deleuze, 1989) can replicate its properties for a wanderer audience in a cinematic VR experience. This framework, initially, provides a "movement-image" regime (Deleuze, 1986) that can be used to articulate methods for structuring an open story world and integrating pre-recorded content within an immersive setting. Moreover, the freedom of wanderer audience to explore the story world extract a “time-image” regime (Deleuze, 1989) that grants the consistency of story progression for any perceivers.

To examine the proposed narrative structure and cinematic terminology derived from Deleuze theories, this research consists of three distinctive studies: perception process, narrative engagement and disorientation. The Chapter Four describes the first study on perception process. This study challenges previous characterisations of VR film audiences as largely considered passive observers during their experience of cinematic VR (Zhang et al., 2023; Carpio et al., 2023; Bindman et al., 2018). Through observing audience behaviours throughout the experience, the study seeks to determine if engagement in VR narrative represents a passive “transportation” (Mateer, 2017) into immersive content which indicate an empathetic emotional contribution to the narrative, or alternatively, it brings an active elaboration of incidents to unfold and find causality of narratives which involve audiences in the story progression in a manner akin to a story’s character with self-directed emotional experience.

In this context, this research employs an original approach to study participants’ perceptual process draws on Henri Bergson's theory of the “Creative Mind” (2002) which propose "feeling of duration" as a gauge for perception process. It is the perception of changes in surroundings unique to each individual and can serve as a measure of narrative engagement. The importance of studying the feeling of duration as an indicator of the perception process becomes clear during the design stage of this project. Observing audiences’ understanding of duration in a non-linear timeline and analysing their reactions to unusual representations of time in a VR narrative world helps to understand how dispersed storylines within an immersive story world are better perceived by a wanderer audience.

Therefore, Chapter Four of this dissertation discusses the findings of research on participants perception process to determines the specific characteristic of VR medium in comparison to 2D screen viewer, which is reflected in their perception of duration for non-isomorphic changes within immersive environment.

Subsequently, Chapter Five which focuses on a second study within this research scrutinises the factors that impact engagement with the narratives in a non-linear structure. Considering that the wanderer audiences in a VR film replaces the position of the camera in conventional cinema, they find freedom to navigate within the story world, which introduces indeterminacy in expressing story progression. This concept signifies a shift from traditional cinematic montage to a more interactive narrative exploration, positioning the wanderer audience in the roles of both cinematographer and editor within the story world. Thus, this chapter discusses the finding about the engagement of participants in a non-linear movie’s timeline to define the condition for better participation of VR audiences in a narrative journey across film settings.

Finally, the potential negative effects of disorientation in virtual environments are investigated in a separate study which is discussed in chapter six of this thesis. Participants who experienced the non-linear VR film faces a different kind of 360-camera motions in a seated situation. Each camera motion represents a type of locomotion technique that can be designed for transporting audience's virtual body (avatar) within the immersive environment. Hence, the research observes audiences' behaviours to stipulate which type of camera motion enhances narrative engagement and minimises distractions and the negative effects of disorientation; consequently, it defines a taxonomy for the impact of locomotion techniques on wanderer audiences in a cinematic VR experience.

4. Ethical considerations

The ethical considerations for this project focus on participant safety, informed consent, data privacy, and minimising adverse effects of disorientation. Due to COVID-19 regulation, participants of first test are recruited via social media, however, they are provided with informed consent through detailed forms. Also, the study ensures participant anonymity by not collecting personal identifiers and securely storing data on password-protected devices. Participants are able to withdraw from the study at any time, and their data will be retained for six years following university regulations.[1]

To address potential risks like motion sickness, participants are advised to stop the VR experience if they feel unwell. The second experiment immerse participants in an unusual situation compared to real-life experience as various type of camera motions are designed to investigate VR locomotion techniques. The film also represents non-isomorphic events and inorganic time representation to emphasise the virtual nature of the story world. In this condition, clear signs within the VR environment help distinguish it from reality, and a consent letter informs participants to suspend their sensory credibility during the experience.

5. Conclusion

Through three studies which examines VR audiences' behaviours, the research justifies the reconstitution of an original terminology and conceptual foundation for cinematic VR. This includes advocating for the development of tools that facilitate the creation of a "virtual body", the avatar of the wanderer audience that allows them to navigate the narrative space. In this context, the research introduces and discusses the concept of "virtual duration", the subjective perception of duration by wanderer audience, contribute to the realm of cinematic virtual reality by replicating the concept of “cinematic time” (Stiegler, 2011, p.30) as it ensures the consistency of time representation in an immersive narrative experience. The study also revisits and refines terms such as spatial shot, out-of-field, depth-of-field, and montage within the context of immersive media. Additionally, it proposes relevant definitions for "story-world" and "cinematic narratives" tailored to immersive storytelling.

[1] Find the form for full ethical approval and consent letter in the Appendix I -Full Ethical Form – Approved..

In conclusion, this dissertation outlines "Story-without-End," a method for weaving together concurrent narrative timelines within an open-world VR cinema. This method originally establishes exploration patterns that highlight the interactive nature of an immersive storytelling form. The research culminates in "Déjà vu" as a creative practice which explores the construction of interconnected virtual worlds with a "rhizomatic" structure (Deleuze and Guattari, 1976). Additionally, it examines the "principle of infinity", the contribution of "Story-without-End" framework to interactive immersive storytelling that embraces narratives without definitive endings, thereby inducing a feeling of indeterminacy as viewers explore the story world.

Chapter one: Perception and Interaction in Cinematic VR

1.1. Perception

1.1.1. What is perception?

When studying perception, the goal is to understand the mental activities that help to form a broad view of the surrounded world. “Perception, in humans, is the process whereby sensory stimulation is translated into organized experience” (Epstein, Et. al., 2024). It means that perception results from both the incoming stimuli and how these stimuli are processed. By examining how different stimuli (like light and sound and movements) lead to perceptions, educated guesses can be made about how the process of perception works. This involves recognising oneself and linking one's identity to the outer world. From such investigations, theories can be developed about how an individual perceives. Thus, the conceptualisation of perception involves the convergence of two distinct realms, namely the "inner world" as expounded by Henri Bergson (2002), and the external world. Bergson, in his work "Matter and Memory" (1991/1911), delineates this encounter as the interplay between matter and mind.

Alternatively, Gestalt theorists, like Fritz Heider (1920), argue that our ability to organise what we perceive is built-in from birth. It's a natural part of how our brains work, not something we learn by putting simple things together to make complex wholes. As Heider himself said, "solving theoretical problems often doesn't require experiments. We can figure them out based on everyday experiences" (Heider, 1983, p. 87).

In this context, some theorists believe that organisation in perception comes from learning. Gibson (1969) suggests that repeated exposure to things happening together leads us to link them mentally. Perception, for theorists like James Gibson (1967) and Eleanor J. Gibson (2002), is a direct process. We don't need past knowledge or guesswork. The information our senses pick up is detailed enough for us to make accurate judgments about our surroundings.

However, according to Bergson (2002), forming general ideas about external reality is consisting of using background knowledge to find meaning and then creating novel concepts. Conscious beings use these concepts to understand the world around them. This process starts with noticing new things in our environment that challenge our previous knowledge. Our intelligence kicks in as we watch objects interact and things move over time. We actively look for and interpret meaningful signs from these interactions, allowing us to build facts. By recognising the connections between these facts, consciousness can then draw conclusions, ultimately leading to a broader understanding (generalisation) of reality.

In this respect, Bergson’s theory can shed light on the process of perception in virtual reality (VR) experiences. It provides explanation for how the human mind functions when encountering an entirely new experience, which is relevant to many individuals still have been experiencing virtual environments as a novel experience. Referring to Bergson (2002), when a conscious being encounters something novel, its intelligence instinctively begins to shape the phenomenon into a comprehensible idea. Bergson characterises this shaping process as "subjectivity" (Bergson, 1991). According to him, we have a tendency to extract essential facts from a given situation to assert control over our intellect when interpreting new laws.

Nevertheless, the process of perception initially involves self-identification. From the perceiver's perspective, its body is not merely a mathematical point in space, leading to the assertion that "no perception takes place in a mathematical instant in time" (Ansell-Pearson, 2005, p. 1116). Instead, the individual body, functioning as an organic entity, introduces a delay in reaction to effectively construct a perception across spatial distances. As expressed by Ansell-Pearson, "Perception measures the possible action of a body over things and vice versa" (ibid, p. 1117).

In this context, as discussed by Sermijn et al. (2008) regarding the concept of "rhizome", introduced by Deleuze and Guattari (1976), the self is not a static or fixed entity; rather, it embodies a fluid and continually evolving narrative. The metaphor of the rhizome characterises the approach to understanding the "self-as-a-story," (Sermijn et. al., 2008) akin to a rhizome, a plant with no central root but an intricate network of interconnected roots. This metaphor illuminates the conceptualisation of thinking as an experiment, applying rhizomatic thinking to the process of self-identification.

Sermijn et al. (2008) posit that the self-stories, amassed as memories, exhibit "monstrous" properties, characterised by non-linear organisation of time, unclear causality, and a non-fixed spatial arrangement. These elements render them a rhizomatic, interconnected narrative of self, conceptualising the entirety as a "multiplicity" (Deleuze & Guattari, 1976). Thus, for VR audiences who immersed in a story world in which storylines organised and interconnected in a verity of space-time blocks, the perceptual process applies a rhizomatic understanding of durations dispersed as multiplicity of movements in surroundings which results in a personal feeling about the duration of changes in external reality.

Nonetheless, the pivotal factor initiating the entire process of understanding reality is the fulfilment of intellectual curiosity. The cognitive process is motivated by the proposition that every consciousness inherently seeks to anticipate the future. Human minds initiate the formation of a pre-existing reality in the form of potentialities. "We do not, in general, aim at knowing for the sake of knowing, but at knowing in order to take a stand, gain a profit, in fact, to satisfy an interest" (Bergson, 2002, p. 140). Therefore, generating interest in a conscious being is paramount to engaging a reader with a narrative. Bergson contends that the role of an artist is to enrich human perception by introducing novel possibilities. For him, the creation of artwork involves disrupting the order of perception within the human mind. Consequently, comprehending the perceptual process and utilising background knowledge is pivotal to understanding how an artist can guide audiences to perceive novelty.

1.1.2. Background Knowledge

Smith and M. Coster (2000) and Smith and Collins (2009) have delineated two distinct processes for recollecting accumulated memories, aiding in the interpretation of a phenomenon. The first is "association processing," operating subconsciously to retrieve categorised information, even going so far as to "filling in unobserved details and the like" (Smith, & M. Coster, 2000, p110) to construct a comprehensive representation of the typical properties of the environment. Conversely, "rule-based processing" engages consciousness and utilises symbolic rules, such as words and concepts. It is a theory-based analysing which "bind together information about different aspects of an object or [novel] experience in its context" (Wiles & Humphreys, 1993, p. 160).

In connection to this, the memory system employed by an individual to recall memories from a virtual reality (VR) experience offers insights into their intellectual and/or emotional engagement with the content. Opting for a rule-based system implies the user's endeavour to intellectually interpret the immersive situation, while association processing suggests a more emotionally engaged interaction with the virtual world.

However, the human mind necessitates motivation and cognitive capacity to engage with novel phenomena (Smith and Collins, 2009). In instances where individuals possess low cognitive capacity or motivation, their elaboration predominantly relies on salient peripheral cues and applies a “similarity-based” analysis (Clark, 1997). However, it is imperative for them to consciously assess the relevance of these peripheral cues. "If a quick glance leads to a tentative answer supporting one's existing beliefs, self-interests, self-presentation, or goals, little further processing is likely to occur" (Smith & M. Coster, 2000, p. 120).

However, in a VR narrative experience, users might confront a dramatic incident leading to an unforeseen change in the environment, causing a sense of unfamiliarity and a lack of applicable rules to make sense of the situation. Consequently, users resort to manipulating past experiences and condensing them into new symbolic concepts. In this context, users transition from similarity-based categorisation, utilising familiar cues to retrieve relevant rules, to theory-based categorisation, "by focusing attention on the most correct or appropriate aspect of the input" (Clark, 1997, p. 167).

Thus, when VR audiences encounter a non-isomorphic dramatic movement in their surroundings, they are driven to construct their personal interpretation, which hinges on their ability to elaborate the novelty of phenomenon, thereby unveiling distinctions in their cognitive capacity which reflect in their perception of the duration of changes in their surroundings (Bergson, 2002).

1.1.3. Perception of duration

As Bergson expounds, when the human mind perceives a movement, be it regular or irregular, the intellect perceives "movement just as a series of positions; the duration of movement will then break up into 'moments' corresponding to each of the positions" (Bergson, 2002, p. 31). This forms the foundation of Bergson's theory regarding the reconstitution of time as duration. From this standpoint, our comprehension of time involves the intersection of two distinct durations: the duration of the external world and the inner duration. The moments and relative positions merely represent "snapshots" captured by our understanding to construct a sense of "continuity" (Bergson, 1991), shaping our perception of external duration.

As Bergson contends, in the process of forming an impression of external duration, our consciousness turns to "an inert world" (Bergson, 2002) when confronted with a novel situation to anticipate future occurrences. Within this inert world, the sense of duration regarding the external movements is shaped through "a series of infinitely rapid repetitions or quasi-repetitions" (Bergson, 2002, p. 71), signifying changes in the external world. This rhythmic pattern delineates the life of conscious beings and how it gauges duration based on the perceived rhythm. In simpler terms, the internal progression of concepts, recalled by consciousness, aligns with the sequence of movements in the external world. Simultaneously, observers undergo a "specific wait" (Ibid) to apprehend these external movements. In this context, the feeling of duration arises from the hesitancy in recognising changes and predicting subsequent movements.

In narrative artworks, specifically within the realm of cinema, Deleuze (1986) characterises a "cinematic illusion" by highlighting cinema's unique ability to create moving images through orchestrating movements within a narrative world. In the cinematic realm, the snapshot, symbolised by twenty-four frames per second, serves as the fundamental unit employed by filmmakers to manipulate durations within the narrative world (Bazin, 2005). Consequently, filmmakers wield the power to manipulate the reader's perception of duration by crafting dramatic durations within the story-world (Deleuze, 1986).

In this respect, within an immersive narrative environment, the audience's perception of duration correlates with the depth of their engagement with the story, as they read and interpret the conceptual flow crafted by the storyteller. Thus, the internal perception of duration differs from the objective timing of movements, contingent upon the comprehensive process of assimilating the “whole” when confronted with alterations in the external reality. In this regard, the extent of freedom granted to a virtual body for exploring the virtual world directly influences the expansiveness of perception of time by presenting potentialities that can be actualised through audience interactions.

However, this perception of duration is not uniform across individuals, reflected in the schema of personality. Minchin (2013) characterises this individual perception of duration as pure duration. According to her, the inner feeling of duration “enables us to enter into the depths of ourselves; its characteristics are qualitative, heterogeneous, and inseparable" (Minchin, 2013, p. 14). In this context, when referring to present time, our consciousness contemplates a specific duration interval. In other words, the distinction between present and past is, “if not arbitrary, at least relative to the extent of the field which our attention to life can embrace… But there will always be something arbitrary in its choice of that privileged perception" (Bergson, 2002, p. 105, 106). Thus, the understanding of present time forms the basis for distinguishing personality as it engages in the interpretation of the external world—an individualised undertaking of recalling memories that related to extent of the feeling of being present there, a virtual presence within an immersive story world.

1.1.4. Virtual presence

The term "presence" has been defined in various ways in the literature of VR experience. Sheridan (1992) characterises it as a "mental manifestation," while Draper, Kaber, and Usher (1998) view it as a "general existential phenomenon." Berkman and Akan (2019) and Cavazza and Young (2016) define it as a "cognitive state" marked by a sense of "being there" within an environment.

Lombard and Ditton (1997) elaborate on the concept of presence, characterising it as the "perceptual illusion of non-mediation" (Lombard and Ditton, 1997). This denotes a level of experience where both technology and the external physical environment become imperceptible to the user. Virtual presence shares similarities with telepresence, as both aim to create the impression that the user is situated in a particular place or environment, even when physically absent from that location (Furht, 2008). Thus, virtual presence in narrative VR denotes a perceptual process in present time wherein "the term perceptual shows that the illusion involves continuous (real-time) responses of the human sensory, cognitive, and affective processing systems to objects and entities in a person's environment" (Riva et al., 2007).

In simpler terms, virtual reality technologies engage users with virtual content, creating simulations that can be perceived as direct real-life experiences within a virtual environment. While users acknowledge the mediated nature of VR technology, the degree of immersion is contingent upon their willingness to identify themselves as integral parts of the virtual world (Cavazza and Young, 2016). In this context, "immersion" refers to the technology's ability to induce presence, the feeling of "being there" (Slater and Steed, 2000), enabling users to conceptualise their position within the new environment.

Consequently, notwithstanding the graphical representation and technological capabilities of the medium, the user's role plays a decisive role in determining the type of virtual presence. According to Riva et al. (2007), "presence is not influenced solely by the environment's graphic realism, display dimension, and other technological features but, to a great degree, by the characteristics of the experience, including the emotional ones, provided by the technology." (Riva et al., 2007, p. 54),

In this context, two significant factors influence the level of presence in a virtual story world; technology and narrative, distinguishing between two types of presence; objective and subjective presence. Wallach (2012) emphasises that "presence is influenced by personality and technological factors, as well as by the interaction between the two" (Wallach, 2012, p. 107). In other words, objective presence in virtual space is linked to the technological and graphical aspects of stimuli, while subjective presence, driven by engagement in the narrative, shape an emotional contribution to the narratives which enables users to perceive themselves as an integral part of the story world.

1.1.5. Narrative engagement

The situation of VR audiences engaging with a story differs from that of spectators watching a 2D movie. The distinctive feature of the VR medium is that each individual undergoes immersion in a virtual world, a simulation of real life, before delving into the narratives conveyed through visual representations (Louchart and Aylet, 2003). The VR user's experience of virtual presence is influenced by several factors, notably their personality, which contributes to variations in the level of immersion. (Soto, et. al., 2016)

Narrative VR immersion actively involves participants in identifying the causality of movements within a virtual story world. Hence, the act of interpreting the story requires an additional effort, a subjective presence, to connect with the content presented by the virtual system (Hu and Bartneck, 2008). This engagement in narrative goes beyond the process of elaborating a real-life simulation and elevates interaction with VR stimuli. In other words, VR audiences "occupy the same environment as the characters in the film" (Yu et al., 2016, p 4).

Alternatively. as Mateer (2017) explores, involvement in reading the story leads to a state of "transportation" (Green and C. Brook, 2000, p 701) into the narrative. Mateer equates the concept of transportation to Coleridge's "suspension of disbelief"[2] and asserts that

[2] The concept that emotional involvement in a narrative requires audiences to react as if the characters are real and the events are occurring in the present, despite being aware it is 'only a story.' British poet Coleridge coined it as the "willing suspension of disbelief for the moment" in 1817, specifically referring

transportation "is not unique to medium or genre and requires that the recipient be able to develop a compelling mental model of the narrative world and circumstance, including knowledge of character or subject; full transportation equals full concentration equals full engagement" (Mateer, 2017, p 20).

In simpler terms, transportation into a narrative necessitates a concentration on the unfolding story as a convergent process. Conversely, the creation of a fully immersive virtual space involves a divergent process of scrutinising the entire surroundings, influenced by personal judgments. Green and C. Brook (2000) explain that "connections are established to an individual's other schemas and experiences 'under high elaboration.' In contrast, under high transportation, the individual may be distanced temporarily from current and previous schemas and experiences" (Green and C. Brook (2000, p. 702).

Therefore, immersing a surrounding story world among the characters of a pre-scripted reality prompts an additional effort to scrutinise and investigate the signs implemented within the virtual space as diegetic cues. These cues serve to illustrate the connections between different "sets" (Deleuze, 1986) of the story world and offer an understanding of the whole. This process significantly influences the level of immersion by providing a subjective experience. It involves the audience in an "involvement" (Cavazza and Young, 2016) with an additional layer of reality, which necessitates a more effortful analysis process — a rule-based processing in which storytelling conventions determine the rules. Thus, narrative engagement in an immersive environment is more akin to elaboration than transportation, as it demands an active role rather than a passive one. Kim and Lee (2022) suggest that in a virtual environment, the observer has an active role in creating the aesthetic experience, rather than being a seldom passive viewer.

In essence, the audience' agency changes the narrative engagement for VR medium to an act of analysing the changes in an active role. The element of change is that whether audiences' interaction be a seated exploration of surrounding or a full-body movements that engages various senses, the consciousness behind the virtual body of user has a subjective presence inside story world with an emancipated viewpoint to explore the changes.

This distinctive aspect of the narratology in VR medium lies in offering a specular form of enjoyment compared to traditional cinema. Immersive film experience provides a mental state that reflects two forms of enjoyment, one derived from full body immersion in a real-life simulation and the other raises by ability of exploring a world of accessible narratives as a

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to literary works' audiences. Schramm argues that this expectation extends to all forms of entertainment (also see entertainment function): individuals are "prepared to go along with a story or a spoof or a good joke, to identify and agonize with a character who never lived... to have a certain empathy with fictional characters, to go along with the conventions of films or broadcasts" (Chandler and Munday, 2011).

pleasurable activity. The psychological mechanisms contributing to these enjoyments are associated with both immersion and narrative engagement. Immersion indicates a high level of cognitive involvement, while narrative engagement refers to the feeling of being a part of virtual world (Jennett et al., 2008; Steuer, 1992; Sanders & Cairns, 2010). Thus, distinguishing the types of enjoyment among participants in a VR experiment, provides insights on the extent of narrative engagement in comparison to the level of immersion.

VR enjoyment involves the heightened satisfaction, positive affect, and overall positive experiences reported by users in comparison to traditional 2D movie watching, as supported by various investigations (Ijaz et al., 2020; Klimmt et al., 2018; Shafer et al., 2019). Research on VR enjoyment indicates that users express this satisfaction through positive evaluations of graphics, sound quality, and overall satisfaction in VR interaction (Shelstad et al., 2017; Peng et al., 2019). Studies reveal that VR immersion triggers more positive affect, happiness, flow, and surprise compared to non-VR experiences (Pallavicini et al., 2018, 2019; Pallavicini & Pepe, 2019). It is important to note that VR devices may not always result in positive experiences, as they can also amplify negative emotions such as distress, nervousness, discomfort, or shame (Hartmann & Fox, 2021; Lavoie et al., 2021).

However, while various distractions can break virtual presence and reduce the level of immersion, enjoyment of narrative engagement can compensate adverse effects depends on the reader's effort to follow causality links between dramatic events. Immersion in the virtual environment and engagement with the narrative hinge on the distance between users and the roles they are expected to embody in the experiment. This distance may stem from various factors such as system limitations, real-world distractions, or simply an experiment lacking emotional appeal. Bouvier (2008) notes, "Emotions will help to reduce this distance by distracting users' attention from these disturbances and thus may encourage users to get caught up" (Bouvier, 2008, p. 3). In simpler terms, "even a low-immersive system may induce high levels of presence if the VR scenario engages emotions" (Chirico & Gaggioli, 2019, p. 222). It means that the VR designers strategically are able to manipulate the level of presence and controls emotional contribution by facilitating the audience's transition from an objective, ghostly observer to an interventionist interactor (Cavazza and Young, 2016).

In this context, in the immersive medium of VR, the filmmaker orchestrates patterns of interaction and audience' agency to manipulate the environment, rather than framing the camera. As a result, the director maintains control over the emotional contribution to the story by providing user interaction tools to unfold the narrative. Thus, narrative engagement in an interactive VR movie is evidenced by the user's trace of interaction with the story-world, actively exploring the surroundings to discern the causality of events.

1.1.6. Disorientation and the importance of guiding wanderer audience

A crucial tool for VR users to immerse themselves in a virtual environment involves enhancing their ability to analyse their physical body coordination through their Point of View (PoV) in relation to the orientation of the virtual space (Azar, 2021). This factor significantly influences the level of presence, thereby affecting the user's engagement and interpretation of phenomena in virtual environments (Slater & Steed, 2000).

In this context, becoming disoriented adversely affects the quality of the immersive experience. Disorientation is a mental state characterised by a loss of control over physical posture and is defined as the "inability to determine one's true body position, motion, and altitude (or, in water, depth) relative to the Earth or one's surroundings" (Britannica, 2003). According to this definition, disorientation may stem from a brain or nerve disorder, or limitations in the normal sensory apparatus. Key orientation cues are typically received from the eyes, ears, muscles, and skin. "The senses may not perceive gradual changes in motion and may overestimate the degree of abrupt changes and overcompensate when motion stops" (Ibid).

As a result, immersing oneself in a virtual world through sight and sound senses while the other body senses are still engaged with the physical world may induce spatial disorientation in the audience's movements within the immersive environment. Whether audiences' motion is facilitated by a camera led by a cameraman or intentional body and head movements, disorientation proves to be a crucial factor determining the user's ability to comprehend the image in their surroundings and significantly affects their engagement with the narrative, as it influences the user's ability of exploration (Fearghail et al., 2018).

Moreover, the inability to locate story elements that assist in unravelling narratives within an immersive environment generates a sense of disorientation, impacting the quality of the experience and virtual presence (Rothe et al., 2017; 2019). However, as audiences actively explore their surroundings and successfully identify cues to follow the narrative, their virtual presence is expected to improve. In this regard, designing an immersive experience highly necessitates considering methods to guide audiences in finding dramatic cues and following the narrative in their surroundings, allowing them to unfold the relationship of dramatic incidents through story progression.

To design the guiding method, it should be considered that how many senses will be engaged in experiencing and interacting with the application. Conventional cinema is an audio-visual art presented through a 2D or 3D screen with a stereo or surround sound playing system. However, the VR medium can provide haptics, engage the sense of touch, and transforming the visual field into an immersive representation of moving pictures. In other words, VR uses the senses more like a real-life experience. Thus, the guiding methods used in the actual world can be applied in a VR simulation, including light, sounds, colours, signs, pathways, etc. The key aspect is that in a VR simulation, these signs are related to a story that determines the convention of the virtual world. Moreover, the guiding signs' effectiveness is determined by how they become "diegetic" or "non-diegetic" in relation to the story (Rothe et al., 2017).

Considerably, the factor that distinguishes a story world from a real-life experience is its non-isomorphic dramatic durations pre-designed by a director. The VR filmmaker should consider that the time an observer spends investigating an immersive environment takes longer than reading a 2D image. Alternatively, extending the duration of an immersive shot can impact the story's progression and potentially render the story absurd for a group of experienced VR audiences. Thus, "to maintain story flow, the viewer's attention cannot be allowed to wander indefinitely. One way is to use audio cues, which can be highly directional" (Yu et al., 2016, p. 5). Sound and light can help the designer concentrate the audience on a specific area, guiding them to observe the movements and the action-reaction schemas that drive the narrative and facilitating the identification of threads between storylines for better interaction.

1.2. Interaction

1.2.1. What is Interaction?

Defining a particular condition for interaction in cinematic VR experiences means setting a particular level of agency for audiences to influence the pre-designed story world in real-time (Murray, 1997), which makes them an "interactor" (Smed et, al, 2019) in a pre-scripted story. This paradoxical nature of interactive narratives is evident in Adams's (2013) definition of narrative as "the unchangeable material presented to the interactor" (Adams, 2013, p. 25). In contrast, meaningful interaction occurs when the interactor engages with dynamic material that can be altered in real-time.

Smed, et. al., (2019) contends that the single interactions inside the experience are reactive. However, this reactive nature of interaction poses technological challenges from a narratological/authorial perspective, as it requires maintaining the flow and engagement of users with the story (Reyes, 2017).

In this respect, one of the main conditions of interaction, as Crawford (2013) states, "is a logical convention between two agents (human-human / human-computer), where each utterance makes sense with respect to the previous utterance and the agents' relationship" (Crawford, 2013, P. 29). This principle set the foundation for interactive storytelling that designer must consider the level of agency for audiences in exploring the story's episodes as part of process of designing story world.

Consequently, the interaction within a cinematic VR narrative is about giving audiences the ability to explore story-world freely which provide them a unique experience as they are obtaining a personal perception of the story's temporal progression. Subsequently, interactors have a different experience each time they use the system or at least be able to create several experiences from a story. This implies that interaction with narratives should yield a virtual presence for the audience, involving them in narratives as they focus on establishing a meaningful relationship between dramatic movements and making decisions to explore the story-world based on their interpretation of story's elements.

Therefore, for designing storylines in an open story world, it must be considered that audiences perceive a multiplicity of stories that concurrently progress in the surrounding. In this case, the level of agency to locomote within this open story world helps the audience generate a comprehensive understanding of the whole story.

In this context, Vallance and Towndrow (2022) introduce the concept of "Storyliving", where participants actively engage and immerse themselves in a story, feeling as if they are living within it. Unlike traditional storytelling, Storyliving focuses more on the participant's psychological process and experience "within" the story rather than just the narrative itself. Thus, storytelling in an open-world cinematic VR goes beyond traditional VR storytelling by giving participants more agency, personalisation, and dynamic interactions. It shifts from pre-defined, scripted narratives to a "Space-writing" (Reyes, 2022) which indicates a more active and participatory form of storytelling, allowing participants to shape their behaviours within the virtual environment based on potentiality for wandering around the story world and experiencing different possibilities for story progression based on their interactions.

Alternatively, designing an interactive story world can be referred to the narrative theory discussed by Marie-Laure Ryan (1991; 2006), known as Possible Worlds (PW) theory. This narrative theory draws parallels between the concept of parallel universes in physics and possible worlds in literature and narrative. PW theory posits narrative function as "machines for producing possible worlds" (Eco, 1984, p. 246). Developed by scholars like Umberto Eco (1984), Thomas Pavel (1986), Lubomír Doležel (1998), and Ruth Ronen (1994), and rooted in modal logic, PW theory provides a cognitive model for understanding branching fiction, exploring mental constructs of characters and conflicts within the narrative universe. This model confirms that the movement of individual worlds, which replicates dispersed episodes of a story within a VR 3D setting, constructing possibilities in the reader's mind for different interpretations of the story, leading to a feeling of indetermination.

1.2.2. Feeling of indetermination: Possibilities against Realities

To initiate interaction with the external world, an elaboration grants consciousness the ability to choose between different options. This involves a process of reading before engaging in interaction. However, the question that arises is how does consciousness feel the freedom to choose? Bergson (1991; 2002) sheds light on this by discussing how time prevents everything from being presented simultaneously. The reader encounters a delay in perceiving the movements and changes in the external world, resulting in a sense of freedom in perception and a corresponding delay in reaction. Therefore, elaboration induces a feeling of indetermination.

In essence, indetermination is linked to time, specifically the existence of duration required to comprehend reality. In other words, the time spending on perceiving serves as a liberating force, freeing us from the deterministic unfolding of the material world and providing us with the capacity to be creative. Bergson contends that there is an immediate perception that underlies the functionality of this freedom. Elaboration involves foreseeing the future in terms of possibilities, creating a pre-existing reality, and interacting with the external world to actualise some possibilities while making others inaccessible. Indetermination, in this context, emerges as a creative response to changes by predicting the future.

However, Bergson (2002) sees this function of human mind as a common mistake stems from that it incorrectly perceiving a possibility as a reality with an image from the past that is yet to be enacted. This cognitive function hinders us from perceiving reality in its true receptacle. As he says, it is the true freedom to see reality first-hand and then interpret its possibility through an act of personal investigation.

However, an open world of story enables the interactor to actualise the past beyond the linear progression of timeline through the agency of exploring all storylines concurrently flow in the space. This structure of story world constantly regenerate new possibilities as interactor has access to all parts of story-world and explore it to actualise new realities in form of verity of interpretations for a specifics event. Thus, the liberty of wanderer audience is shown in finding an answer between different possibilities and creating several new versions out of a pre-existed story. The possibilities are formed in audiences' minds as explanations for the causality of the narrative. These possibilities are the perception that guides the audiences to interact and enable designers to keep control over the story by shaping the space of the story-world, "the state of things," as Deleuze (1986) explains.

The storyteller strategically designs impulses to set aside exactitude, guiding the reader to work with possibilities. In essence, the distinction between interacting in the real world and the story world lies in prioritising the reality of the world over the possibilities. The reality of a story world is actualised through audiences' exploration based on the conventions set by the storyteller to make the story legible and interactable. Thus, interactive storytelling endeavours to showcase a pre-existing world while allowing for the generation of different readings or versions of story in real-time.

In this case, the design of interactivity is about representing a determinant story in a way that gives the reader freedom to go beyond the world's determination and feasible several states of things by personal choices. Deleuze (1986) articulates this condition as a state that is prior to the actualisation or determination of the state of things, so-called "any-space-whatever".

> "Any-space-whatever is not an abstract universal, in all times and places. It is a perfectly singular space, which has merely lost its homogeneity, that is, the principle of its metric relations or the connection of its own parts, so that the linkages can be made in an infinite number of ways. It is a space of virtual conjunction, grasped as a pure locus of the possible." (Deleuze, 1986, p146)

In essence, an "any-space-whatever" freed the human body from the physical limitation of "Spatio-temporal coordinates" (Deleuze, 1986; 1989). Thus, making an any-space-whatever is feasible in a VR film by giving the agency of unlimited exploration to wanderer audience which creates a feeling of indetermination in grasping all times and all places at once. In this case, the story world turns to an "any-space-whatever" which is a space without a chronological timeline and determination of time. It brings beginning and end, birth and death altogether, and freed the story from the linear representation, making it an endless repetition of states. In this situation, the wanderer audiences feel themselves in a place where all alternatives are consistent and coexist simultaneously. The key factor enabling this awareness is to ensure audiences that interacting with the virtual system can offer freedom from spatial-temporal limitations.

1.2.3. Ludic narrative Versus Cinematic experience

As discussed by Reyes (2017), achieving cinematic VR immersion presents a dual challenge of "preserving narratological consistency on one side and granting real interactive experiences on the other side" (Reyes, 2017, p. 93). This highlights the distinction between a ludic narrative in a gaming application and designing interactive narrative interactions for a VR movie, despite both being grounded in the "player's perception of character, setting, or plot changes" (Wilson, 2016, p. 29).

In this respect, Ryan (2009) points out that narrative engagement in cinematic VR differs from experiencing a VR game application because audiences interact with the VR system as observers who experience pre-recorded content in real-time. While in a game, the agency of generating the story in real-time through interaction leads to a different kind of emotional contribution. Thus, the boundary between the game and the cinema lies in the agency of audiences in engaging with story progression. For this reason, the present research focuses primarily on the nature of emotional contribution within filmic experiences in VR applications, rather than drawing upon theories related to user experiences in gaming environments.

Generally, the immersive image provided by a VR system is termed as an "environment-image" (Pierluigi Basso, 2019; Andrea Pinotti, 2017), known for breaking with the mimetic tradition of visual representation to become both reprogrammable and explorable (D'Armenio, 2022). The concept of a reprogrammable immersive story-world implies interaction that regenerates the environment and its entities in real-time. This represents a "character-centric" design for interactive storytelling in the VR medium, a prevalent style in VR role-play games. On the other hand, a cinematic VR environment is distinct, adopting a more plot-centric approach to interaction and movement within an only "explorable" story-world, where spectators retain the role of a wandering observer over pre-recorded movements.

Having said that, the term of a cinema without camera and montage, which is applicable to an open-world format of cinematic VR, does not imply a cinema without translation in space and a predetermined expression for each image, which respectively are function of camera and montage in traditional cinema. In fact, in an open-world cinema, the camera is removed, but the camera motion is passed on to the audience as they displace within the virtual story world. Moreover, there is no montage, but the ornamentation of virtual space and the agency to explore the many layers of space have been replaced. In this situation, the cinema is gamified since it has the features of open-world storytelling; however, it differs from the game category because of the role that it assigns to the audience to be an explorer seer.

1.3. VR Medium

1.3.1. The characteristic of the VR experience

Virtual reality (VR) experiences can generally be categorised into seated and room-scale formats. Seated VR experiences are non–location-based and can be accessed from any setting, as they require users to remain seated or in a fixed standing position throughout the experience. On the other hand, room-scale VR experiences enable users to navigate the virtual environment through real-body movement. In this regard, most room-scale applications are categorised as location-based VR (LBE) experiences, which employ real-world locomotion and multisensory environments to increase the sense of immersion.

LBE storytelling within immersive media is often defined as "a time-limited, location-based experience that invites audiences into a fragmented narrative across multiple mediums, engaging various senses and requiring active participation" (Polydorou, 2023, p. 2). In other words, an LBE experience allows participants to move freely within a VR narrative space, rather than relying on teleportation or other artificial locomotion techniques that use in home-based VR, thereby significantly enhancing the sense of presence and agency.

LBE environments frequently incorporate large tracking areas and physical set pieces, enabling users to roam freely and interact with virtual props with or without any physical counterparts. Empirical findings by Woods et. Al, (2024) in a large-scale study at a VR opera installation support the significance of this embodied interaction. They reported that free-roam walking and multisensory effects, such as a blowing breeze, were rated by 726 participants as the most influential factors contributing to presence, even surpassing the lack of visual fidelity and low quality. Nevertheless, location-based experiences can also be designed for smaller domestic spaces, offering a more limited yet still embodied form of movement.

Building upon these insights, this research adopts the principles of location-based and room-scale VR to investigate real walking as a narrative and perceptual process, exploring how embodied locomotion within a virtual story-world contributes to the narrative engagement, emotional contribution, and virtual presence.

As soon as a VR system enables an audience to engage in real-body movements and real-time interactions, the interactor becomes a translator in the space, embarking on a personal narrative journey through the story-world. D'Armenio (2022) terms this movement of the VR user as a "perceptual movement" (D'Armenio, 2022), complementing with the changes within an immersive environment. In this context, VR establishes a correlation between the visual syntax of the designed story-world and a kinetic syntax based on the interaction of spectators with a "transparent world" (ibid). Referring to the theory of movement-image" (Deleuze, 1986), D'Armenio reconstitute the transparent world of a VR experience as an "unbreakable relationship between the qualities of images and qualities of movements" (D'Armenio, 2022, p. 121).

In this context, Deleuze's articulation of the concept of "virtuality" (Deleuze, 1966) offers a theoretical framework for analysing the user's perception and movement within this transparent world. It provides a way to understand the relationship between designers and viewers in a fully immersive experience by asserting that "the virtual is opposed not to the real but to the actual" (Deleuze, 1994, p. 208).

Deleuze adopts the concept of virtuality from Henri Bergson, who discusses the subjectivity of the human mind when faced with "living matter" (Bergson, 1991). Bergson posits that it is through engagement with the material universe that a conscious being experiences a form of virtual life, characterised by virtual perception, virtual action, and virtual memory. This virtuality is derived from an actual whole that is a representation of changes, however, it is "non-givable" in its entirety (Bergson, 2002). He views subjectivity as a reduction of objective reality, suggesting that consciousness does not illuminate the object but rather obscures certain aspects of it. This leads him to argue that "representation is always there, but always virtual" (Bergson, 1991, p. 36).

This concept is applicable to Virtual Reality (VR) experiences, which, while offering simulations of real-life experiences through immersive technology, employ their own conventions of representation within an artificial layer of reality. Therefore, engaging with a VR simulation contrast with real-life experiences due to these conventions of representation, rather than differing from the human mind's capacity to perceive virtuality. In this regard, the real-body movement of users in the virtual world, recreated by VR equipment (VR headset, controller, etc.), imposes dynamic limitations and locomotion techniques on physical movements, shaping a distinctive motion experience for the user which impact their perception of the virtual world.

However, it is essential for each VR user to differentiate themselves from the actual environment and establish a connection with their avatars, the virtual bodies they embody within the virtual setting. Referring to Bergson discussion on perception, "the body extracts from the material or moral environment whatever has been able to influence it, whatever interests it: it is the identity of reaction to different actions which, playing upon them, gives them resemblance or brings it out" (Bergson, 2002, p. 43).

In other words, in an immersive representation, the perceptual movement of a "living body" (Bergson, 1991) equipped with locomotion techniques, differentiates the observer from the universe's continuity. This notion suggests that the uniformity of space and time reflects "the work of solidification and division that a body performs on the continuous movement of reality to establish a base for action and to instigate real change" (Bergson, 1991, quoted in Ansell-Pearson, 2005, p. 1116). Within this framework, the virtual body that a VR user acquires serves as an agent of freedom. It is a distinct virtual entity that introduces a break in the continuity of VR space as it navigates through the environment.

In other words, representation depends on the characteristics of the observer's body. According to Bergson (1991), the interaction between the virtual actions of objects on the body and the body's actions on objects constitutes perception. Thus, freedom lies in perception which is contingent upon the potentials for movement and interaction of a virtual body within the virtual world forming the perception for a wanderer audience.

1.3.2. Spatial-Temporal Coordination

In open-world cinema, replacing the camera with the wanderer audience shifts the responsibility of signifying the story's entirety to the reader, who navigates the story world. The movement of wanderer audiences aims to uncover the "causes" to generate a general idea about the whole, while the storyteller employs “announcements and secrets” (Deleuze, 1986) to encourage the discovery of the whole. However, the elements that connect these two is the spatial and temporal coordination of perceiver and perceived in story world that grants a cohesive story experience.

Eliminating the camera's viewpoint doesn't equate to discarding the point of view; it merely shifts cinematic representation from an impersonal cinematographic consciousness formed by a camera to a personal consciousness shaped by the wanderer audience's freedom to coordinate the point of view. The absolute liberty of wanderer audiences replaces the camera, freeing the observer from the psychological constraints of the camera's eye. However, the wanderer audience retains temporal and spatial coordination, confining them to an "eye" upon a "filmic psychology" (Morrissette, 1985).

Morrissette (1985) emphasises that "the camera is not a natural eye" (Morrissette, 1985, p45) but a psychological eye, projecting images on the screen with a perceived causal relation between sentiments and their manifestation. In this view, whether the camera characterises the viewpoint, or the observer/perceiver shapes the point of view, subjective perception persists due to the existence of a perceiver with specific coordination in the story world. This dynamic signifies the interplay of internal and external realities or the clash between "idealism" and "materialism" (Deleuze, 1986), creating subjective and objective positions for perception.

As Bergson (2002) posits, the image is qualitatively placed in consciousness, and movement is quantitatively placed in space. Materialism is "wishing to reconstitute the order of consciousness with pure material movements, the other [the idealism is] the order of the universe with pure images in consciousness" (Deleuze, 1986, p81). Thus, as the wanderer audiences undergo a real-life simulation, the anchoring of the perceiving subjects is defined by freedom to coordinate their position, the same condition that apply to natural perception in real-life.

However, in the representation of a story, the material world around the perceiver becomes unreal, a tale, leading to the substitution of "implicit knowledge" (Bergson, 2002) and demanding extra intentionality for the conditions of natural perception. Despite benefiting from an unrestricted point of view, the wanderer audience still needs to construct a "mental image" (Deleuze, 1986) from the virtual reality they are immersed in. Even if an eye that can be "everywhere at once" (Robbe-Grillet, 1984) is created by means of VR medium, still, the process of interpretation involves imagination, and memories tethered to spatial-temporal coordination of observer. In essence, the wanderer audience determines the distance and duration of the perceiver over the dramatic incidents and story progression, respectively.

Hence, by altering spatial and temporal positions, the wanderer audience can forge a unique cinematographic consciousness of pre-existing “states of things” (Deleuze, 1989).

In this situation, the mental image formed in the audience's mind is an abstraction of "spatio-temporal coordinates" (Deleuze, 1986). In other words, the spatial and temporal constraints of perceiver generate the image in the perceiver's consciousness, while the decoration of space-time blocks inside a story world demonstrate a chain of actions-reactions in the story progression. Therefore, spatial-temporal coordination is the generic element of VR storytelling which signifies relationship between perceiver and perceived.

Chapter Two: Story-without-End: Reconstituting Deleuze theory for an open-world cinematic VR

2.1. Methodology of constructing cinematic concepts

The rules of constructing an open-world cinema, as proposed here, are derived from a theoretical approach aimed at adapting Deleuzian ontology for the virtual reality (VR) medium. In this particular case, the initial approach is an examination of the theoretical foundations of the "movement-image" model, which played a crucial role in redefining the term of "cinematic narrative" within the context of virtual reality. This investigation lead to the development of a work of art known as the "Deja-vu" project, which not only introduces novel cinematic concepts but also facilitates the emergence of a distinct "time-image" regime. Concepts for an open-world cinema are articulated through this method as a theoretical practice.

According to Deleuze (1989, p280), cinematic concepts emerge as a consequence of engaging in cinematic practices. However, these concepts are not classified under the category of movie theories. There are no pre-existing explanations for cinematic objects; rather, theoretical practices have been developed alongside the objects of cinema, the film's contents, in an attempt to explain them. Through the intersection of many theoretical practices, various styles of cinematic narrative are defined. Therefore, in the context of a creative art project that seeks to provide an artistic design as justification for conceptual ideas, the theoretical investigation is consistently intertwined with the artistic design. In other terms, the theoretical framework of the "movement-image" is explored as a method to construct a narrative structure for a VR story-world, to the extent that it allows the development of cinematic narrative regarding the "means of communication" for VR medium.

Nevertheless, through interference across various narrative designs can one determines whether each event within this framework is understandable to the audience or fails to contribute to the overall coherence of the story. Thus, in practical design, it is necessary to return to the conceptualisation stage in order to identify a more appropriate model that can enhance the design of the story world.

The works of Deleuze, specifically "C1: movement-image (1986)" and "C2: time-image (1989)," extensively examine several examples from the history of cinema, thereby clarifying various cinematic ideas that share similarities. The theoretical framework developed by Deleuze offers a taxonomy of narrative models in film, which are differentiated by their specific approaches to the methods of storytelling. In this regard, the replication of these models within a virtual reality (VR) medium does not simply involve duplicating each model to assess its compatibility with VR and its ability to generate an open-world narrative. Instead, the underlying concepts presented by a model are examined through practical projects to determine their potential for developing original VR cinematic concepts and to explain the process for applying the model within the VR medium. Thus, in this practice-based research, experimental practices are conducted to examine the approach of project in reconstituting principle of cinematic VR storytelling[3]. The focus of experiments is on articulating concepts that reflect the conditions for establishing an open-world storytelling method, with the aim of making it replicable in other practices.

In conclusion of this practical articulation of cinematic concepts, the interactive VR film, “Déjà vu” is designed to exemplify a distinct narrative form known as the "Story-Without-End," serving as an illustration of open-world cinema. Its spatial structure of story-world and temporal coordination of storylines inside the virtual world follows a regime of movement-image. In other term, the structure of the story world serves as an immersive representation of what Deleuze has characterised as a cinematographic world.

Also, this project introduces a new approach to facilitate interaction within an open-world cinematic environment by allowing the audience to act as wanderers, giving them the freedom to explore the story world. This approach supports the concept of "direct time representation" (Deleuze, 1989) and the "time-image" regime defined by Deleuze, which evolves from the movement-image structure. This type of interaction allows designated cinematic events within the story world to be experienced according to the audience's exploration intervals. The following discussions of this chapter cover the basic principles needed to create an immersive story world and to set up cinematic conventions within the framework of open-world cinema. Furthermore, it discusses how audiences’ agency to explore the virtual world enables a direct time representation for pre-recorded content in the practice Déjà vu.

2.2. Deleuzian approach to cinematic narrative

2.2.1. Movement and time

Time as a chronological progression can be traced back to either movement within the story world or the use of successive shots. The application of montage, which makes a relationship with movement or the order of shots, determines the perception of time, whether considered as intervals, the episodic sequences, or as a “whole” for the story. This is why the “movement-image” regime does not provide a direct time representation. Instead, the movement-image regime curates a “sensory-motor schema” (Deleuze, 1986/ 1989) as a sensible evolution of the story observed by a camera. "The sensory-motor link is thus the unity of movement and its interval, the specification of movement-image or action-image par excellence." (Deleuze, 1989, p 272)

In this regime of movements, every image on the first level represents an “audio-visual syntax” (D’Armenio, 2022) that implies the image as an utterance. Thus, image signs are first interpreted in their arrangement inside the image. Meanwhile, camera movement and the use

[3] The methodology and approach of experimental practices within this project is explained in-depth in the next chapter, “Methodology”.

of montage create a sensory-motor situation that connects pictures and makes them interpretable in relation to the story's development. Thus, the “kinetic syntax” (Ibid) of the movement-image regime that connects the signs throughout a cinematic representation is a regime of image suppression. When the camera follows a sensory motor in classic cinema, it builds a mental image for the spectator by following a causality for events. In this situation, the camera acts as a conscious being, unfolding stories and representing time by the movement that is connected using the intermediary of montage to maintain continuity for exploration of the story world by the camera.

This subordination of time to movement is broken down if the camera-consciousness is no longer defined by the movements that it may follow or make, but by examining the possibilities that it can access to build a mental connection between images. In this case, the camera is liberated from the sensory-motor schema and represents a regime in which movement is "aberrant" (Deleuze, 1989, p36). In this instance, "the sensory-motor schema is no longer in operation, but at the same time it is not overtaken or overcome. It is shattered from the inside. That is, perceptions and actions ceased to be linked together, and spaces are now neither co-ordinated nor filled” (ibid, p40). As a result, each image is captured in its pure optical and auditory condition and interacts with other images as an independent living matter in all of its parts and on all of its sides. Hence, the wanderer camera is a cinematic body that emancipated from “indirect time representation”, the conventional constraints of time representation applied to the story progression through montage, with a surplus of exploring “potentiality over actuality” (Haines, 2011) inside the story-world.

The aberrant movements produced by the new regime of camera motion directly represent time, as they replace the continuity in the representation of characters' stories, the sensory-motor situation, with a false continuity of images which give it pure optical and sound situations, a "direct time-image" as Deleuze (1989) referred. In this situation, the montage is within the image, which indicates that the montage occurred in the depth of the image. In other words, the role of montage in linking images, which attempted to produce the causality, replaces with showing the qualities that each image can reveal in its totality. In this case, perception does not recognise the progression of the story by recalling previous memories, but rather by entering into a relationship with the image’s elements and establishing a causality through its own fantasies. Therefore, the mental image is made up of possibilities that can emerge as a result of aberrant movement through the story world. Alternatively, the actual image presents trajectories that can be folded to establish novel ways of exploring the story world.

2.2.2. Time and space

According to conceptual (cognitive) metaphor theory (CMT) (Lakoff and Johnson, 1980/1981/ 2008), there are two basic metaphorical models for conceptualising time in terms of space: “the ego-moving model maps our movement through space onto our imagined movement through time, while the time-moving model represents time as an entity moving through spatial locations, the ego being just a passive observer” (Dunat, 2023, p. 1).

Deleuze argues that movies, like natural perception, are limited by our bodies. However, he also sees film as a powerful tool that can break these limitations. Deleuze suggests that “through montage, the mobile camera and the emancipation of the viewpoint” (Deleuze, 1986, p. 3) an objective perception can reveal images as they are, a “pure duration” (Deleuze, 1989). This pure duration allows us to see images independent of our physical limitations. By connecting images to movement and light to matter, Deleuze suggests film can create a world of its own. In this way, film has the potential to expand human understanding beyond the constraints of our bodies and reshape how we think about the world.

In essence, “both Deleuze and CMT theory recognise the centrality of human perception in the representation of the world and the constraints it poses on cognition.” (Dunat, 2023, p. 2). Cognitive Metaphor Theory (CMT) emphasises how our bodies and basic sensory experiences shape how we understand the world (Johnson, 2013, p. 26). It sees metaphors as a creative tool for building meaning**.** On the other hand, Deleuze argues that our senses and brains limit how we perceive the world. Deleuze wants to bypass this limitation and directly access the true nature of things, independent of our perception (Deleuze, 1986, pp. 62–63, 122). In simpler terms, he wants to understand the world as it truly is, separate from how our bodies and senses experience it. Thus, he suggests cinema as a medium that can break the sensory-motor schema of story and brings images in its pure totality.

Departing from traditional philosophical notions of time discussed by philosophers like Kant (1724-1804) who defined time as a calculatable and representable entity of a whole, Deleuze, building on Bergson's ideas, emphasises the qualitative nature of duration to achieve a true definition of reality. Duration is shaped by an observer's limited senses and function of consciousness in perceiving and elaborating changes (Bergson, 2002). In this respect, a key aspect of Deleuze’s analysis that resonates strongly with immersive experiences is his perspective on the reversal of the traditional dominance of space over time. Deleuze argues that "time is not something internal to us, but rather the opposite; it's the environment in which we exist, move, live, and undergo changes... Our subjectivity is not our own; it belongs to time, which is akin to the soul or spirit, the essence of virtuality" (Deleuze, 1989, pp. 82-83).

In this context, the virtual reality stimuli entirely immerse its user in an artificial virtuality. In other words, the immersive experience of an open-world film offers the wanderer audience a liberated perspective to explore reality beyond the constraints of linear time, though generate a virtual duration in which a user lives. This represents a significant shift for spectators of open-world movies. Traditional cinema often alters the camera's viewpoint from an objective to a subjective position to make the representation impersonal. In contrast, open-world cinema achieves impersonality through the audience's freedom to move within the virtual world. Instead of following a pre-established temporal sequence of events within a shot, the wanderer audience creates their own temporal perspective to interpret the immersive scenes, providing a unique experience of surrounding events. Therefore, the audience's sense of presence, and their inclination to interact with the environment, is enhanced by the feeling of "being there [which] is actually the ability to do there" (Slater and Steed, 2000).

In this context, each shot in an open-world cinematic experience can be seen as a distinct block of space-time, representing an event that is interconnected with the entire story and its progression. It is an immersive image interacting with other shots in its entirety. Designers and storytellers intentionally arrange all the shots within a movie's timeline, spacing them out to create a cohesive framework of movement-images. However, giving the wanderer audience the ability to disrupt the linear timeline and explore events in any sequence transforms the cinematic representation into a regime of time-images. This regime, derived from the audience's movements within the story-world, rearranges events into an individual sequence of "befores and afters" (Deleuze, 1989), allowing each wanderer to discover the causality within the entire story-world.

2.2.3. Generating a cinematic consciousness in open-world VR

In film, the director shapes the "quality" and "power" of each scene by controlling the distances and durations between the viewers and the actions (Deleuze, 1986, p. 36). The director's role is to provide nuanced interpretations and enable the audience to anticipate what comes next, even as observers. This approach allows viewers to engage actively with the film, creating a unique experience. In this context, perception is influenced by the spatial distance that either connects with or avoids actions. Referring to Aristotle's theory of drama, distance signifies "the psychological proximity one might have to an artistic narrative and its depiction. Optimal distance is necessary for effective emotional engagement, avoiding trauma or indifference, achieving what Aristotle termed catharsis" (Wiley, 2003, p. 8). Thus, distance shapes a "perception-image," (Deleuze, 1986, p 30) where the viewer acts as an agent bridging the gap between actions and reactions, linking interactions and the variability of the narrative elements.

From Deleuze’s perspective, a cinematic story world is a "mechanism of announcement" (Deleuze, 1986), where the depicted movements crystallise a "state of things" as seen through the camera's lens. In this context, the camera acts as the central reference point, structuring the cinematic narrative through "spatio-temporal coordination” by capturing and omitting different movements. However, within his time-image model, Deleuze introduces the idea of a wanderer camera that creates a "centre of indetermination" (Deleuze, 1986). In an open-world cinema, this concept is extended to the wanderer audience, who act as a reference point to create a cinematic consciousness over the story, while making it indeterminate by freely exploring the narrative world.

In this context, Gaudenzi (2013) explores the concept of "assemblage" (Deleuze & Guattari, 1986), examining how entities within a narrative integrate to form a collective mechanism by considering the roles of characters within their environments. In virtual reality, this concept highlights the viewer's placement within a specific narrative layer of the story-world, constrained by the limits of human perception to experience all temporal and spatial aspects simultaneously. Thus, the narrative in VR represents selected events within a defined spatial-temporal framework in three-dimensional space, experienced by wanderer viewers who obtain a cinematic consciousness through exploring various layers of the virtual world with an avatar, selecting their own perspectives on the unfolding events.

2.3. The structure of Open-world cinema: a regime of movement-image

2.3.1. Cinematic VR’s story world

In a cinematic VR world, wanderer audiences’ movement is distinct from the space it traverses, as "Space-covered is past, movement is present, the act of covering" (Deleuze, 1986, p14). Movements continually reconstitute themselves in concrete duration, varying based on the observer's anchor, creating a qualitative perception that distinguishes specific movements from mere spatial shifts. Deleuze argues that movements are translations in space, signifying a changing whole that is always open to transformation.

In this context, shots divide duration into sub-durations, uniting them into a discrete duration intrinsic to the entire universe. Meanwhile, the central concept in narrative structure, the theme of the movie, helps the storyteller to establish a whole, “allowing patterns of actions and reactions in cinematic storytelling” (Poell, 2019, p9).

Thus, through reconstituting the Deleuze’s approach to cinematic narratives for an immersive cinema, the structure of a story-world contains; first, a covering space which is a “transparent world” (D’Armenio, 2022) demonstrated by the mediation of a spectrum of Mixed Reality (MR) possibilities, from a designated VR space in one end to a physical space with augmented virtual elements. Secondly, it consists of the moving objects that are a part of story-world, however, do not indicate any dramatic changes. They have existed to show the changes, the "whole", the durations that are flowed in space-covered and make it a living matter. These moving objects turn the story-world to a space that the dramatic incidents are possible to occur.

Finally, the story-world encompasses dramatic movements manifesting as moving characters or external interventions that influence the changes within the covered space. The interplay of these movements suggests a causality of events pertinent to the story's progression. These movements generate a mental image by creating a link between different parts of the story, while also signalling a change within the entirety of the story-world. In another words, every dramatic movement is crafted to be open to additional movements, thereby forming a "whole" that represents a multiplicity of stories in a predetermined sequence orchestrated by a storyteller.

Therefore, the creation of an immersive narrative involves designing movements that depict events with duration and imply changes within a presupposed whole, subsequently connecting them to advance a continuum of stories. Consequently, the story-world comprise a variety of events and storylines that are interconnected and scattered across a plain.

In this perspective, for all kind of immersive media, a cinematic narrative is a designated event, an interaction of movements in the space that implicate a duration. It contains an aesthetic that generated through interaction of virtual entities with kinetic and audio-visual qualities, still, newer technologies add to this list the haptics feedback and other interaction capabilities for human senses.

However, the designated events demand reciprocal act of interaction from perceiver, an additional motion to be matured by a consciousness. It becomes available through a virtual cinematic body, a designated virtual avatar that an audience engulfs as a part of story-world with an agency to explore the story-world.

Therefore, the interaction patterns implemented within the VR movie are a part of the narrative's structure, working as tools to apply a montage to the multiplicity of durations flow in the virtual space. These tools are designed to help the wanderer audience fulfils the task of finding causality over the changes in the story-world which is the aim of interaction and the act of engagement. This notion of emerging narratives by moving within the virtual environments is the original approach of this project to design a structure for interactive storytelling as it utilises a condition of real-time generation of cinematic narrative through interaction between wanderer audience and pre-recorded contents.

2.3.2. The connections of designer and wanderer audience

The tools to lead the wanderer audiences inside an immersive cinematic story world are the same as conventional cinema. The differences only appear in the discourse of the medium, which contrives the reader's agency in perceiving and interacting with the dramatic contents. In a Deleuzian approach, the storytelling tools in cinema are the frame, shot, and montage. These tools can be reconstituted for an open world cinema in which a wanderer audience is replaced the Deleuze's "wanderer camera".

As Deleuze defines, framing and creating a viewpoint is "the determination of a closed system, a relatively closed system which includes everything present in the image - sets, characters and props." (Deleuze, 1986, p27). In other words, the frame forms the "set" in cinema with two tendencies "saturation and rarefaction" (ibid). As a designer, the director conveys the storytelling style and the concept of narrative to the spectator through designing the story world with one of these tendencies.

The determination of sets is defined geometrically and dynamically. The frame creates an optical system as a point of view to impose justification of the director besides his stylistic implication on the out-of-fields. The dynamic dialectic between the geometry of the "field of view" and the "out-of-field" creates the threads in the spectator's mind to scrutinise the causality of events. From another perspective, it can be said that the frame is the spectator's agency in revealing the story world both spatially and temporally.

Thus, in an immersive environment, framing means imposing limitations on the field of view. Different parts of story-world are separated and reunited in a constant dynamic change in a frame. In this case, the determination of the frame is applied through the duration of movements. "The set cannot divide into parts without qualitatively changing each time; it is neither divisible nor indivisible, but 'dividual' [dividuel]." (Deleuze, 1986, p30). In this regard, in an immersive shot, the frame's determination is applied through movements that connect the state of things to a higher level of the thematic concept of the story, which is a "whole" of story representing as a determinative duration.

This principle also applies to representation of narrative in an immersive environment through a 360 camera. In this instance, movement within immersive image, which is framed in a shot, reveals the relationship of the parts and sets, alongside expressing the change of the whole. Whether the camera is fixed or moving, the shot is the determination of this movement, and the cutting is the determination of the shot. As Deleuze indicates, "the shot, in general, has one face turned towards the set, the modifications of whose parts it translates, and another face turned towards the whole, of which it expresses the - or at least a – change... Hence the situation of the shot, which can be defined abstractly as the intermediary between the framing of the set and the montage of the whole” (Deleuze, 1986, p36)

However, in an open-world cinema, a 3D space works as a fixed shot, a “slice of space”, a plane where the movement is indicated by moving objects and bodies in space. In this case, "the whole is identical to the set in-depth, such that the moving body goes through it in passing from one spatial shot/plane [plan] to another, from one parallel slice to another, each having its independence or its focus” (Ibid, p42). The immersive shot can demonstrate the multiplicity of movements around the space like a “sequence shot” in which an audience, whether fixed and having a seated experience, or freed to explore in a room-scale VR experience, perceives the movements through a depth of field that provided slices of space at once. Hence, the wanderer audience creates a “temporal perspective” over the narrative by connecting foreground and background. Alternatively, the designer uses effects, like colour and lights, to emphasise on depth-of-field and reframes the space in durations in order to constituting a layered story world.

In this context, Lev Manovich's exploration of the concept of the "fold" (Deleuze and Strauss, 1991) in his book "The Language of New Media" (2002) is suggesting an aesthetics for experiencing layered virtual reality. The fold, according to Deleuze, signifies the intricate folds and infoldings in which reality is composed, with surfaces curving and overlapping to create new dimensions and connections. This concept suggests a dynamic and continuous process where multiple layers and perspectives coexist.

In the Déjà vu project (Figure 2.1), the design of 3D space creates an open-world environment where viewers can comprehensively see all blocks of the film set. As the wanderer audience explores one scene, it comes to the foreground while two other scenes remain as layers in the background. The coordination of temporal sequences across these three locations ensures that the audience perceives a specific series of actions within this environment at any given time.

In this case, the immersive image is presented to the viewer with temporal framing, while the montage is achieved by emphasising depth-of-field. Consequently, the wanderer audience's perspective is limited to the pre-designed and synchronised temporal and spatial framework of the virtual story-world. This includes the spatial arrangement of character movements within scenes and the timing of events in each location.

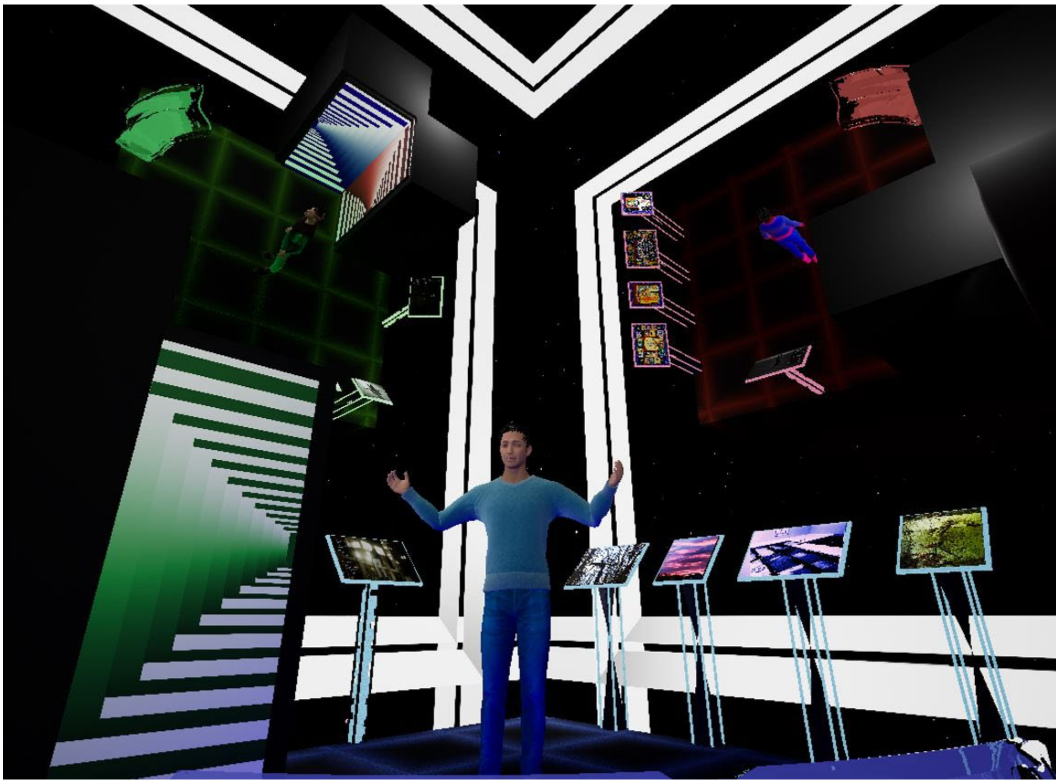


Figure 2. 1: Screenshot from the Déjà vu's set.

Considering the movement-image regime, Deleuze identifies two dimensions of the out-of-field: "a relative aspect, where movement within the frame of an image extends into a broader set of a similar nature, and an absolute aspect, wherein movement, regardless of its frame, relates to a dynamic whole it expresses" (Deleuze, 1989, p238).

The first aspect involves the interconnection of framed images based on their spatial positions, shaped by the camera's viewpoint over a set in the space. In this context, sounds do not originate from the out-of-field but exist within it, serving as indicators of other sets in space and forming a continuum for the camera's movement. Sounds guide the camera's viewpoint, revealing different parts of the space.

Conversely, in open-world cinema, where the audience can freely explore a 3D virtual space, sounds function differently. Although all movements are visible, spatial sounds audible only from specific distances, create a kind of out-of-field. The audience is compelled to move and explore to establish connections between visual elements in the space, reshaping the "relative aspect" into an out-of-field of hearing. In this framework, these spatial sounds adopt a new narrative role, prompting the audience to move and generating a cinematic experience.

The second aspect of out-of-field, the absolute, emerges through the temporal arrangement of events—movements outside the temporal coordination of the audience. The storyteller's predetermined whole assigns an absolute position to each movement on a timeline, rendering them inaccessible through specific temporal coordination. These inaccessible movements, acting as out-of-field elements in open-world cinema, introduce spatial oppositions.

In this respect. the virtual body of the audience, the avatar, with spatial-temporal coordination forms new connections between visual elements, reconstructing mental images that prompt contemplation of alternatives. Spectators are then compelled to interact with the story world in various ways, with Deleuze noting that “this alternative can be presented in an aesthetic or passional, ethical or religious form or can even play between these different forms” (Deleuze, 1986, p150). In essence, the function of visual elements such as light, darkness, and colours in cinematic images is to contribute to the creation of spiritual alternatives, intensifying the conflict of "virtuality" (Deleuze, 1996). This conflict underscores the existence of a virtual life in virtual reality, fostering audience awareness of alternative possibilities. Directors control this virtuality by presenting alternatives, prompting audiences to choose and providing a “consciousness of choice” (Deleuze, 1986, p 147).

However, the interaction of the wanderer audience beyond the limitation of time and space challenges the design of the story world to keep the internal consistency of storylines. The break in consistency appears in the loop of “action-perception” or the sensorimotor that leads audiences to engage with the virtual system. As Bouvier (2008) says to maintain this consistency, two factors should be respected in any design: "firstly, we will have to take care not to break the causality link between the user's actions and the system's feedback. This means we have to implement real-time algorithms and provide high-frequency displays. Secondly, we must maintain the time and place consistency among various sensory modalities associated with an event or a virtual object” (Bouvier, 2008, p.6). Maintaining these two factors helps the wanderer interactors not to lose the mental image that provides the consciousness of alternatives and leading them to continuously seek causality and avoiding interruptions in their subjective presence.

2.4. Representation of time in an open-world cinema: the regime of time-image

2.4.1. The breakdown of sensory motor schema

According to Deleuze (1989), in conventional cinema, what the camera sees is objective, and what the character sees is called subjective. However, it is the same camera that shows the viewer what character is seen and transforms from an objective to a subjective viewpoint and vice versa. Thus, the evolution of these two image poles results in the cinematic storytelling style. However, as he discusses in relation to Pasolini's films the special form of "free indirect discourse" (Deleuze, 1986, 1989), a wanderer camera which is freed from following characters’ story enters into the invention of its fiction as a character inside the story-world and contributes to the invention of stories of the people in this fictional world. This condition influences the viewer's experience of time since it shifts the camera's position from being a follower of a sensory-motor schema to a free traveller in a world of stories among "a people" (Deleuze, 1989) who solely belong to this story-world.

Replicating this situation for an open-world VR cinema, the immersive image consists of pure optical and sound signs, "opsign" and "sonsign" in Deleuzian terms, which transform the linear time representation for the character's movements to a "series of time" (Deleuze, 1989, 155). In other words, the story that a wanderer audience can grasp includes a series of "befores and afters" (ibid). The virtual body of the audience in an open-world VR movie is located in the present time and explores pre-existing events in a non-chronological order in real-time. As a result, this virtual body feels a presence inside the story-world in a personal timeline, which influences its perception and process of recalling memories from a series of befores and afters incidents which are always accessible to actualise.

In this case, the agency of the wanderer audience, as well as the visibility of its virtual body for the people of the fictional world, impacts audience perception and interaction with the fictional word. In the interactive VR film *Lone Echo (2017),* for example, the audience's avatar is visible to the characters and can simulate a physical relationship by touching the AI character and receiving spontaneous responses from her, whereas in *Invisible Hours (2017),* the wanderer audience explores the cinematic world without being observed by others. In each example, the audience's reactions to the virtual object and individual characters varies, and their experience of the peculiar timeline in which their virtual body exists is different. In the former, the audience feels itself in the same timeline as other people in the story-world, whereas in the latter, the audience is able to influence the story-world chronology and create its personal present moment, as well as the existence of its virtual body, amongst other virtual elements.

Nevertheless, In both cases, what distinguishes a cinematic storytelling is that it moves from the outside to the inside, or, as Bazin (2005) puts it, from the setting to the characters. In other words, there is space before action, and the virtual body creates its spatial and temporal coordination in the immersive world at any given time. It causes audiences acquiring a perception of the present time and then interacting with the world and its people based on its ability to explore the environment and apply changes to, whether the virtual body be visible or invisible to others. Thus, the ability of real-time exploration which result in the creation of a personal timeline, a direct time representation in Deleuzian term, is the key property of a cinematic VR story world.

2.4.2. Virtual Body and Virtual Duration

In traditional cinema, Deleuze describes montage as "the operation that influences the movement of images, extracting the whole from them, representing the image of time indirectly” (Deleuze, 1986, p. 48). In contrast, open-world cinema relies on the spatial-temporal coordination of the observer to establish causality for dramatic events. The wanderer audience, capable of transcending time-space limitations, alters the duration of dramatic movements by disconnecting elements from their prior states as they wandering around the story world. However, the presupposed whole which remains unchanged, challenging the audience to interpret the narrative and relate it to a story.

The actions of this designated virtual body impose a false continuity on the story-world continuum, disrupting the pre-defined narratives' sensory-motor schema and enabling individual audiences to craft a personal journey within the story-world. In this instance, applying constraints on avatar’s transportation and manipulation of the display timeline are tools used by designers to maintain control over the wanderer audience's experience. For example, in the opening chapter of *No Man's Sky VR* (2023), users must repair a spaceship using manual guidance within the virtual world, controlling their movement. In Lone Echo (2017), set in a spaceship, users learn to use tools to navigate a non-gravity space, restricting movement and causing them to miss incidents in far-off sections of the spaceship.

In the case of Déjà vu, limitations are imposed on audiences, restricting their movement between three scenes solely through tactile interaction with doors using their virtual hand. Without teleportation techniques, the audience must physically walk within the virtual space to reach a door and transition to another scene. This real-body movement generates a duration, and since the audience lacks control over event timelines (e.g., rewind or fast motion), they are confined to an incomplete understanding of the entire story-world constantly which encourage them to follow travelling within the space.

Consequently, the virtual body acquired by wanderer audiences generates a virtual duration, as it allows them to freely traverse the story world irrespective of temporal or spatial constraints. In contrast to traditional cinema, where montage applies false continuity to create cinematic time, the virtual duration, shaped by audience movements, acts as a cinematic duration, indicating the viewer's comprehension of the entire story. Based on Stiegler's (2011) discussion, "cinematic time" refers to the synchronisation of an individual's personal time with the temporal flow of a cinematic narrative. This conceptualising of cinematic time highlights the transformative power of cinema to shape personal perception through its controlled pacing and sequence of events. Stiegler (2011, pp 31-33) suggests that cinematic time has a profound effect on individual identity by aligning personal experiences and expectations with the pre-constructed narrative and temporal framework of the film, thereby influencing how individuals perceive themselves and their future potential within a collective or societal context.

Thus, to make a comprehensive understanding of the story progression for a wanderer audience, the agency of wanderer audiences in utilising their avatar involves their interpretation of story progression as it is establishing connections between story parts based on the audience's locomotion techniques at each specific moment. From another perspective, the design of interaction patterns is linked with the threads that connect story parts which indicate societal position of audiences in story-world.

Moreover, in a Deleuzian re-reading of virtual duration, it is a “virtual co-existence” (Deleuze, 1989). For wanderer audience the present time is consist of the actual time of the experiencing pre-made contents by moving inside the story-world and the past as recollection of personal memories of the content that still are accessible. For Deleuze recollection of past in a virtual co-existence with present, is actualisation of memories not in their previous forms but in form of a “crystal-image” that is a circuit of virtual image of past and actual image of present. Thus, time is not chronological as the perception works outside of successive time in a co-existence of two timelines that one is toward the past by turning the present into the “past-in-general” (ibid) and one foresees the future by actualising a virtual memory of the past into present. However, the open-world cinematic VR suggests the actualisation of the past events in present unlimitedly as they are still accessible for wanderer audience. It is a representation of past in its “pure state” (Deleuze, 1989). Whereas the present contains pieces of time ruptured by the movement of a virtual body, the past can be recollected outside of normal successive time by audiences’ decision and shape their perception of present moment.

In this perspective, the digital incarnation into an avatar turns the wanderer audience to a creator of narratives in a VR continuum by providing a structure for exploration of the story-world. It is a virtual life in form of exploration of virtual memories that generates a peculiar virtual perception through a digital actualisation. In this regard, the involvement of audience in creation of a cinematic aesthetic indicates a quality of kinetic and visual syntax that results to a virtual duration perceived by wanderer audience as a temporal perspective over the story.

The quantity of virtual duration is measurable as the mechanical time that a wanderer audience is spending to interact with the story-world. However, the perception of the wanderer audience from changes in the environment create a feeling about the duration of whole experience. In this regard, the qualitative duration a wanderer audience feels about the whole virtual journey is directly related to the quality of the temporal perspectives that obtained over the cinematic experience.

In one hand, the feeling of duration correlate with the quality of engagement with the narratives as the wanderer audience consists of a conscious effort to unfold the layers of virtual realities. For example, in Lone Echo II (2021), user agency has improved compared to its predecessor, Lone Echo (2017). This enhancement is reflected in more realistic interactions with AI characters who react believably to user improvisation. Although the storyline is predetermined, the increased believability of the AI character's reactions enhances the overall experience and influences the time a user spends on the virtual journey. Thus, the virtual body crafted by a designer serves as the curator of a cinematic experience, and its quality is evident in the duration audiences felt immersed in the movie.

In the case of Déjà vu, improvements to the virtual body are provided through haptic feedback to virtual hands upon touching virtual objects within the scene. This feature gives audiences a sense of touching a tangible object. Additionally, the game design encourages audiences to start their journey from a seated position, mimicking a real chair in the physical space. To fully engage with the movie, audiences must sit on a physical chair, symbolised in the virtual world by a glass chair. This substitution of a physical object with its virtual counterpart enhances the sense of presence in the virtual world, allowing audiences to touch and use a virtual chair during their virtual journey. Consequently, it intensifies the tactile experience during Déjà vu and influences how audiences perceive the existence of their virtual body in the virtual world.

Additionally, the virtual duration relates to enjoyability of the immersion in VR system. The immersion in virtual world suspended the ordinary and intellectual relation to the actual world. The enjoyability of this condition come from the notion of Deleuze on “involuntary memory” (Deleuze, 1966) that bring us joy at it is not experienced in contiguity with the past sensations but as an event that has no equivalent in empirical reality and hence hinder the idea of death raised by successive time. Thus, an immersive experience provides the moment of joy as the reader of a crystal-image is freed from the order of time and perceives a variation of virtual timelines that are “real without being actual, ideal without being abstract” (Deleuze, 1966 quoted in Pearson 2005, p. 1117).

2.5. A narrative framework for open-world cinema

2.5.1. Story-Without-End

The design of the "Story-Without-End," is based upon the concept of rhizomatic narrative stated by Deleuze and Guattari (1986) which applies two main principles to create a network of narratives; first, the principle of connection, which states that each point of a rhizome can be connected to any other point in the rhizome; and secondly, at whatever point a rhizome is ruptured or destroyed, it will always keep growing according to different lines or connections, indicating the principle of a signifying rupture. The proposed framework examined in the Déjà vu project offers these two principles to explore the network of narratives.

The structure of Story-Without-End is founded on this definition that a storyline is an order of events that represent the progression of a story for a specific location within story-world, contains spatial shot in a block of space-time. Meanwhile, the story-world represents a continuous “whole” by connecting locations through threads in a circular graph. The threads that connect different storylines in an endless loop are the iterative journey of story’s characters across all the story-world that removes the determination of setting an event as the specific ending for the storyline in each location. Consequently, there isn’t a beginning event for the story-world, hence, the first principle of rhizome, principle of connection, applied to the structure of story-world. This characteristic provides the immanency of all movements within the story world as it determines each motion with a spatial-temporal property.

In this instance, the spatial-temporal design of the story-world adds an additional layer to the sequence of events within each location. This sequence includes the events that happen to a character as it moves between various locations. Consequently, the storylines interact each other and create a causality that acts as a mechanism of announcement and secrets, encouraging the wanderer audience to explore the entire story-world.

This dual order of dramatic events is perceivable because the wandering audience can alter the spatial-temporal coordination within the story-world and follow the characters on their journey. Consequently, the movement of the wanderer audience as the perceiver creates a temporal perspective on the diverse sequence of events for the moving characters and concrete virtual locations. It confirms the second principle of rhizome, the principle of signifying rupture, because the wanderer audience can at any moment explore a variation of events, each of which can be ordered and interpreted based on the observer's path through the story-world.

In this regard, the “Story-Without-End” proposes an original design principle to make this wanderer audience's rhizomatic journey infinite. As long as each character's journey represents a sensible causality in a circular order, the “principle of infinity” states that the loop in the journey of the story's characters within various locations of the story-world will place the sequence of events in each location in an endless loop. It is a design for a machine assemblage that considers a story's protagonist as an entity repeating a trajectory in a movement-image machine. Significantly, the character's journey within the story-world represents a character arc by involving a series of incidents; however, there is no moment in the character's journey whereat his or her relationship with a place is altered. The incidents that happen to the characters in any blocks of space-time compel them to advance to the subsequent spatial-temporal coordination.

In this respect, the journey of the characters is the sequential progression of the narrative as they move and shape the dynamic of the virtual world and create a spatial cinematic framing of the space as time passes. As changes in space are indicated by their movements, the parts of the story-world become interconnected and a whole is formed. Alternately, all of the character's movements within the narrative world are determined by a spatial-temporal coordination of pre-recorded 3D content scattered by a designer. Meanwhile, the exploration of the wanderer audience creates an interactive cinematic experience consisting of a personal interpretation of the narrative based on their movement within the story-world.

Moreover, the story-world is an any-space-whatever as it represents a variation of causalities for each movement at any point of time. It makes all possibilities available while the level of agency for perceivers allows them to actualise a personal cinematic journey over an endless story by exploring the dramatic events that are impersonal to any observer and immanent to story-world.

2.5.2. Project Déjà vu as a design of any-space-whatever

In the Deja Vu project, the implementation of Story-Without-End framework introduces a novel approach to interactive storytelling in virtual reality (VR) by seamlessly blending past, present, and future elements (Figure.2.2). This structure functions as a versatile space where the audience can simultaneously engage with various timelines of a movie, creating a loop of events that gives the impression of an endless story.

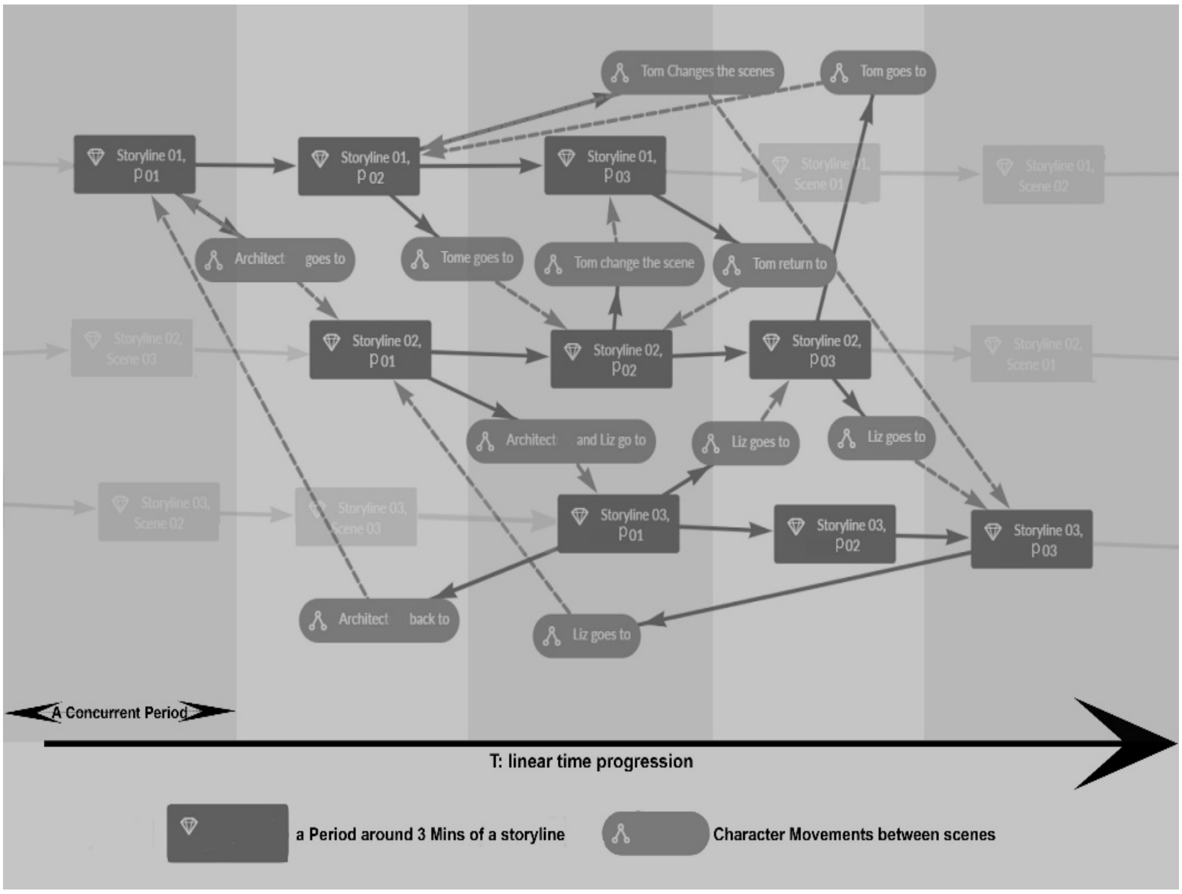


Figure 2. 2: Déjà vu's story map depicts the method of synchronisation for three concurrent timelines.

In the Déjà vu movie, events within each space-time block, or location, follow a linear order. However, the characters' journeys between different movie locations introduce an additional layer of order to each incident. Consequently, each dramatic event within a location can be understood in relation to various orders of characters' journeys. Consequently, the movie lacks a linear timeline to depict the overall story, and events are interlinked in a circular manner, challenging traditional notions of befores and afters in linear storytelling. This design encourages audiences to piece together the scattered events in different locations, prompting them to navigate a unique order of "befores and afters" and interpret the causality of events differently with each experiencing.

Also, the Déjà vu movie offers an 'any-space-whatever' experience by representation of all timelines in a non-chronological order, allowing audiences to grasp the entirety of the narrative simultaneously. Placing all locations on the interior surface of a cube allows audiences to visually take in all places at once, even though they cannot hear sounds in other scenes from their current location. However, this feature creates an incomplete understanding of events in other locations forces viewer to travel within the story-world. As the progression of the movie timeline is beyond the control of wanderer audiences, their journey never reaches a complete understanding of whole at once, fostering a continual sense of exploration throughout the movie.

What sets the Déjà vu project apart from current open-world VR films like Invisible Hours (2017), Lone Echo (2017), Lone Echo 2 (2021), L.A. Noire: The VR Case Files (2021) is its method of synchronising concurrent timeline to create a non-linear story. In current open-world movies, events unfold in a specific order, creating a linear narrative. For instance, in Invisible Hours (2017), the story takes place over a three-hour timeline on a particular island with various locations, such as a large house and a dock. The audience can teleport between locations, manipulating the linear timeline by rewinding or fast-forwarding. The task for the audience is to solve a mysterious murder by exploring these interactions. The movie maintains consistency by unifying the space and offering a chronological timeline, providing a coherent representation of the story. Befores and afters are clearly defined, allowing audiences to use their agency to explore both space and time to uncover the scattered secrets in this open-world setting. This pattern of unifying space and following a chronological timeline is also seen in open-world role-playing games like No Man's Sky VR (2023), contributing to the creation of a cohesive open-story world.

In plot-centric products like Invisible Hours, where the story is pre-established and the audience takes on the role of a wandering observer, the motivation to explore the virtual story-world arises from the movie's theme—in this case, solving a murder. The audience follows characters gathered in an isolated location to delve into each individual's story. Characters act as the connecting threads between different parts of the story that the audience can explore. However, in character-centric games like No Man's Sky, users perform tasks by interacting with objects to advance their journey through space.

In Déjà vu, characters serve as threads connecting different parts of the story. However, the story's consistency is maintained through the characters' continuous visibility to the audience. Audiences can observe all characters simultaneously, preventing them from disappearing and causing any mental dissonance related to story progression. While the linear timeline in a unified location maintains the story-world's consistency in most open-world VR experiences, Déjà vu transforms this linearity into a concurrency of three different timelines in an infinite loop and upholds the story-world's consistency through the characters' ongoing journeys between different space-time blocks.

The practice of unifying space aids the audience of Invisible Hours and No Man's Sky in having a coherent experience. In the case of Déjà vu, the unified space serves as an interactive element, fostering audience awareness of alternatives, contributing to a cinematic quality, and facilitating a comprehensive understanding of story progression.

The next chapter outlines how Déjà vu is created, including how to synchronise storylines during scriptwriting and again in the post-production phase. This chapter also delves into various aspects of this creative process, sources of inspiration to write the story and explore opportunities for future enhancement in detail.

Chapter Three: Practice design: “Déjà vu: an Endless Virtual Journey”.

3.1. Story

3.1.1. Plot

The story centres around an Architect. He gets annoyed by a recollection of rejection by the character Liz, a former love. As a result, he decides to create parallel realities of that tragic day in order to rearrange the events as he wishes. In three parallel universes, he redesigns the location where he met Liz and proposed to her, each reflecting a distinct timeline: past, present, and future. In the past timeline, Tom, the young architect, is waiting for Liz to declare his love and suffer rejection; nevertheless, Liz experiences déjà vu, which forces her to halt Tom from making his proposal. In the present timeline, the Architect recounts to Liz how she previously rejected him, causing him to design this virtual reality. Finally, the Architect and Liz are a happy couple touring an art gallery in the future timeline. Later, Liz has second Deja Vu incident, and the Architect recognises that there is something wrong in the matrix he constructed and that the virtual system's meddling with past events caused Liz to reject the proposition in the first place.

3.1.2. Method for synchronising timelines and writing storylines

The story is represented through three different timelines. The young Tom and Liz who appear in each storyline are not aware of events taking place in the two other storylines. Only Architect can see other timelines and travels between them to impact on each story's progression as he wishes. Also, Liz characters is affected by the chronological order of timelines and has a different relationship with other characters on each parallel universe, while Tom travels between various places considers them as different booths for an art gallery.

To write the story it is considered that each location has a distinct storyline parallel with other locations which concurrently happens and get effected by other location's storyline as characters moves between them. Also, it is considered that each character can be in one location at each instant of time, and they cannot be duplicated in the virtual space. Thus, each storyline must represent a complete story arc, meanwhile each character's journey has to represent a logical order of incident that occurred for the character which makes a circular order for this journey, means that the incidents that happens for each character in each location prompt them to continue travelling, offering a sensible causality in each character's story.

In this respect, writing story start with drawing a story map (Figure 3.1) to synchronise the storylines in each location. In doing so, each location's storyline is divided into three equal periods lasting for three minutes (it is depicted in story map as P01, P02, P03) based on the action of the character Architect who spend three minutes in each location and then travel to the next parallel storyline. Thus, the cutting point for each period is displacement of the Architect in the space. Then, the story of Architect's journey is written in its circular order. He starts from storyline one, the past timeline, and addressing the audiences describe them the nature of this virtual reality and the reason for his design by briefing the story. Then after three minutes while he checks his watch travel to the storyline two and wait for Liz to join him. He is a stranger for Liz thus tries to make a connection and incept an idea in her mind about the love proposal that she received in previous timeline makes her think about alternative. After three minutes Architect asks Liz to travel to the next storyline. Architect spends another three minutes in the storyline three with Liz as his lover and then leaves her and return to the beginning point of his story to find the glitch in his designed matrix of story.

Writing the story of Architect's journey, gives a method to how synchronise three different storylines and a starting point for witing the story of other characters. In the next step the story of Liz's journey is written as she has faced with Architect in two different timelines, hence her story is completed by continuing after Architect left her in storyline three and returning to the first storyline which represent past events to meet Tom and receives the love proposal. Thus, she enters in the location for storyline one in the second period (P2) and meets Tom over there in period two. And then third period of her journey she encounters the Architect again in storyline two and loop in her journey is completed. Also meeting between Liz and Tom in past timeline is the starting point to write Tom's journey. In this stage most of the events in each storyline is determined thus to write the Tom's story it is considered that he never meets the Architect. The story of Tom is to wait for Liz in his booth, where he exhibit some of pictures that has taken from her, to join him and offer his proposal, however he decides to go and checks other booths and then he realises that one of his pictures exhibited in another booth which belong to someone called Architect, and this is the reason that he displaces inside the space and never meet the Architect.

In summery method for writing the story is to start with writing a character's story and divide the storyline into period that this character spends in each of them, then synchronise the storyline regarding the first character journey and complete other character's story based on their confrontation with the first character.

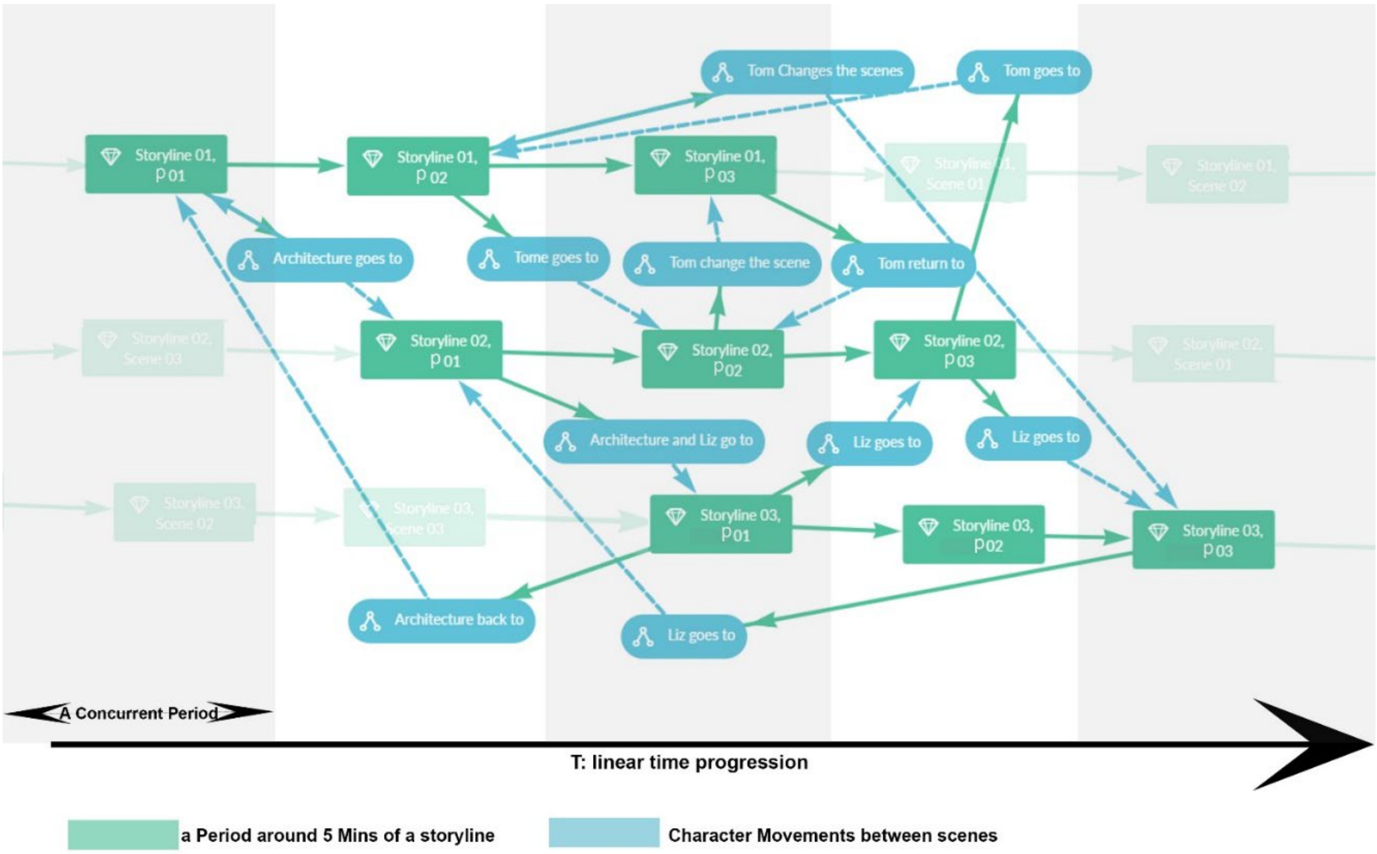


Figure 3. 1: Déjà vu's story map

The script is attached as an appendix[4], it is suggested to gain a better interpretation from the "whole" of the story, after reading the script in linear order (each storyline from beginning to end), re-read the journey of each character and follow each of them separately through different storylines till a loop is completed. It is better to begin with Architect and then, Liz and finally the young Tom.

3.2. Sources of inspiration

3.2.1. Theory of Many-Worlds Interpretation and Decoherence

Many worlds interpretation (MWI) is one of three main quantum mechanics theories that try to provide an interpretation for the relationship between microscopic and macroscopic worlds. Refer to Schrodinger's cat experiment in quantum physics that illustrates the concept of superposition, a fundamental idea in quantum mechanics. In this hypothetical scenario, a cat is placed in a sealed box with a radioactive atom and a vial of poison. If the atom decays, it triggers the release of poison, causing the cat's death. However, until the box is opened, and the cat's state is observed, it exists in a superposition of being both alive and dead simultaneously, reflecting the peculiar nature of quantum particles that can exist in multiple

[4] Appendix XIV – Déjà vu Screen Script.

states at once until observed. Schrödinger's cat serves to highlight the paradoxes and counterintuitive nature of quantum mechanics. (Carlson, 2020)

The Many-Worlds Interpretation (MWI) of quantum mechanics, proposed by Hugh Everett III in 1952, offers an alternative explanation for the Schrödinger's cat thought experiment. According to MWI, the cat doesn't exist in a superposition of being both alive and dead; instead, the entire universe splits into multiple parallel branches, or "worlds," every time a quantum event occurs. In the context of Schrödinger's cat, when the box is closed, the cat is simultaneously alive in one branch of the universe and dead in another. Each of these branches continues to evolve independently. (Shumacher, 2019)

In Many-Worlds Interpretation theory, the observer is a part of quantum world; hence, its observation determines the superposition that cat is alive or dead, consequently, both scenarios can be existed. In other words, as soon as the observer open the box both cases are brought to exist divided into two parallel universes. This interpretation eliminates the need for wavefunction collapse and suggests that all possible outcomes of a quantum event actually occur in different parallel realities. MWI implies a vast, constantly branching multiverse in which every conceivable quantum outcome is realised in a separate, non-communicating universe. In fact, MWI provide a deterministic approach to interpret the reality while provide various possibilities of an incident.

This approach that robust the role of observer and its psychological state and its spatio-temporal coordinates in interpreting the phenomenon initiates the idea about the design of a method for interactive storytelling in VR medium. Through designing concurrent storylines of an incident that based on the observer's spatial and temporal position can interpret differently, this method of interactive storytelling provides a determinative world of pre-recorded contents in which different possibilities are coexisted; however, the observer is free to choose its own interpretation from phenomenon through travelling inside the story-world.

Additionally, the theory of "Decoherence"[5] (Schlosshauer, 2019) is a fundamental concept in quantum mechanics that helps explain the transition from the superposition of states to apparent classical behaviour in the Many-Worlds Interpretation. Decoherence suggests that when quantum systems interact with their environment, such as air molecules or other particles, the entanglement and interference between multiple quantum states diminish over time. In the context of MWI, decoherence plays a crucial role in maintaining the separate, non-

[5] The theory of decoherence in quantum mechanics was developed and proposed by several physicists, but it was primarily formulated by Erich Joos, H. Dieter Zeh, Claus Kiefer, and Thomas P. Ball in the 1980s. These physicists contributed significantly to the understanding of how quantum systems interact with their environment, leading to the concept of decoherence, which is now a fundamental idea in the field of quantum mechanics.

communicating branches of the multiverse. As interactions with the environment cause quantum superpositions to lose coherence and become distinct, it creates the illusion of a classical, definite reality in each branch, making it appear as if only one outcome occurred, while actually, all possibilities are unfolding in parallel within the multiverse.

This complementary theory to MWI, is the source of inspiration to design the structure of the story-world in project Déjà vu. To find a way to connect different simultaneous storylines, it is considered that in some point of time decoherence of parallel universes could be collapsed and the characters enter into a parallel universe. These points of "coherence" become available through doors that implemented in the scene working as a so-called "time-gates" that connect concurrent timelines. In writing the story, it is assumed that the characters are not aware of travelling between different timelines, except for the Architect who is the designer of the story world. Character Tom changes his storyline; however, his historical information about the sequence of events doesn't impact by his time-traveling as he is a younger version of the Architect who doesn't got impacted by historical sequence of timelines. Hence, Tom sees parallel universes as different booths of an art gallery. Alternatively, character Liz is acting differently in each timeline because she is the reason that Tom and Architect are changing their timelines in order to impact her decision and change it as their wish. Thus, the historical information of character Liz is ordered in sequence of past, present and future timelines; in past she met Tom, in present she meets Architect as a stranger and in future she is Architect's partner.

In the Déjà vu project, the character Liz is the character who is impacted by the historical order of events; thus, she is the only one who can experience a déjà vu. The design of coherence points that connect parallel universes, results in a déjà vu for character Liz. She experiences an event in a timeline, then, when she passes a time-gate and travel to another universe, this event is repeated in the new timeline as a completely new occurrence. However, Liz experiences the repetition while doesn't know the reason, and it causes to recall all relevant information about the circumstances of the incident in the first instant. On the other hand, her journey into parallel universes is in a loop and repeated endlessly; consequently, when she is in the past timeline with Tom and experience a déjà vu triggered by one of Tom's dialogues, she remembers the event from the future timeline when she heard the same dialogue from Architect. The same situation happens when she is in the future timeline with Architect as she remembers her confrontation with Tom. In this context, the loop in design of narrative structure causes the future events impact the past and story of Déjà vu is concluded that Architect realises his design of virtual system effected the past events in reality and rejection of his proposal in the first instance!

3.2.2. Chris Marker's "La Jetée" 1962

"La Jetée" is a 1962 French science fiction film directed by Chris Marker and is known for its unique storytelling style. The film is presented almost entirely through a series of still images and a voice-over narration. Set in a post-apocalyptic world, it tells the story of a man haunted by a vivid childhood memory of witnessing a woman at an airport shortly before a traumatic event. In an experimental project, scientists send the man on a time-travel journey to the past and future using his haunting memory as a focal point. The protagonist's mission is to help humanity, which is on the brink of destruction, by altering the course of history. The film explores themes of memory, time, and the human condition, offering a haunting and thought-provoking narrative in its minimalist visual style.

The protagonist encounters some people from the future in the film's concluding sequence who promise to free him from the time-travelling experiment that caused him significant mental damage. However, he chooses to go back in time and live with the woman he remembers from his childhood as his beloved. The man is then transported to the airport and sees the woman, but when he attempts to reach her, a member of the experiment's team hiding in a corner of the airport shoots him with a gun and kills him, while the man, as a child, observes this incident. It is the event that triggers the traumatic memory and sets off the entire time-travelling experiment in the first place.

The structure of La Jetée's story, which included a loop in the sequence of events, inspired the design of the looping process in the film Déjà vu. The Architects try to influence Liz's decision by assuring her that she will reject whatever offer she receives, incept the notion so that she can consider alternatives. However, his subsequent dialogue similar to what he said in the past as character Tom, causes Liz to have a feeling of déjà vu. In essence, the impact of the future event on the past in the Déjà vu movie emphasises the deterministic nature of pre-recorded content presented in a form of interactive storytelling method. The parallel universes are put in a loop and interact in such a way that characters can't escape their determined fate, like the protagonist in the La Jetée film.

3.3. Space Design

3.3.1. Diorama

The story of Déjà vu takes place in an art gallery where Tom had shown his photographs of Liz and planned to offer his proposal. Thus, Architect redesign the booth in the art gallery in three different forms; one in the same place that Tom showcases his work, the two others are designed as the same booth; however, one for exhibiting Liz's paintings and the other consists of Architect's illustrations. Tom meets Liz in his booth in the past timeline, Then, Liz meets Architect in the same booth as a stranger who tries to connect with Liz by putting his complements on photographs that are taken from Liz. Finally, the future timeline is the booth with Liz's paintings that show her success as she is coupled with Architect as her partner.

As a method of interactive storytelling to create a depth-of-field, it is considered that audiences be able to observe all three parallel storylines at the same time; however, they are only can hear the sounds belong to their current location. It makes a kind of out-of-field for hearing sense that provoke audiences to travel to other places to follow the story and infold narratives. Hence, the design of space consists of putting universes on the inner surface of a cube (Figure 3.2) and design two doors for each space each of which transfers audiences to ones two other space.

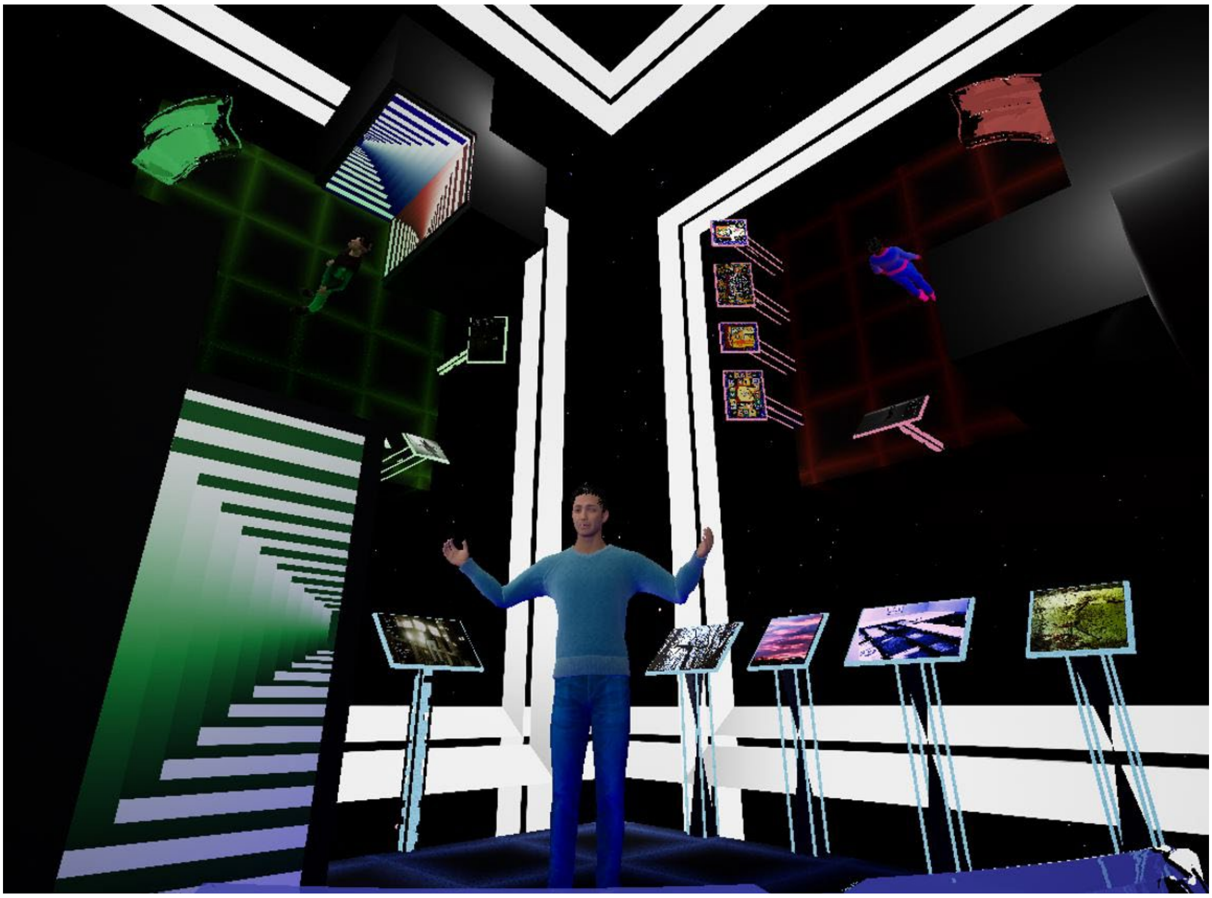


Figure 3. 2: Diorama of Déjà vu

Each location coloured in red, green, or blue to help audiences discern storylines. Additionally, doors in each location are coloured in two opposite colours, thus audiences can choose to travel to each location by touching doors with the same colour. For instance, if they are in the blue location, doors are in green and red which let them to choose to transfer to one this two places.

Also, all three locations occupied an area of four meters by four meters (13.1234 x 13.1234 ft) as a playing area in which audiences can freely walk and interact with virtual objects.

3.3.2. Source of inspiration

The design of the space is inspired by MC Escher’s “Relativity” which is a lithograph first printed in December 1953 (Figure 3.3). It showed a space with three different gravitational directions. Inspired from this lithograph the story-world for Déjà vu is consists of three different gravitational direction each present one of parallel universes.

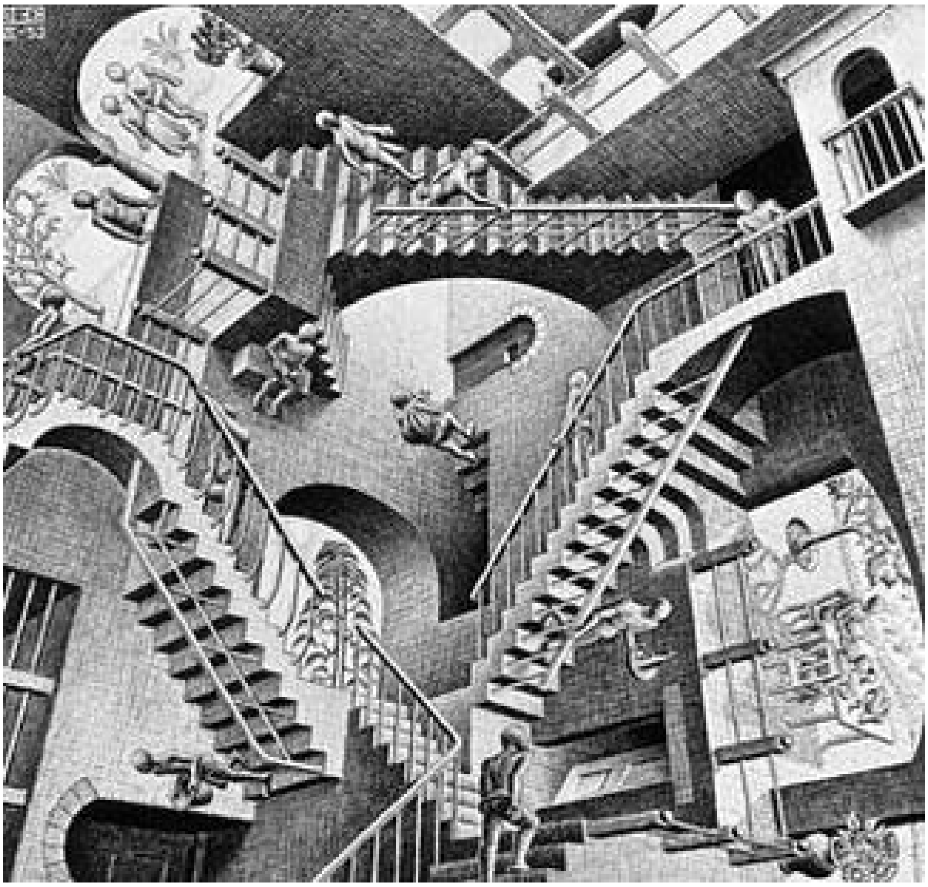


Figure 3. 3: Relativity by MC Escher (1953) – source: (Wikipedia, 2023)

Although in Escher’s work the three directions of gravity is providing orthogonal surfaces in which the wall for one direction is the flour for the other one, however, in designing Déjà vu, the surfaces with different gravity direction are distanced and audiences to change their gravity direction need to touch a door and transfer to a completely different location.

3.3.3. Paintings and photographs

In the scene, there are twelve stands for paintings and photographs, four in every location, each of which serves as a booth for one of three characters. In addition, each booth features a screen that displays information about the artist, Architect, Liz, and Tom. The artist's details, on the other hand, provide information about the narrative's characters, such as name, characteristics, hobby, occupation, fear, and a brief story. The artists' stand is designed in such a way that it reveals the characteristics of story characters for movie viewers who are real visitors to the story of this art gallery.

Based on the story, the character Architect is VR artist who doing photography as a hobby when he was younger, being Tom (Figure 3.4).

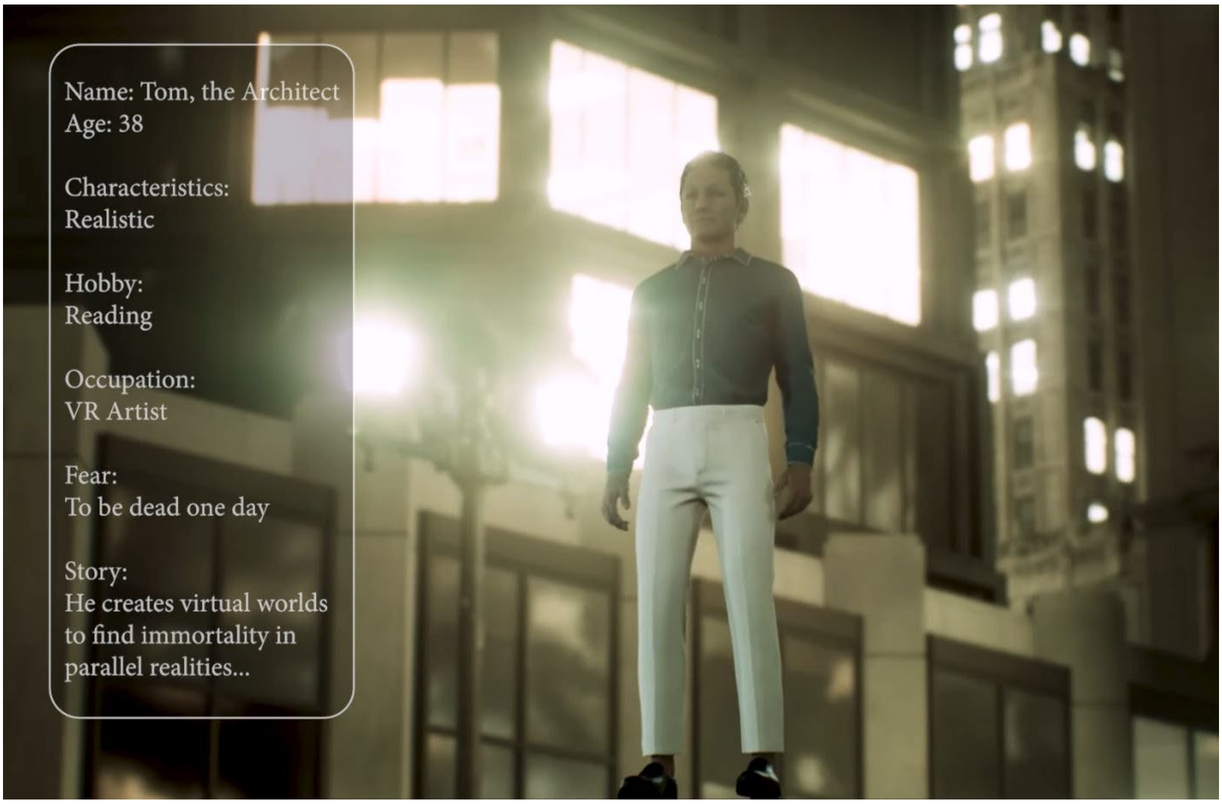


Figure 3. 4: Information about Architect character installed in his booth.

Four photographs are exhibited in the Architect booth (Figs.3.5, 3.6, 3.7, and 3.8). One of the photographs depicts a wall with a portrait of Liz on it (Figure 3.8). This image makes Tom wary about the situation and causes him to travel between his booth and the Architect's booth.

Figure 3. 5:Architect's photographs

Figure 3. 6: Architect's photographs

Figure 3. 7: Architect's photographs

Figure 3. 8: Architect's illustration of Liz on a wall

The screen in Tom’s booth (Figure 3.9) shows that he is age 23 and in love with someone. He is a student of archtecture which proves why he designed a virtual space in the future, as the character Architect to revive the moments of love rejection. The screen directly mention that Tom is going to offer Liz a proposal and he fears of being a loser that are the information about story and characters only works for movie audiences.

Four images displayed in Tom's booth represent Liz in various scenarios, emphasising his emotional attachment to the character Liz. (Figures 3.10, 3.11, 3.12, and 3.13). One of the photographs (Figure 3.13) depicts Liz in the same pose as the Architect is represented in his image, although from a different angle. It reveals a connection between the characters Tom and Architect, who both pictured Liz resembling the same figure.

Figure 3. 9: Information about Tom character installed in his booth.

Figure 3. 10: Tom's Photographs of Liz

Figure 3. 11: Tom's Photographs of Liz

Figure 3. 12: Tom’s Photographs of Liz

Figure 3. 13: Tom’s photograph of Liz in position similar to Architect’s Illistration.

Liz's screen (Figure 3.14) shows that she is a twenty-year-old performing student who paints in her spare time. She is an ambitious character who seeks to prove herself as an outstanding artist and performer, which is why she isn't interested in engaging with Tom at the moment, despite the fact that her main fear is being alone without anybody praising her talents.

The works of art displayed in Liz's booth (Figure 3.15, Figure 3.16, Figure 3.17, and Figure 3.18) are digital paintings that play as a short animation, four to six seconds long, on a loop, and are creations of Laleh Ali Pour[6], a painter and performer who performed in this movie as the character Liz. The subjects of the painting highlight Liz's characteristics as a strong woman concerned about discrimination against women, Figure 3.17: Virginity and Figure 3.18: Wedding night, her anxiety about being watched by others all the time as a celebrity figure, Figure 3.15: Concentration, and her opinion about a haunted lovers' relationship, Figure 3.16: The Lovers, which was painted and animated for this movie by the artist.

Figure 3. 14: Information about Liz character installed in her booth.

[6] The artworks "concertation" (Figure 7.15), "Virginity" (Figure 7.17), and "wedding night" (Figure 7.18) are previously depicted in artist's Instagram page at < https://www.instagram.com/laleh_alipour>

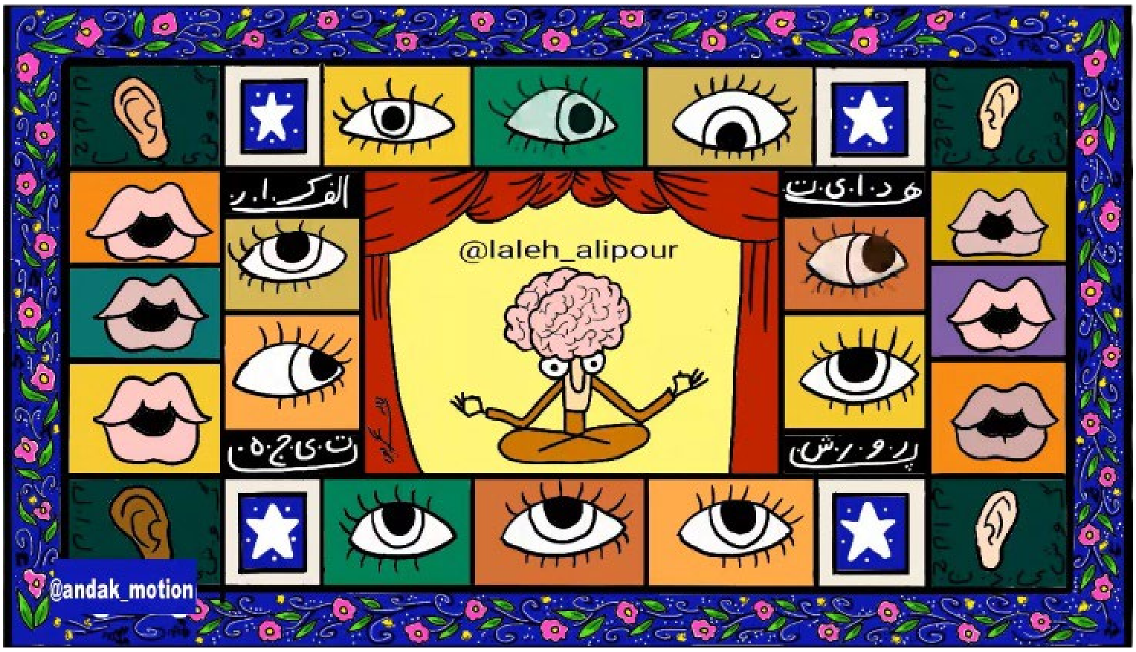


Figure 3. 15: a screenshot from digital painting "Concentration" by Laleh Alipour (2021) installed in Liz's booth as her painting.

Figure 3. 16: a screenshot from digital painting "The Lovers" by Laleh Alipour (2022) installed in Liz's booth as her painting.

Figure 3. 17: a screenshot from digital painting "Virginity" by Laleh Alipour (2020) installed in Liz's booth as her painting.

Figure 3. 18: a screenshot from digital painting "Wedding Night" by Laleh Alipour (2020) installed in Liz's booth as her painting.

3.3.4. Designing a substitutional reality

In definition Substitutional Reality (SR) is “a type of mixed reality addressing the disparity existing between a virtual environment and the physical environment in which the user is actually located” (Simone, 2018, p2). In another words, in a SR application physical object inside a room find a virtual counterpart in virtual environment. For example, a user can hold an umbrella in physical room, while he sees it as a sword inside a virtual scene.

In the Déjà vu project, the starting place of the user to enter the movie scene is a virtual chair with glass materials (Figure 3.19); thus, there is a need to provide users with a physical counterpart that replace the seating place. In this situation the Déjà vu project represent a kind of substitutional reality. This substitution provides a sense of touching of a virtual object for user and enhance the quality of virtual experience. Also, matching the virtual chairs which exists in all three location and a physical counterpart offer a method to connect physical and virtual world. As a result, audiences are teleported to different locations with the same size and having a feeling of walking in an area three time bigger than their physical room in each of which they have a different virtual chair with the same physical counterpart.

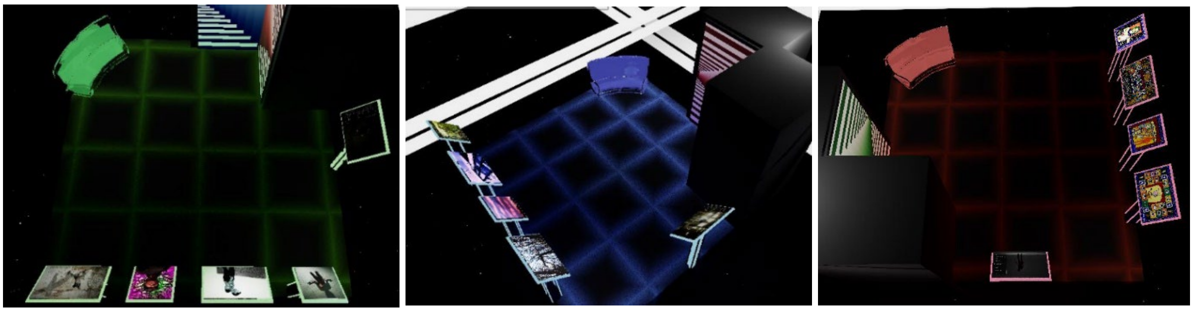


Figure 3. 19: three different virtual chairs placed in the similar corner of each scene and can be substituted with a physical counterpart

3.4. Audiences’ experience Scenario

Audiences can enter the movie from any scene that they choose. While they are inside the virtual story-world, they can see all three different parallel universes at the same time. They can walk freely among the other characters and objects within the scene. They are transported to the other universes by touching the doors in the location that work as time-gates in this design of the interactive story.

To experience this interactive movie, a square in 4x4 meters is the area that audiences can freely walk. The audience wears an VR headset and uses the controller for choosing options and touching the doors. To start the application and enter the movie scene, audiences are needed to sit on a physical bench in the corner of the square; Then, by launching the app, a menu appears gives them instruction for experiencing the movie and asking them to choose between three different gates to enter the story-world.

Based on their choice, audiences are transported to one of the parallel universes find themselves seated on a virtual bench. Afterwards, they can stand up and start walking inside the scene. The characters movements and actions are added to virtual space using motion capture techniques. Therefore, the audience can walk among them while characters move inside the story-world. Characters frequently change their scene during the movie. Audiences can follow them and change their location in the story-world by touching two doors placed in the corner of the area. As soon as the audience touches one of the doors, using the controllers depicted in the shape of human hands, they are transported to one of two other scenes.

All the dramatic incidents are repeated in a loop, and there is no specific ending point for this movie. To finish the experience, the audience should return to their starting point, the chair, and sit on it again. All three different scene are similar, except for the artworks that are installed on the frames; thus, in case that audiences can't recognise the first scene that they started, the alternative way is to press X button on left controller to see the exit menu.

3.5. Technical Development

3.5.1. Cast and Crew

The realization of *Déjà Vu* was enabled by the collective expertise and collaboration of an interdisciplinary team operating across narrative development, performance capture, technical integration, and sound design. At the project's core, the PhD researcher *Mohammadreza Mazarei* acted as Director and VR storyteller, conceiving the narrative architecture and steering the integration of interactivity and immersive logic. *Tom Wine*, an Unreal Engine technician at Staffordshire University, served as Lead Developer, authoring Blueprints for interactive systems and optimising performance pipelines within the virtual environment.

The characters in the story were embodied through the performances of *Laleh Alipour, Pezhman Azizi,* and *Mohammadreza Mazarei,* delivering essential acting and motion-capture work that gave presence and dynamism to each timeline. *Samuel Chu,* as Mocap Supervisor at the Cadman Building's Mocap Studio (Staffordshire University), oversaw the fidelity of motion and the continuity of gesture, ensuring that captured performances integrated seamlessly into the VR domain. On the animation front, *Todd R. Flitton*, Game Animation student at Staffordshire University, served as the rigging artist, mapping motion-capture data onto Metahuman character models.

The sonic fabric of *Déjà Vu* was shaped by *Tiggi McCarthy* and *Barnabas Olga*, Sound Design student at Staffordshire University, who recorded the cast's voices in Cadman's sound studios and designed spatial audio environments and ambient sound textures. The film's continuous background score was composed by *ErikMusic,* licensed for free usage pending credit mention. Finally, *Dr. Melanie Lee* was project supervision and methodological counsel, guiding creative decisions and ensuring their alignment with the broader research objectives.

3.5.2. Technical Information

The technical information for Déjà vu application is as below:

Type: Interactive VR animation

Frame rate: 60FPS

Application: PCVR executing app.

Quality: Unreal Engine “Epic” resolution

Headset compatibility: Oculus Rift, Rift S, Oculus Quest, MetaQuest2 (using Airlink or a USB3.0 cable link)

Support touch controller

No Internet connection required.

Game Mode: Single VR user

Player mode: Room-scale

3.5.3. Software

The Déjà vu application is created with the Unreal Engine software and the Epic Game Metahuman plugin. Character actions are captured using motion capture technology. The mocap data is then fitted to a Human IK and uploaded to a Metahuman skeleton in the Unreal Engine software using Autodesk Maya with a free student license. Adobe Premiere and Adobe Photoshop are utilised to create and edit the video and photographs featured in the setting. The actors' dialogues are recorded using a sound studio with the assistance of sound design students and then added to Unreal Engine to attach to the Metahuman characters that replaced the real actors as spatial sound using the Unreal Engine's sound tools. In addition, all interaction patterns are created within Unreal Engine using the Blueprint tool with the help of an Unreal Engine’s technician at Staffordshire University.

3.5.4. Game Levels

3.5.4.1. Start Level

The Déjà vu application is made up of two distinct Unreal Engine levels (scenes). As audiences launch the program, they enter an empty room with grids (Figure 3.20) indicating the playing area's border. To begin the experience, users should set the safe area on their headset to four meters by four meters and sit on a chair in the corner of the scene (Figure 3.21).

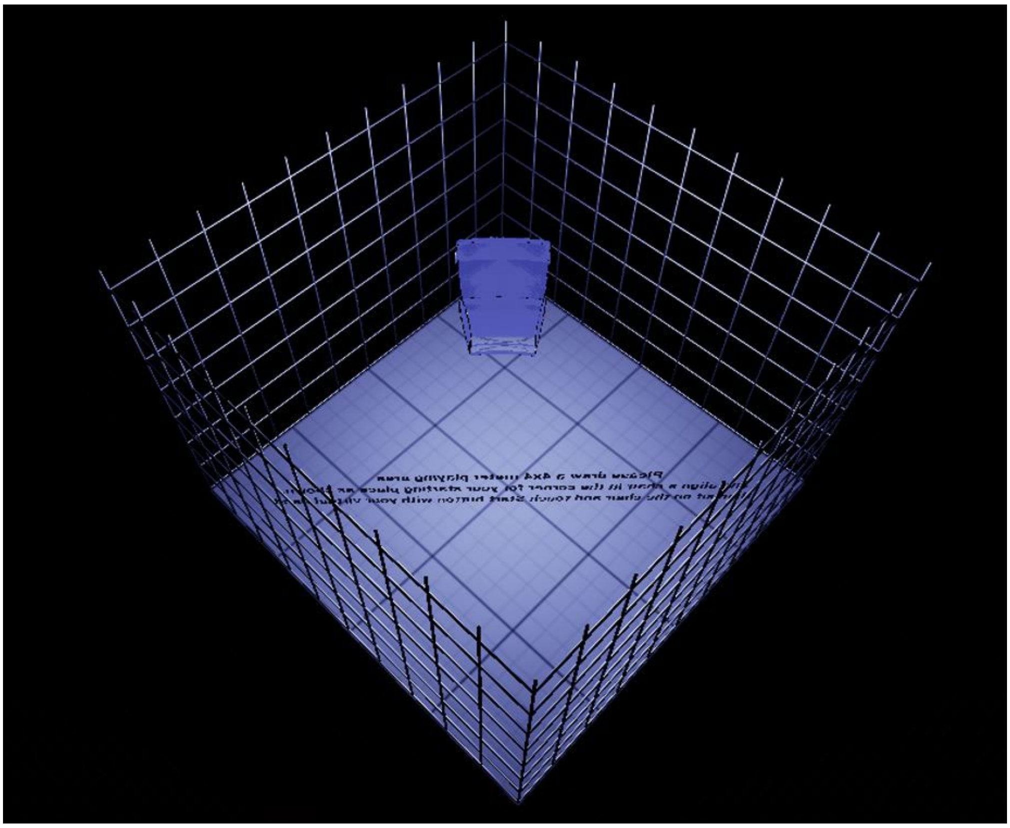


Figure 3. 20: start level diorama

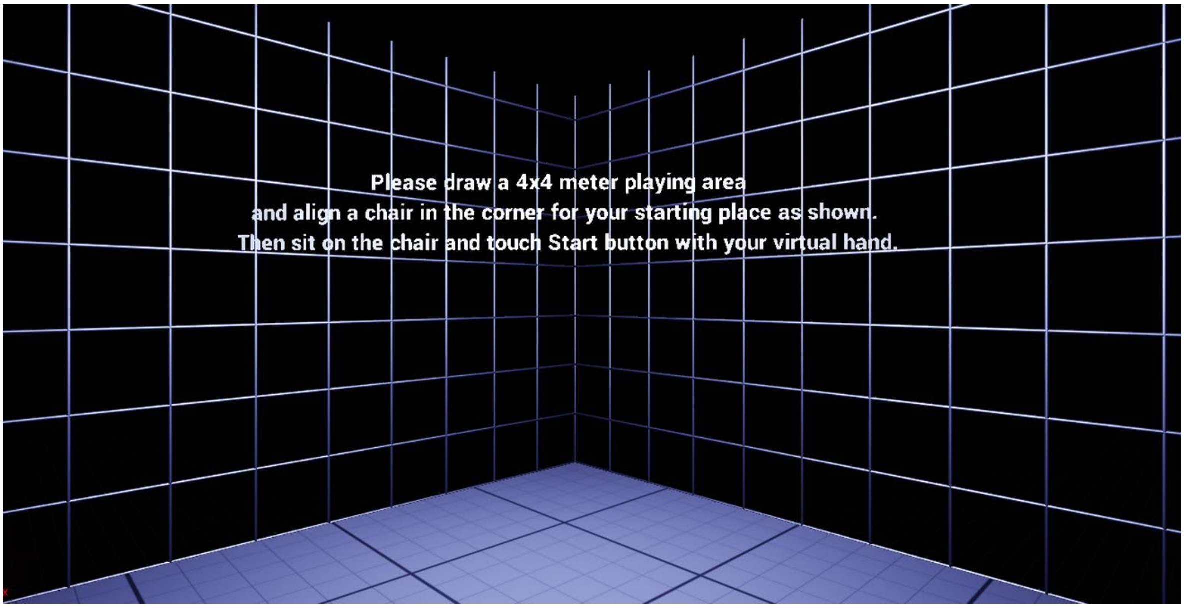


Figure 3. 21: Instruction to set playing area in start level.

After 10 seconds of entering this level, a start button appears in front of the user, allowing them to push start and proceed to the movie's main level. It has a collision box that allows the user to feel a vibration in their controller when they reach for the button. (Figure 3.22)

In the start level, a sequence is designed in a loop that contains calm music and an invisible lighting object that moves upside and returns down, changing the colour of the grids in the surrounding area and giving a living atmosphere to the empty room while emphasising the grids that determine the playing area. (Figure 3.25)

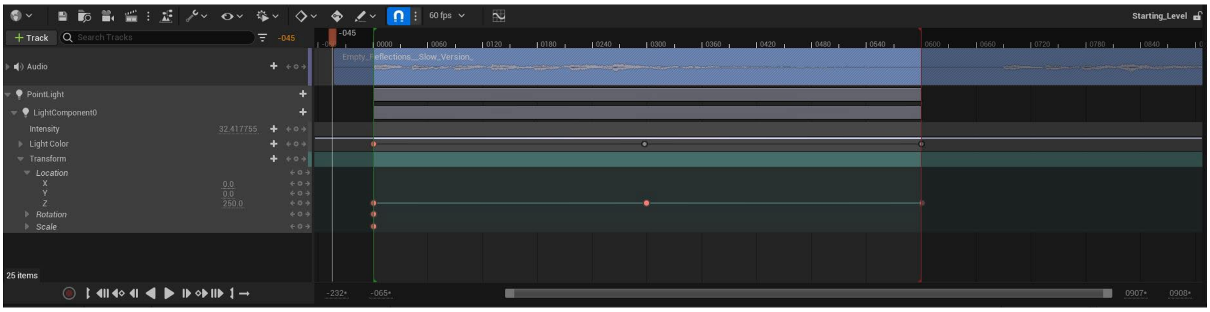


Figure 3. 22: Start level sequence.

3.5.4.2. Main level

The main level of the movie includes all the assets used in the story. Two sequences are designed to advance the narrative. In the first sequence, called the introduction sequence, the Architect character appears in the centre of the blue scene, and addresses the audience, who have been moved from the start level to a blue chair (Figure 3.26).

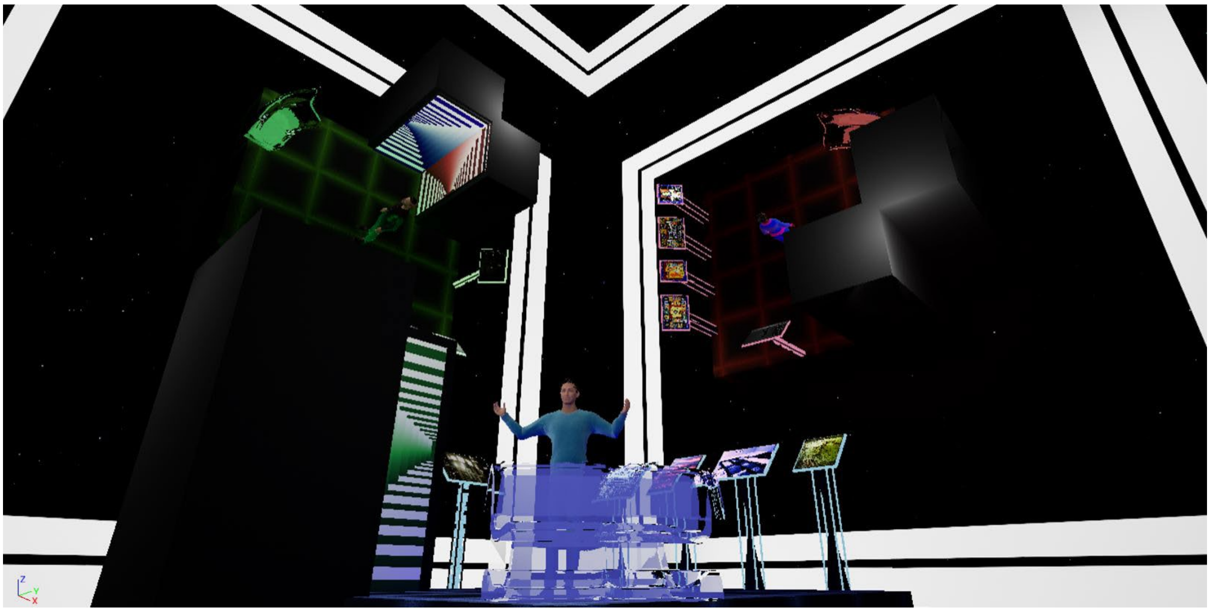


Figure 3. 23: Picture from introduction sequence in which Architect addresses audience and describes the instruction to move and interact with the movie.

The Architect provides a brief synopsis of the story and instructions for teleporting to different locations within the environment and interacting with the story elements[7] At the end of the introduction, the Architect invites the audience to choose one of three options on the trigger menu (Figure 3.27). These options are represented by three different colours—blue, red, and green—each transferring the audience to one of three different chairs in the scene, set as their starting point for experiencing the main movie sequence.

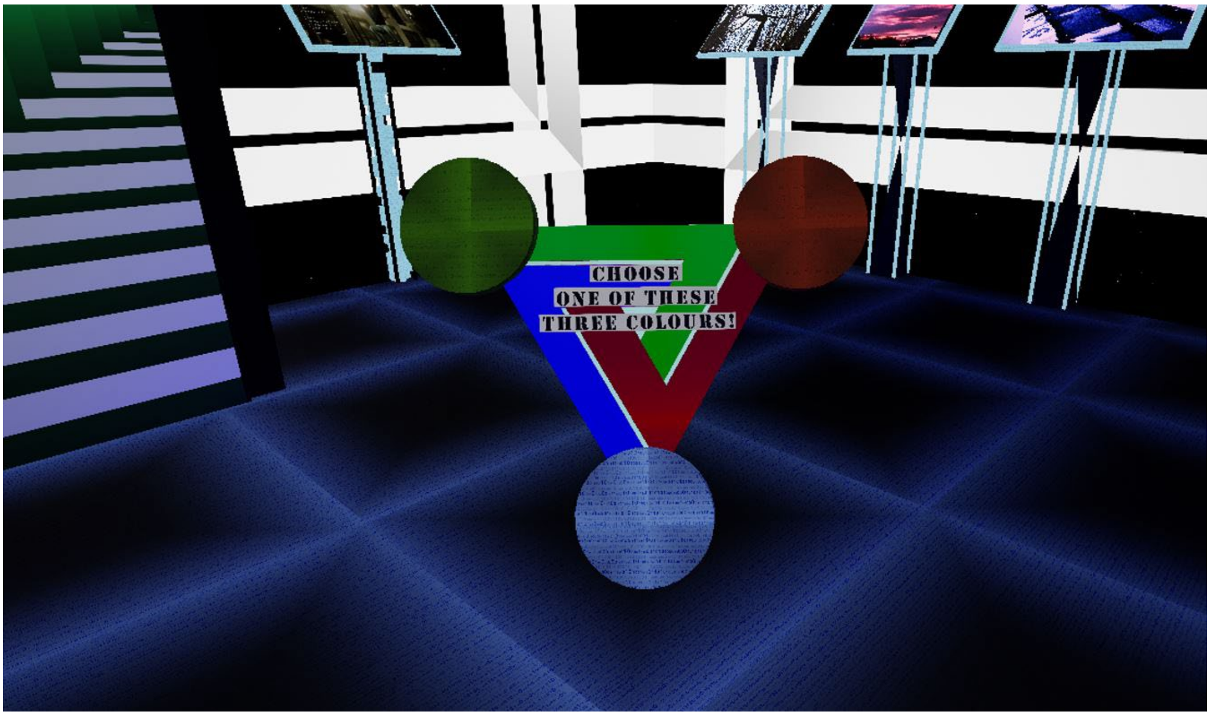


Figure 3. 24: Trigger menu which gives users three option to choose their starting place based on the colour of the scene.

The introduction sequence (Figure 3.28) includes a timeline for the movie's three characters. However, only the Architect has body and face animations. The other two characters, Tom and Liz, briefly appear, walk through the scene, cross doors, and transfer to another scene, providing the audience with an insight into their journey during the main movie sequence. This sequence is on a loop, meaning that after the Architect finishes his explanation and disappears from the scene, users have two minutes to press one of the trigger buttons before the sequence restarts from the beginning.

[7] See Appendix XIII – Déjà vu, Introduction Script

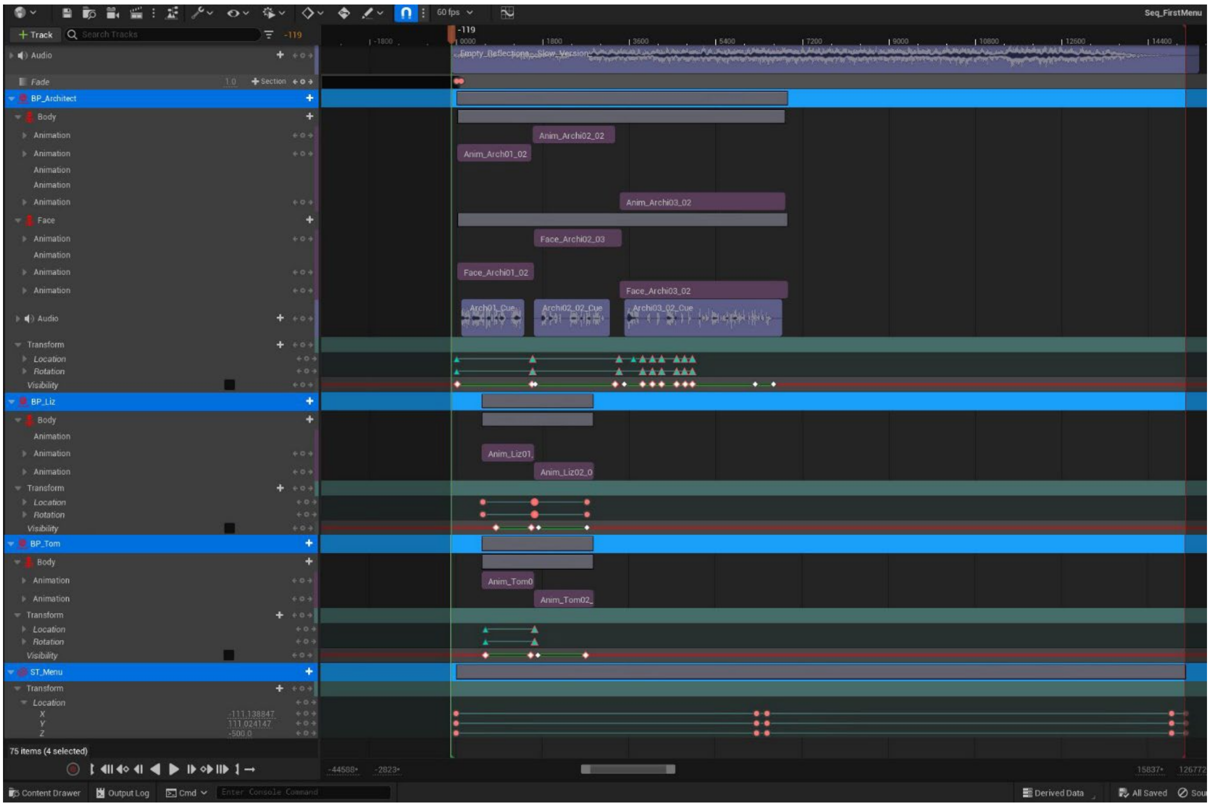


Figure 3. 25: Introduction sequence

After selecting one of the three options, the audience is first transferred inside a sphere that displays a 360-degree video containing the movie's opening title. After twenty-two seconds, they are teleported to their chosen starting point to experience the main movie sequence. A blueprint has been created to stop the introduction menu, transfer the user to the opening title sphere, and then position the user at their starting point (Figures 3.29, 3.30, 3.31, and 3.32).

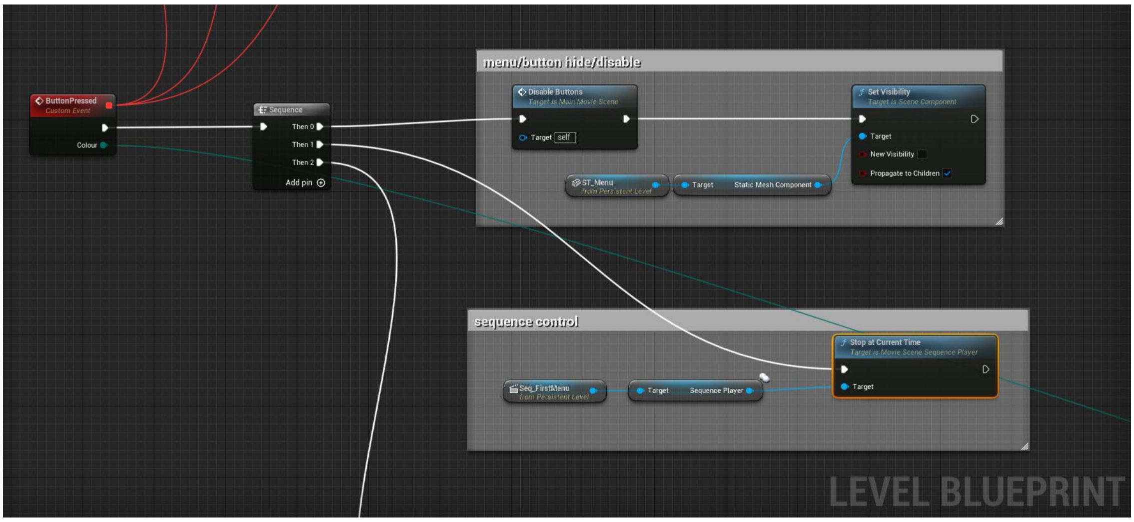


Figure 3. 26: Blueprint to stop introduction sequence and hide the start menu after selecting one of three colours.

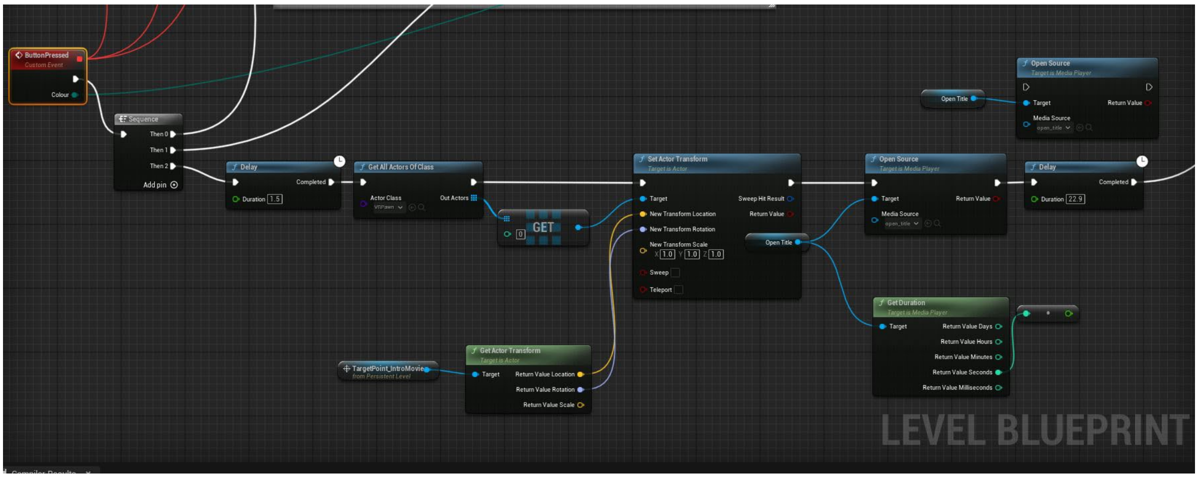


Figure 3. 27: Blueprint to transfer user to a sphere video of opening title.

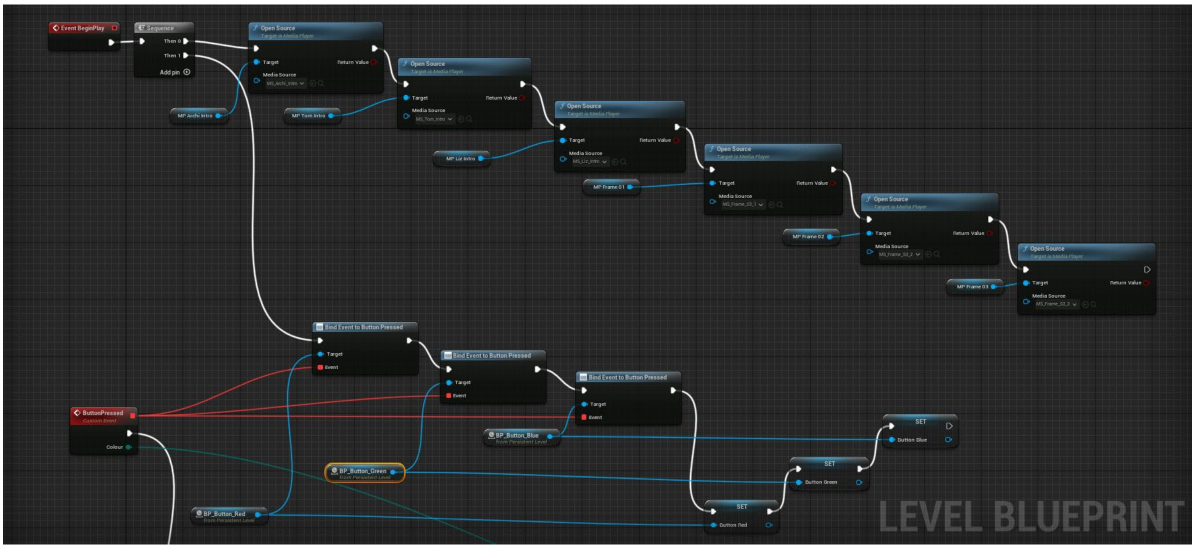


Figure 3. 28: Blueprint to display all videos in the scene as users enter the main level and set the user position to begin the story exploration based on their chosen colour.

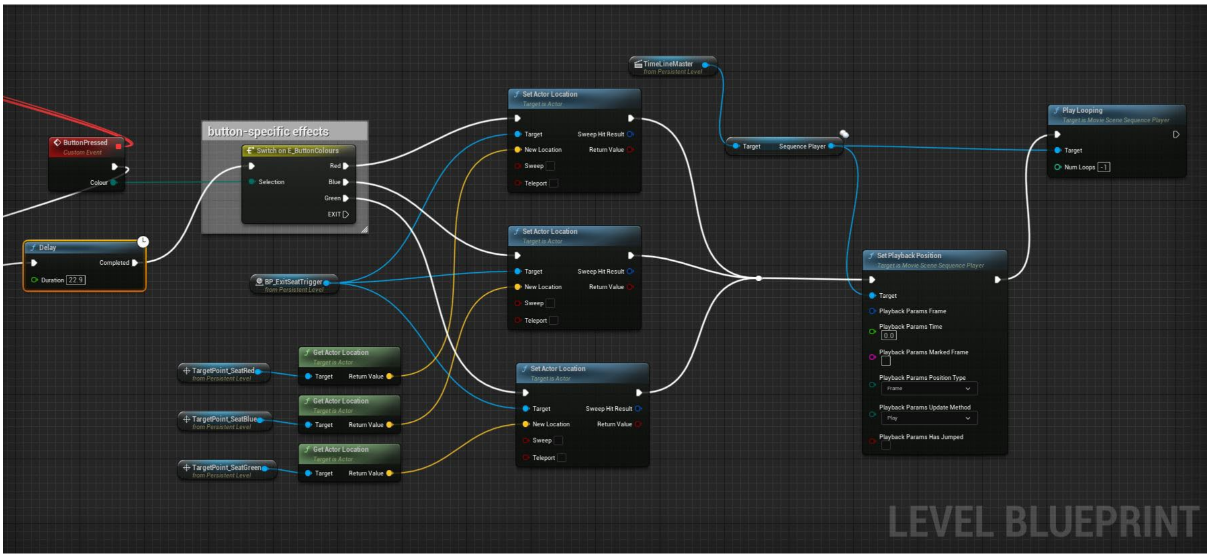


Figure 3. 29: Blueprint to return users to their selected position and start main movie sequence after watching opening title video.

3.5.5. VR player

The VR player used in the Déjà vu application is the default VR Pawn actor from the Virtual Reality Project template in Unreal Engine. However, for this movie, all grabbing functions and teleportation techniques are disabled. The interaction ability of the VR player is limited to pressing buttons, feeling haptic feedback, and interacting with doors in the scene to teleport to different locations within the virtual environment. A blueprint is designed for interaction with the doors using both virtual hands (Figure 3.33) and another blueprint for interaction with trigger buttons and choosing a starting place (Figure 3.34).

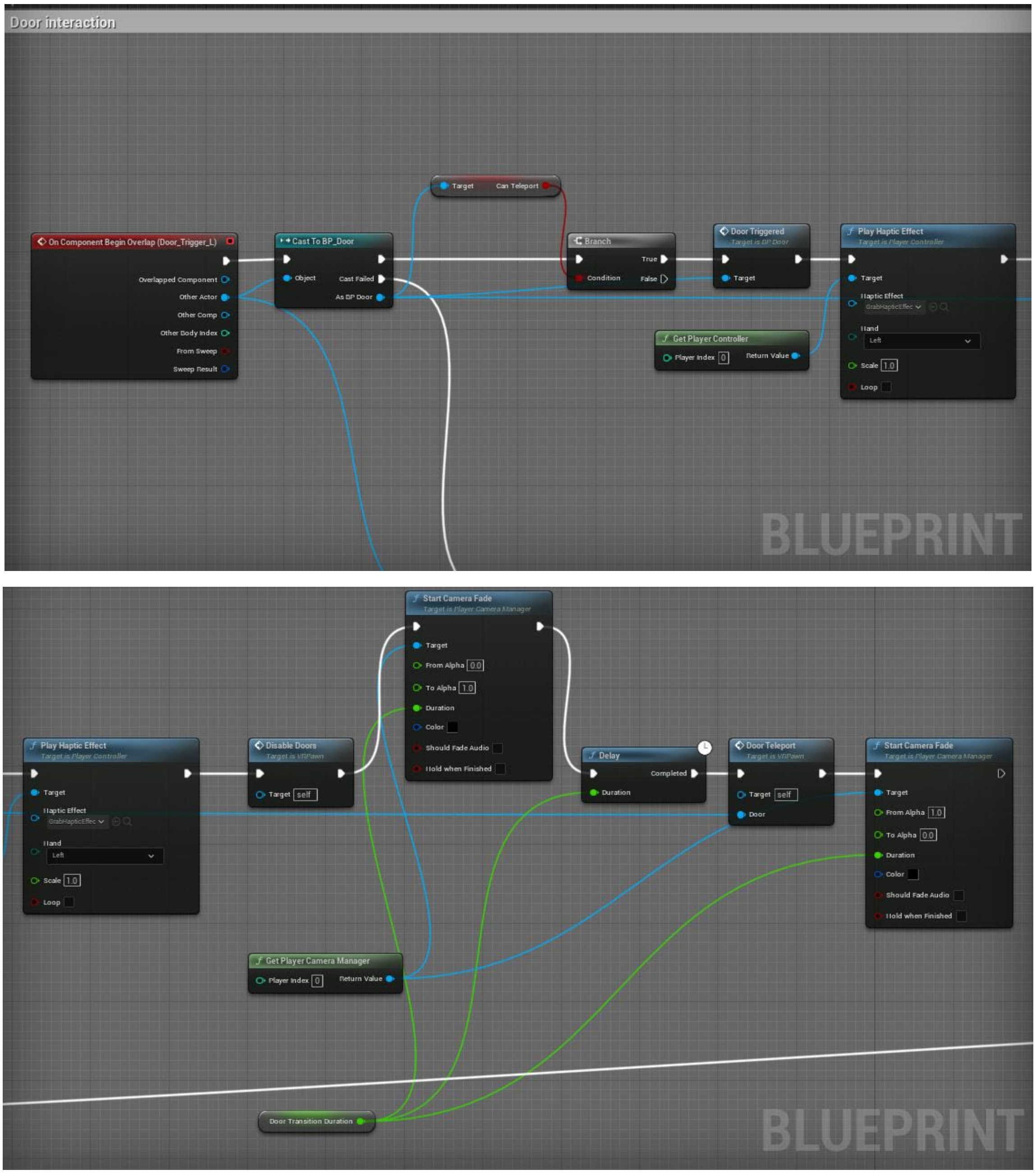


Figure 3. 30: Blueprint for interaction with doors in the scene (feel haptics, a camera fade, transferring to another scene, a camera fade)

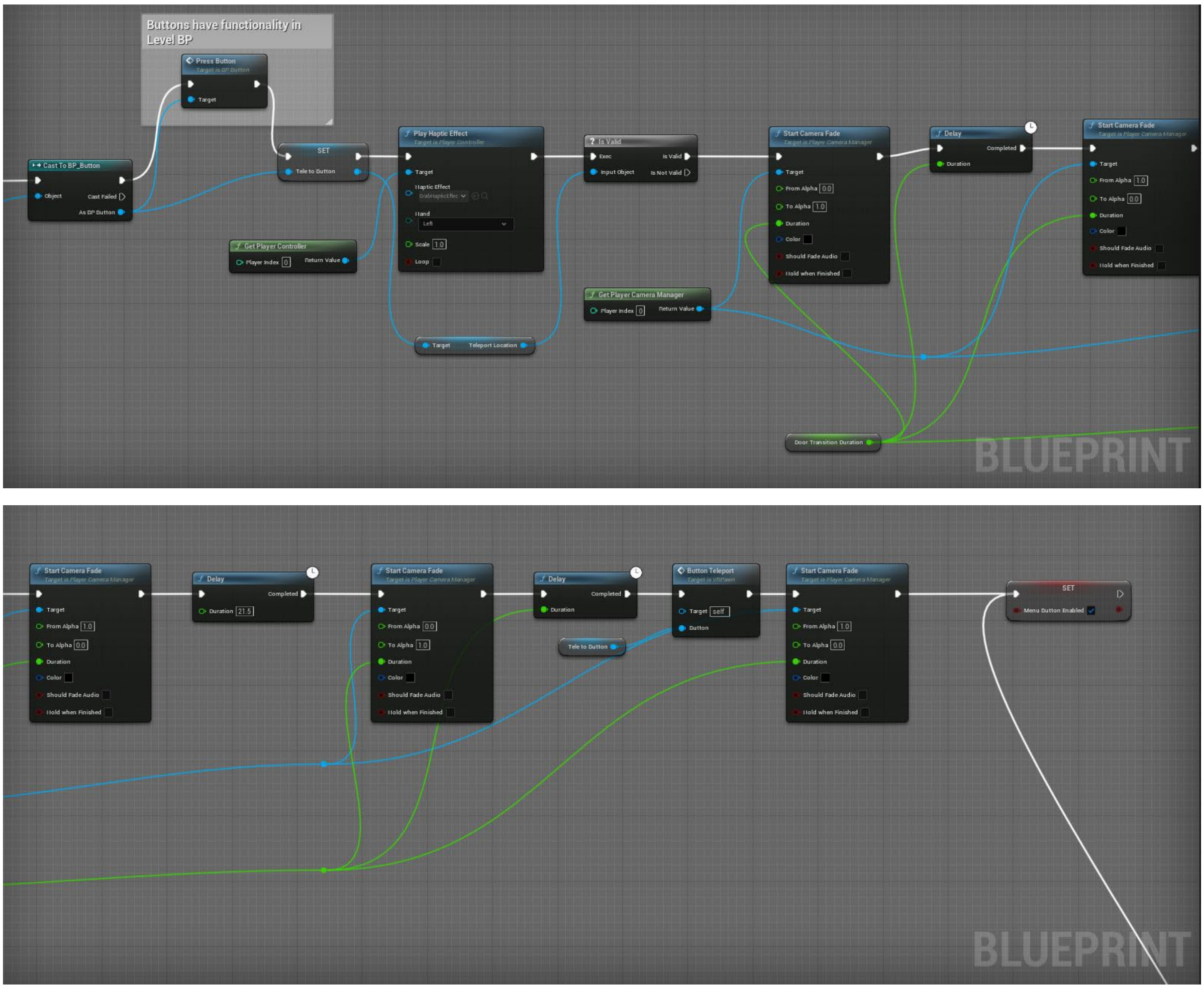


Figure 3. 31: Blueprint for button function on VR player (feel hepatitis, a camera fade, transferring to open title sphere for 22 seconds, a camera fade and transferring to starting place)

The starting point of the VR player for the main movie sequence is determined by the user's choice of one of three different colours. This choice is saved as an interaction pattern. To enable the exit menu, users must return to their starting place and sit on the virtual chair. This pattern challenges audiences to recall their starting point after being displaced among three similar scenes. A function has been added to the VR Pawn that captures the transformation of the starting point and toggles the exit menu when the user enters a collision sphere around the chair (Figures 3.35, 3.36, and 3.37).

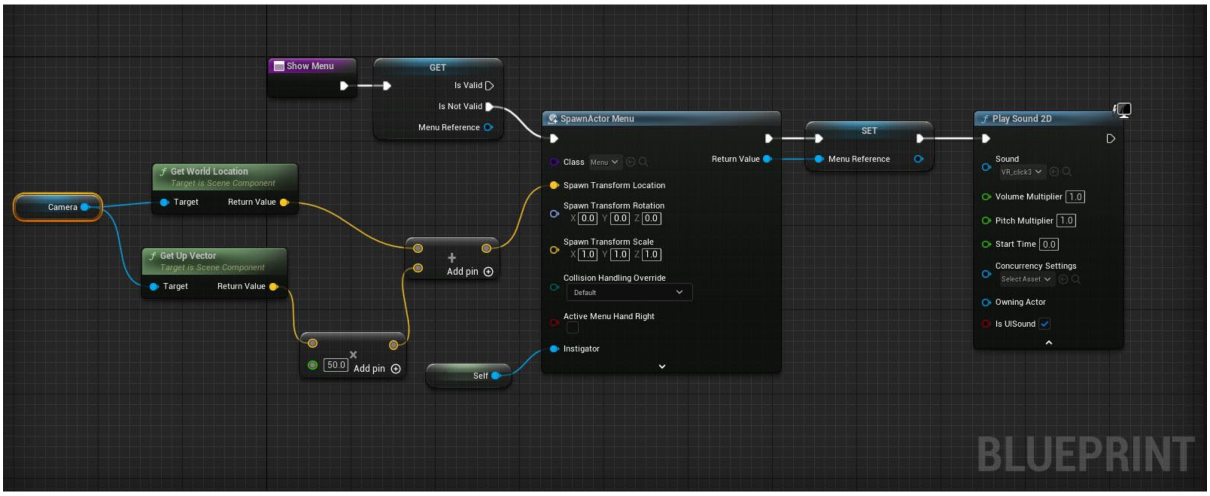


Figure 3. 32: Blueprint to save starting place information.

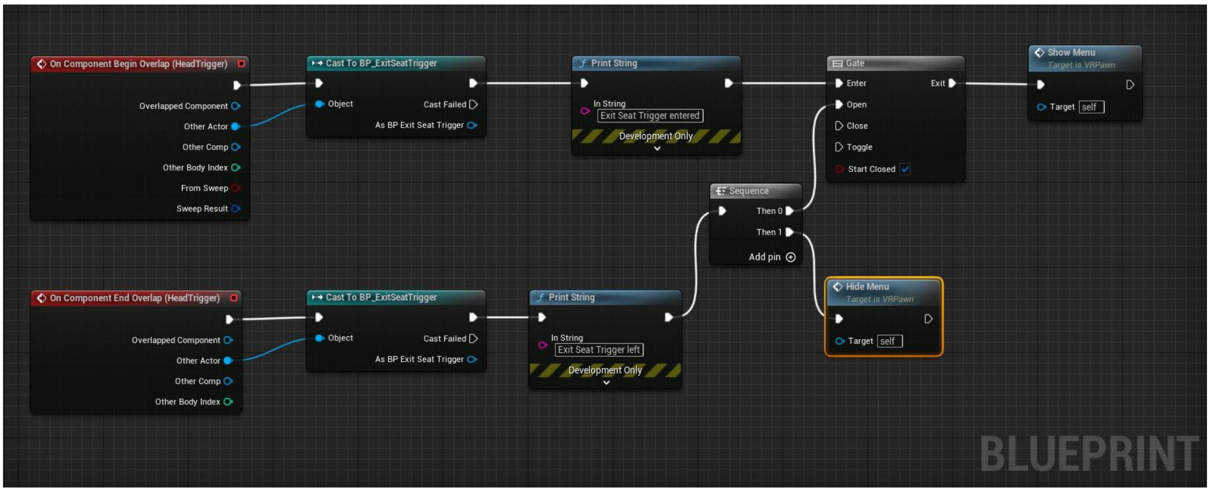


Figure 3. 33: Blueprint to show exit menu as users return to starting place.

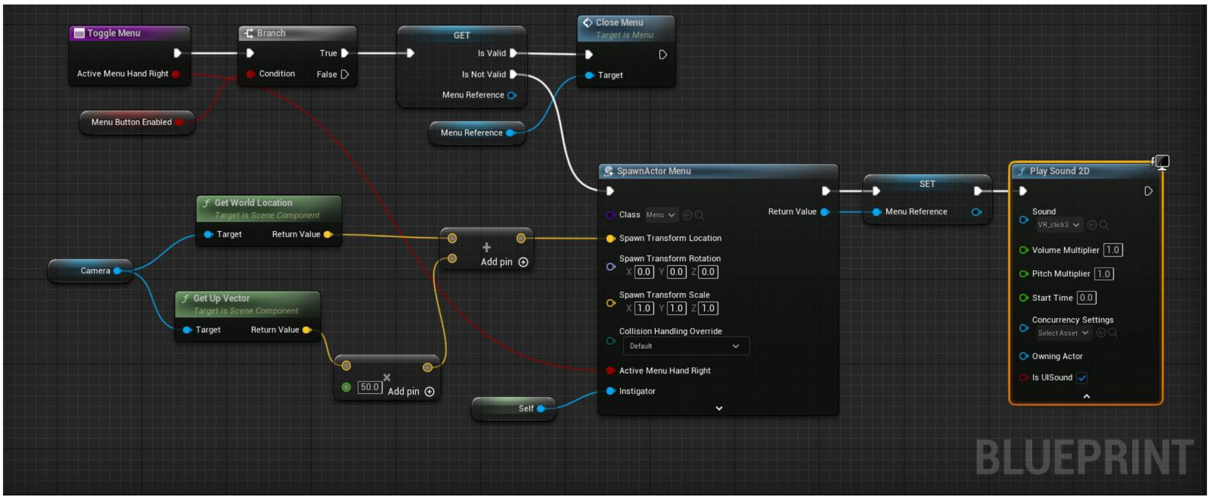


Figure 3. 34: Blueprint to hide the exit menu as user leaves the starting place.

The exit menu (Figure 3.38) gives users the option to exit the game and back to the reality or continue exploring the virtual reality. While seated on the chair, they can hide the exit menu.

The exit blueprint (Figure 3.39) is designed so that if they choose to exit the game, they are first transferred to a sphere that displays a 360-degree video of the final credits before quitting the game.

Figure 3. 35: Exit menu with options to stay or leave the application.

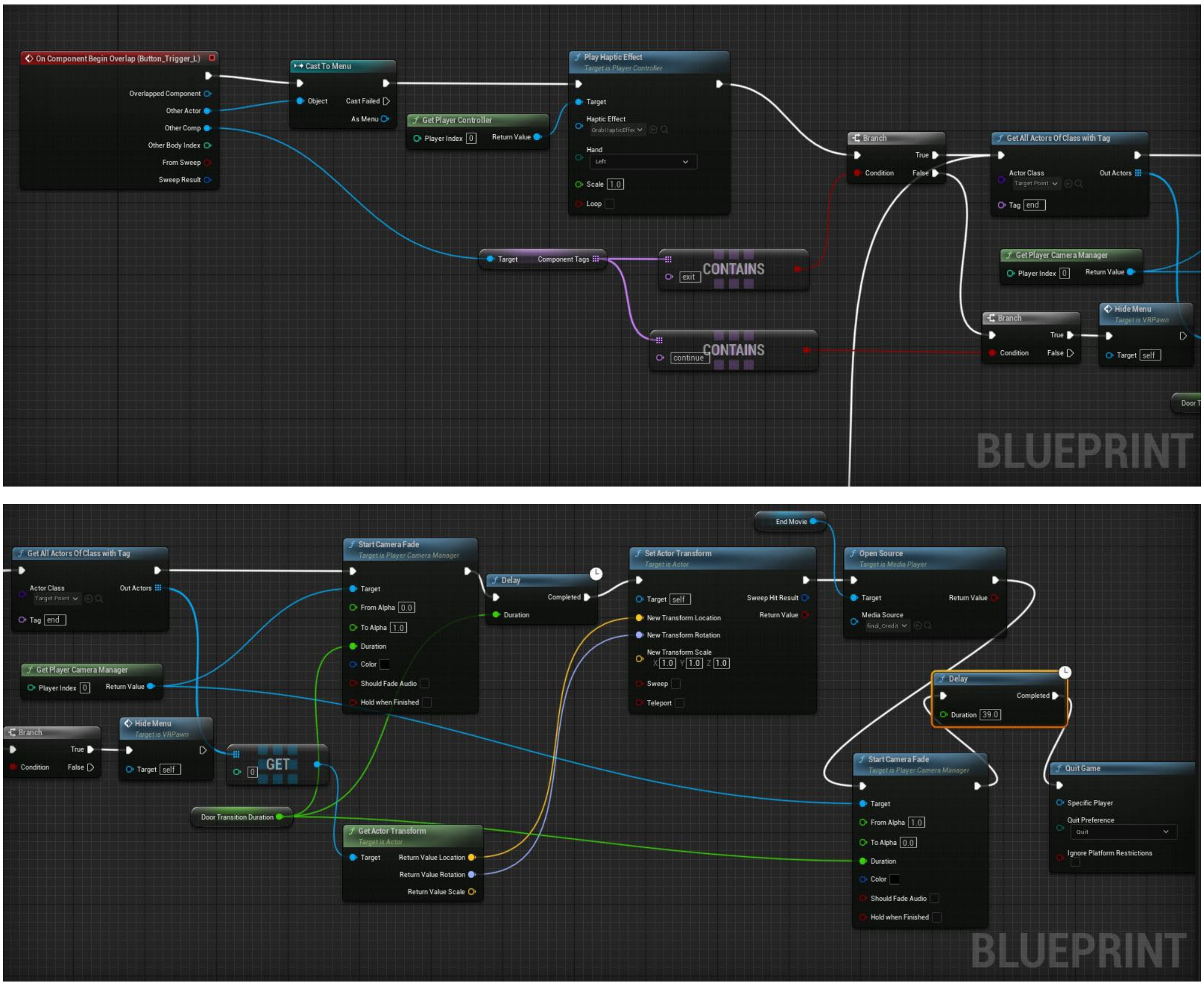


Figure 3. 36: Blueprint for exit menu button function (feel haptics, a camera fade, transferring to closing title movie sphere, exit the game)

3.5.6. Door's blueprint

Doors in the scene are initially created as Unreal Engine blueprints to set up interactive functions. Each door blueprint includes a mesh object with six copies placed in different locations, each with a different texture pattern. When users touch the doors, the door materials change, flipping upside-down and returning to their normal position within a three-second timeline (Figure 3.40). This change in material, along with a video fade and haptic feedback, informs users that their interaction with the doors has caused a change in the scene. The fade-out-fade-in effect on the VR player's viewpoint serves as a transition effect, transferring the user to another scene when they touch the door. This fade effect was suggested by a number of audiences that had been experiencing a demo of movie in Laval Virtual Exhibition.

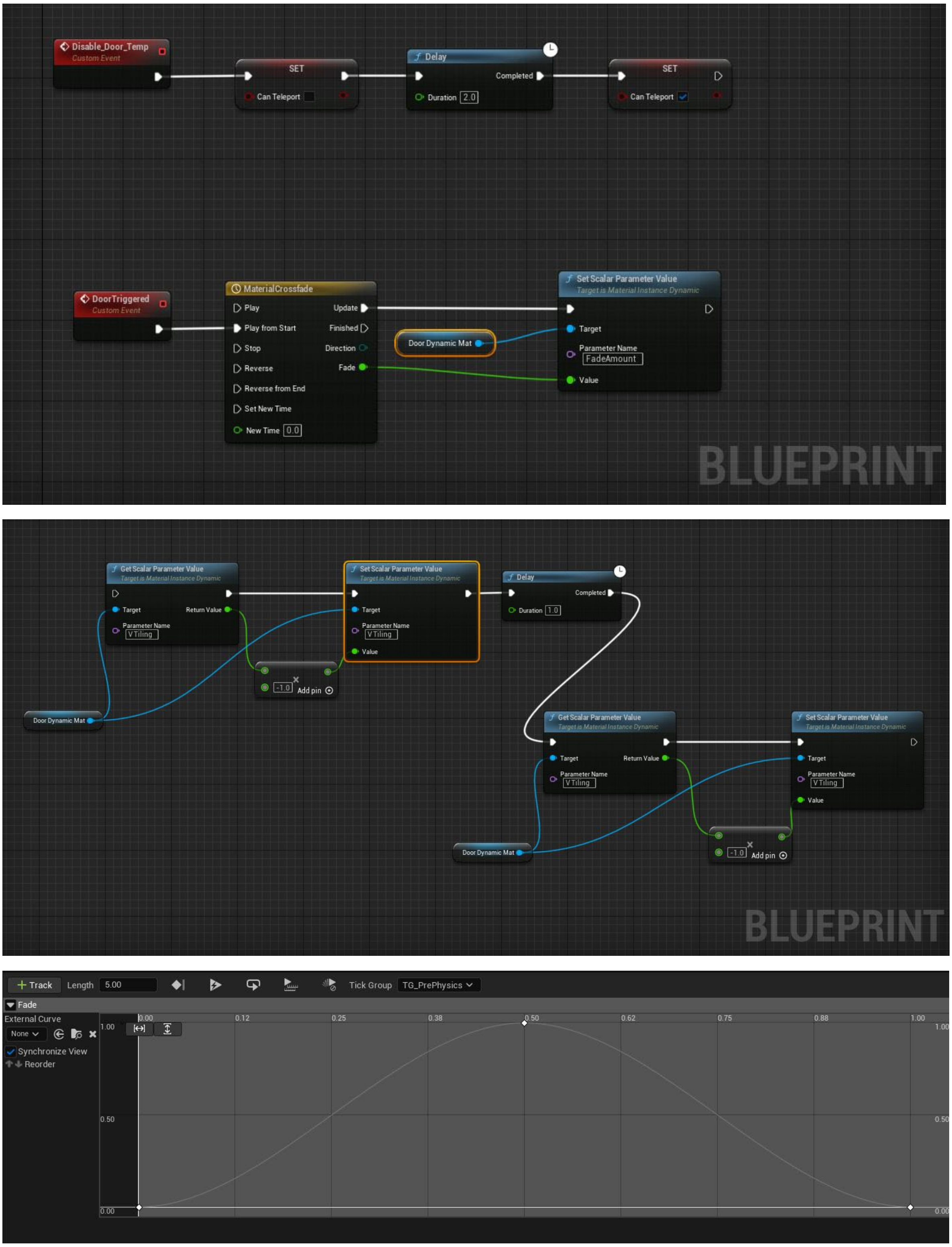


Figure 3. 37: Blueprints and crossfade design for door material change as user touches the doors.

3.5.7. Textures and material designs

All the textures in this movie are designed using Adobe Photoshop and added to the material editor in Unreal Engine to create materials for various actors in the scene. The three locations of the movie are positioned on the interior surfaces of a cube, which serves as a backdrop for the movie scene. The texture used for the cube surfaces is designed to create an optical illusion resembling a tesseract. A tesseract, also known as a hypercube, is a four-dimensional cube. It extends the concept of a square to four-dimensional space, just as a cube extends the concept of a square to three-dimensional space (for more detail, see Coxeter, 1973).

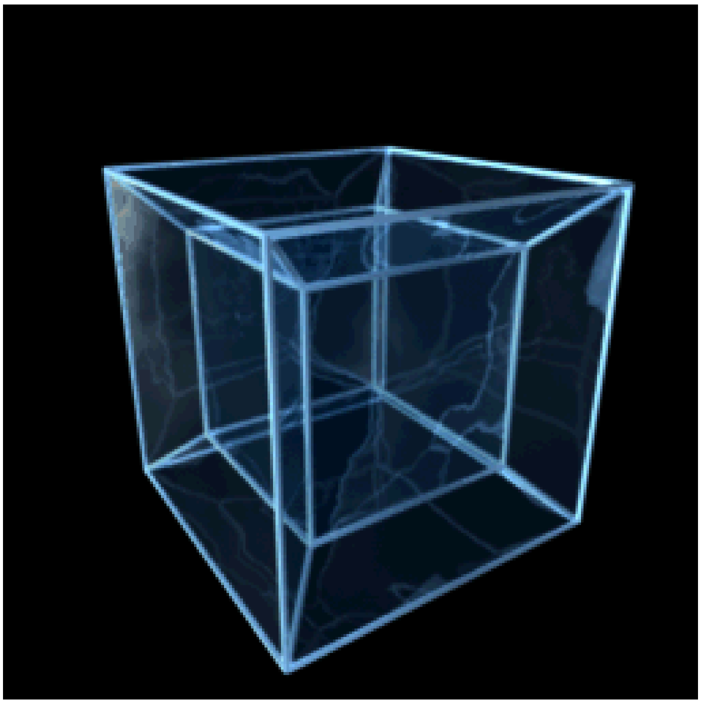


Figure 3. 38: a projection of a rotating hypercube into a three-dimensional space. (Kau, 2023)

This design gives the audience the illusion that they are either inside or outside the cube. The texture designed for the backdrop cube (Figure 3.42) depicts two parallel lines of different thicknesses to create the illusion of depth. These lines form an L shape, which intersects with another L shape rotated by 180 degrees. However, there is only one collision point; in the other corner, the lines pass without collision, creating an illusion of varying depth of field. Creating this illusion for audiences aligns with the concept of designing a story world that challenges traditional perceptions of gravity and spatial relationships within the narrative. The storylines fluidly intertwine, creating a dynamic experience where the connections between different locations continuously evolve.

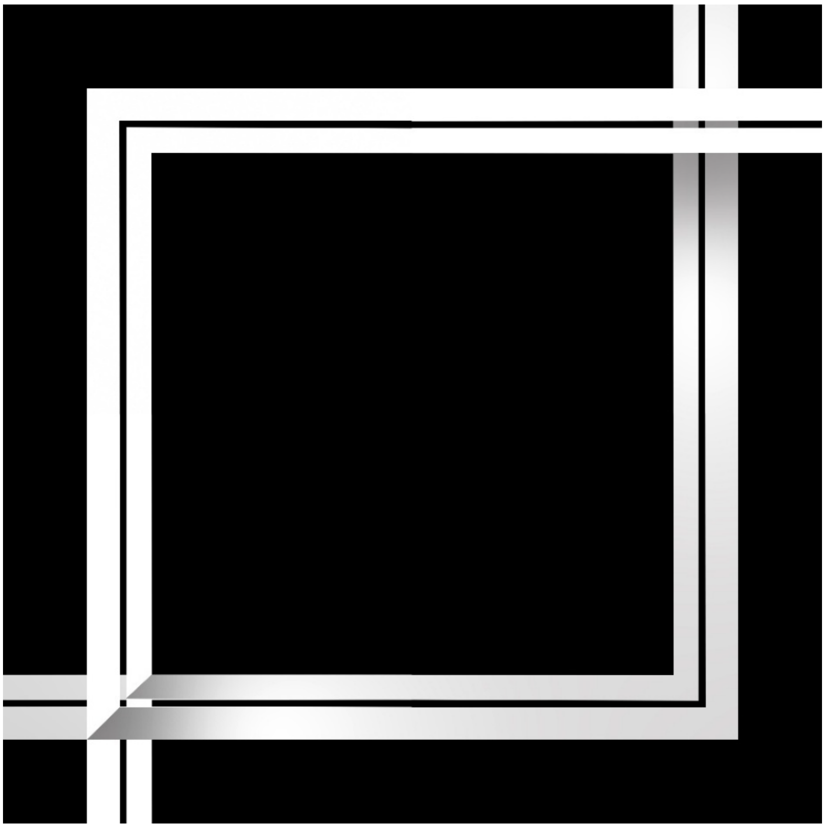


Figure 3. 39: Texture for backdrop cube's surfaces

Six surfaces of the cube are arranged so that if the audience follows the lines across all the surfaces, they experience an optical illusion, making it unclear whether they are inside or outside the cube (Figures 3.42, 3.43, and 3.44).

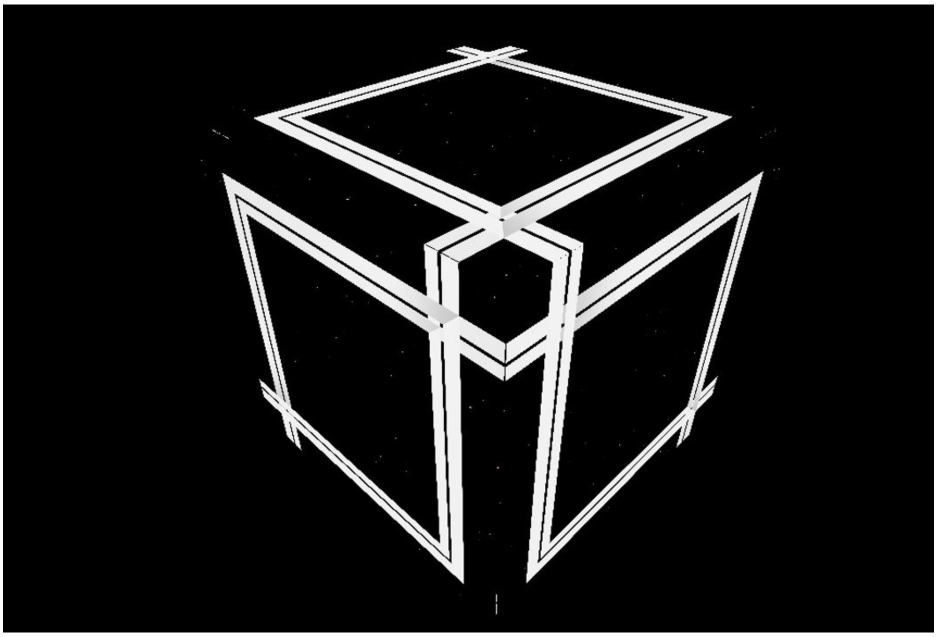


Figure 3. 40: a screenshot of tesseract cube from outside

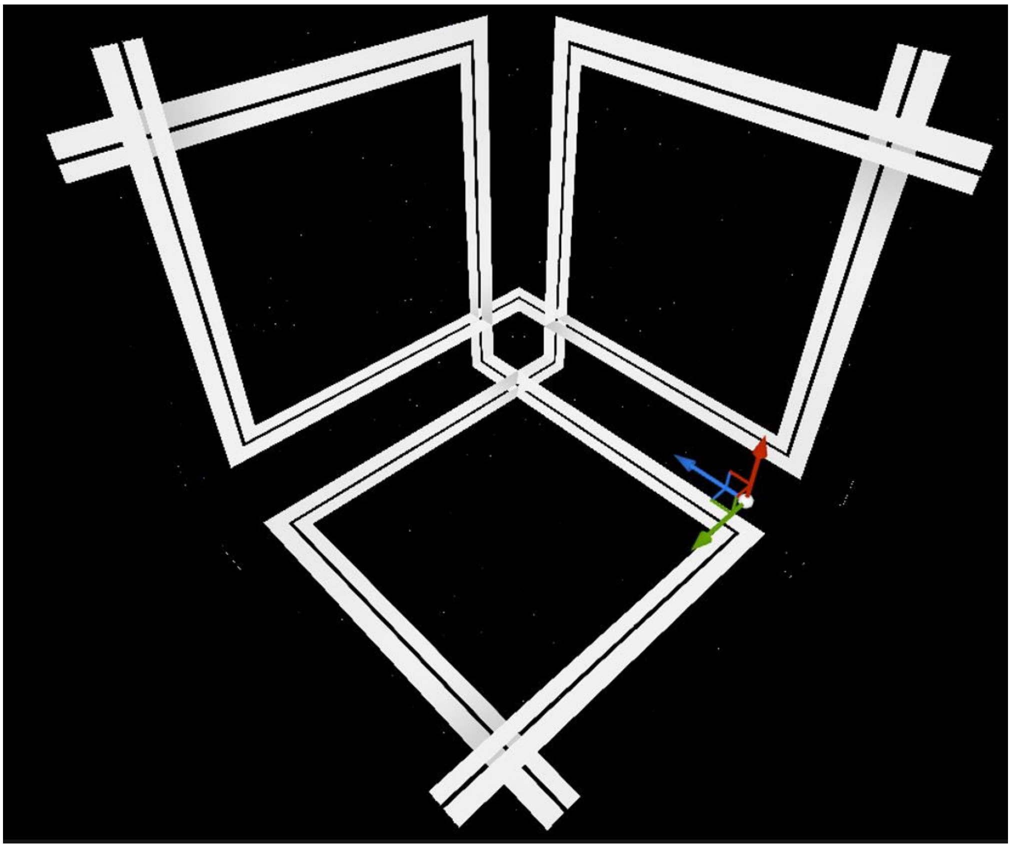


Figure 3. 41: a screenshot of tesseract cube from inside

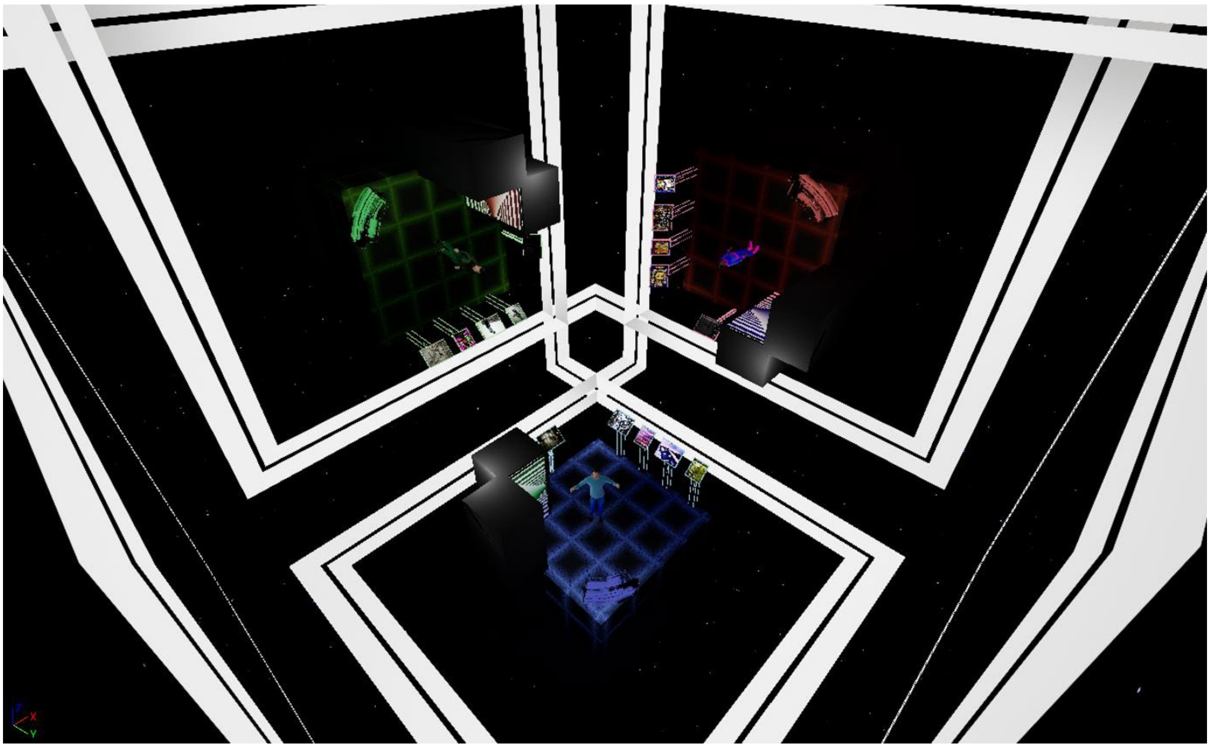


Figure 3. 42: placing the scene inside a tesseract cube

An image featuring a 0 and 1 next to each other is designed to represent the digital nature of the virtual environment in which the movie's events occur. This texture serves as the basis for creating all additional textures for the scene's items in various colours and materials. Figure 3.44 shows the texture in black and white, while Figure 3.45 shows the texture's normal and bump maps, which are used in designing the scene's materials.

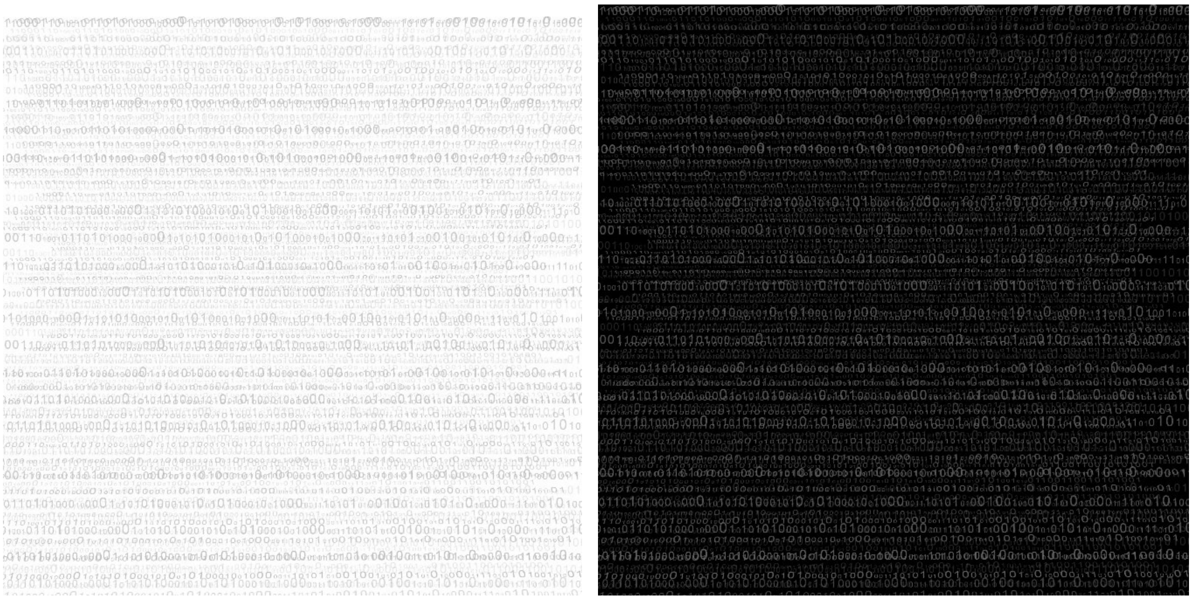


Figure 3. 43: digital texture in black and white

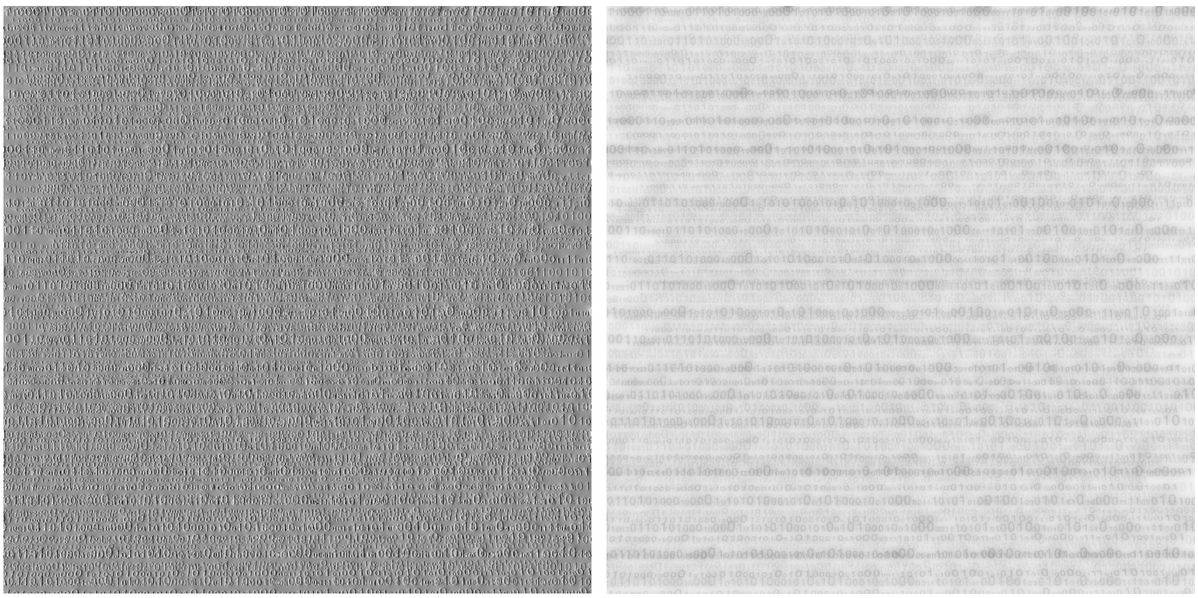


Figure 3. 44: Normal Map (Left) and Bump Map (Right)

The texture assigned to the scene's floor creates the illusion of depth by incorporating a black hole that gradually transitions into a color—blue, green, or red—at the square borders using a gradient effect (Figure 3.46).

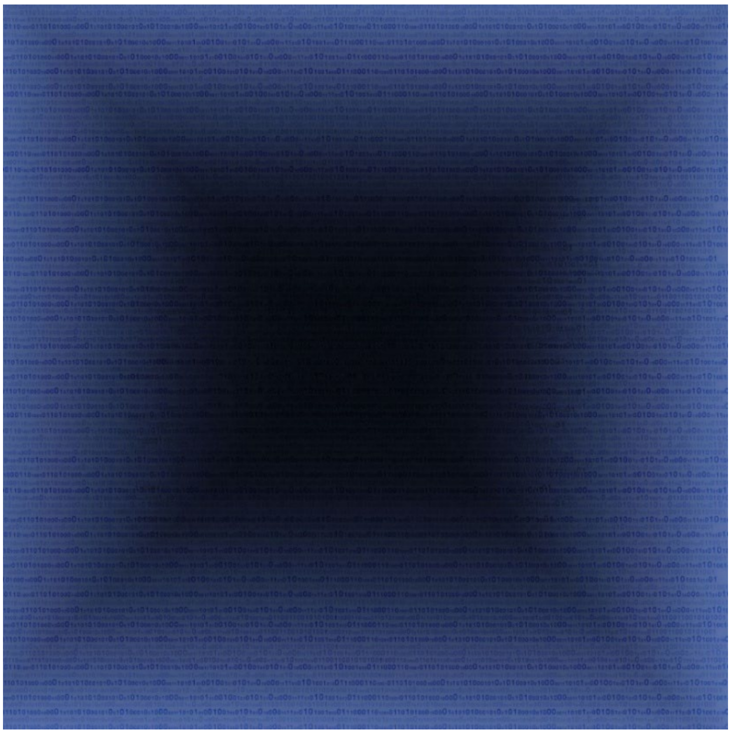


Figure 3. 45: Floor texture

This texture is applied to the floor tiles using the Material Editor, scaling each square to one meter by one meter in size (Figure 3.47). The floor material utilises a Diffuse map, Normal map, and Bump map, along with the Texture Coordinate function to tile the map on the floor.

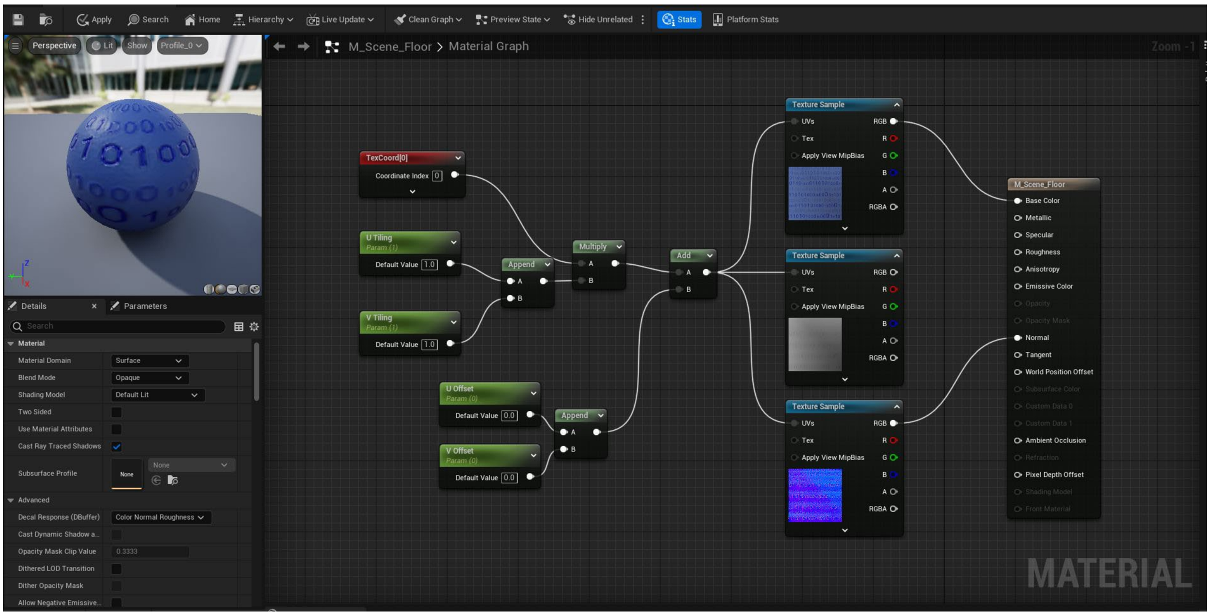


Figure 3. 46: Floor material.

The texture of the doors is similarly developed to create an optical illusion of depth and is applied to the door boxes (Figure 3.48).

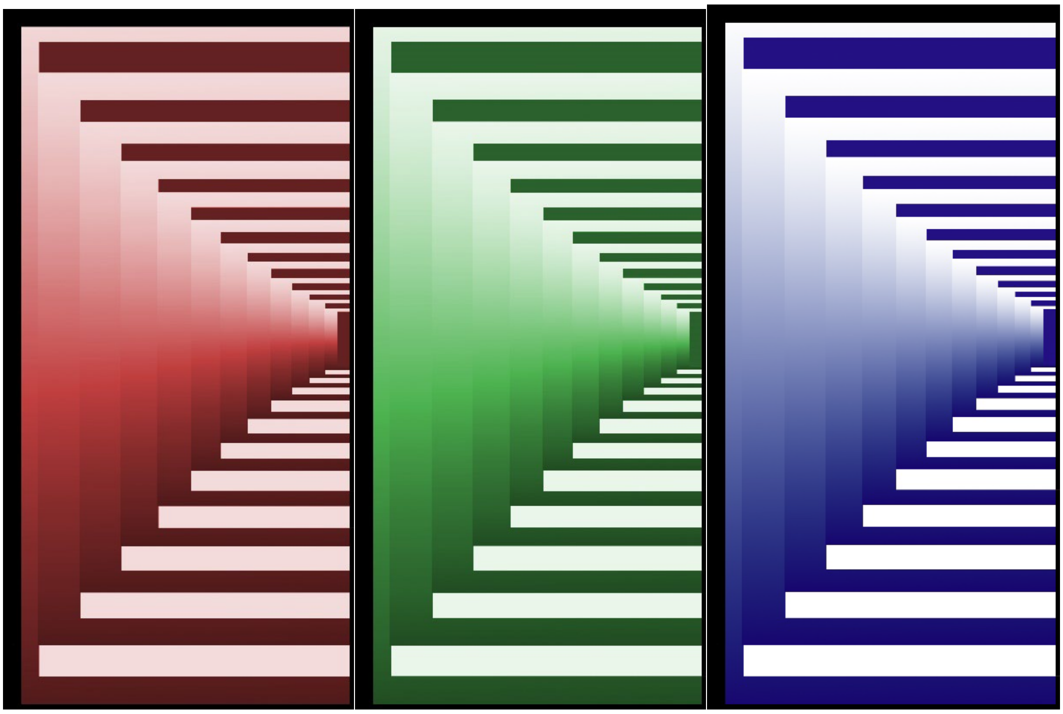


Figure 3. 47: Doors' texture

A reverse version of the texture was produced in the Material Editor, using tiling and offset tools (Figure 3.49). This reverse texture is displayed whenever the audience touches the doors, as designed in the door's blueprint.

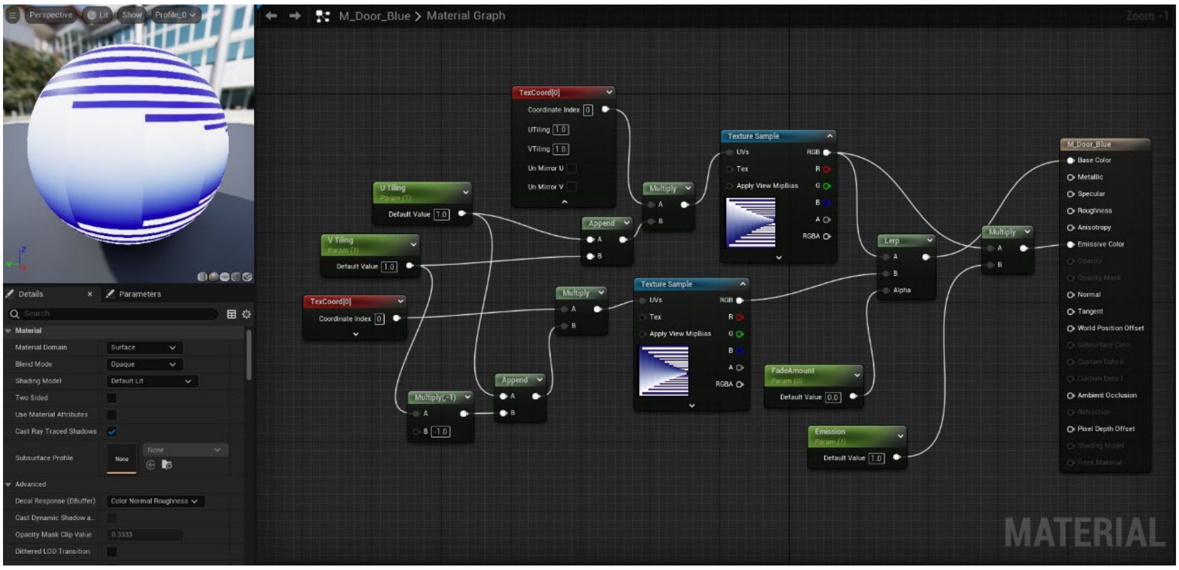


Figure 3. 48: Door material.

A texture (Figure 3.50) is provided for the glass material (Figure 3.51), which is used in the artist's frame in the scene and the seats (chairs).

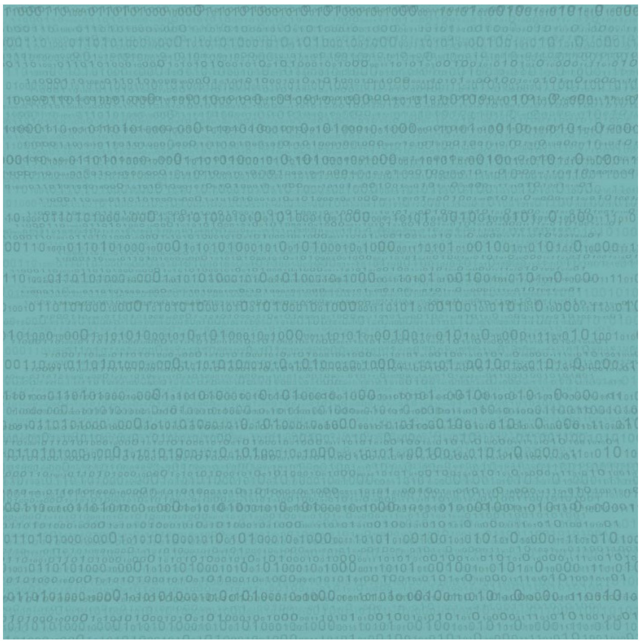


Figure 3. 49: Glass texture

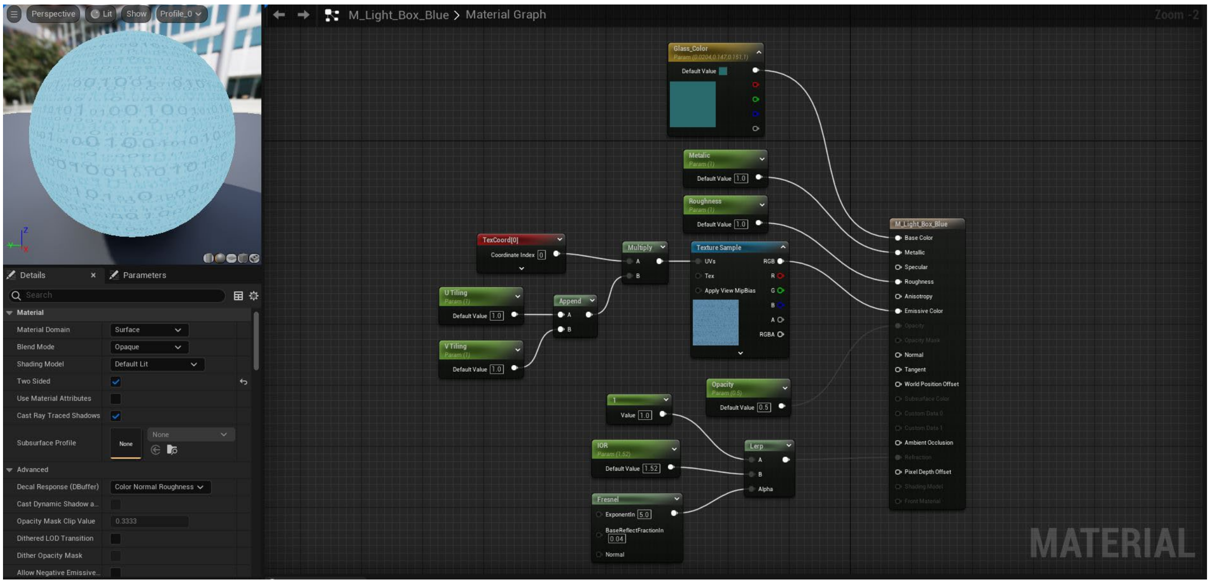


Figure 3. 50: Artist frames material

The Material Editor is used to design the trigger menu that allows the audience to choose their starting place and begin the main movie sequence. By using a texture and material to design this menu instead of the default UI menu template provided by Unreal Engine, the designer had the flexibility to insert the movie logo and customise the text and colours of the menu (Figure 3.52).

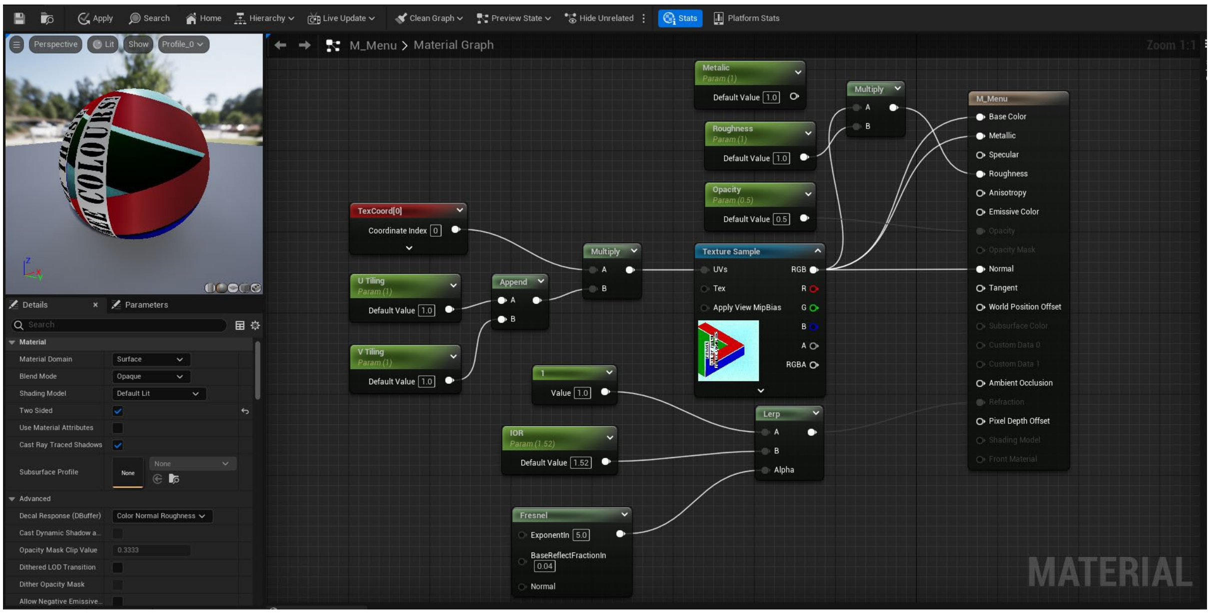


Figure 3. 51: Trigger menu material

3.5.8. Sounds

One of the benefits of using a game engine to create VR films is the ability to make sound spatial. This means that sounds can be attached to characters and heard from specific distances. In this movie, where the audience can observe the entire story-world at once, spatial sounds play a significant role in encouraging them to explore the setting and follow the characters to unfold the story.

Unreal Engine provides this capability by converting raw Wave files into sound cues (Figure 3.53). These sound cues can be attached to a character in the sequencer timeline (Figure 3.54) and configured with attenuation settings to make the sound spatial (Figure 3.55).

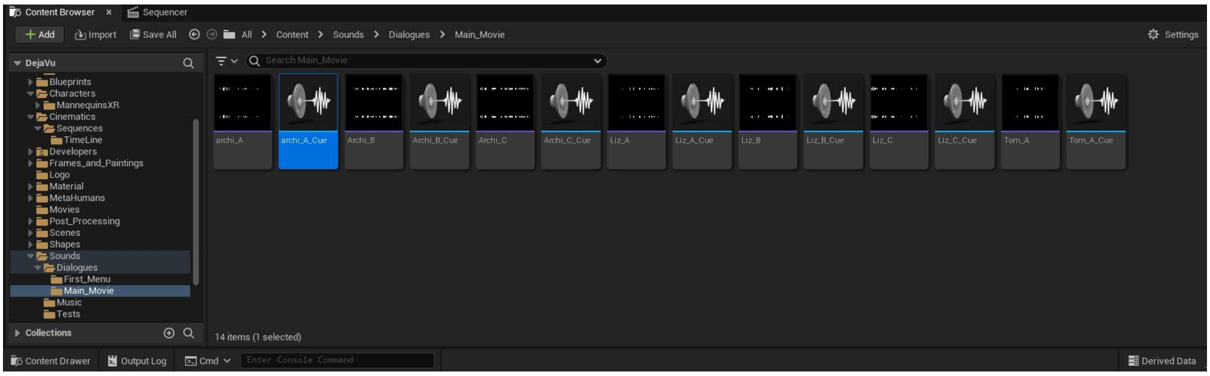


Figure 3. 52: Wave file and the sound cues extracted from them.

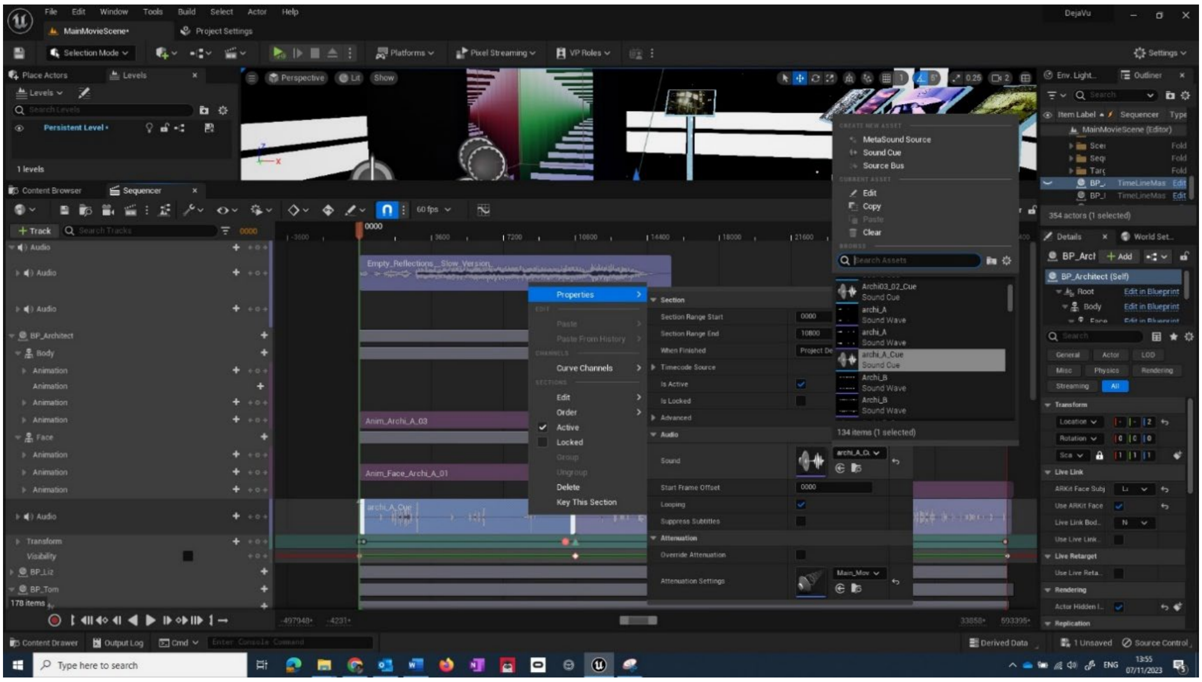


Figure 3. 53: Adding a sound cue to characters in sequencer timeline.

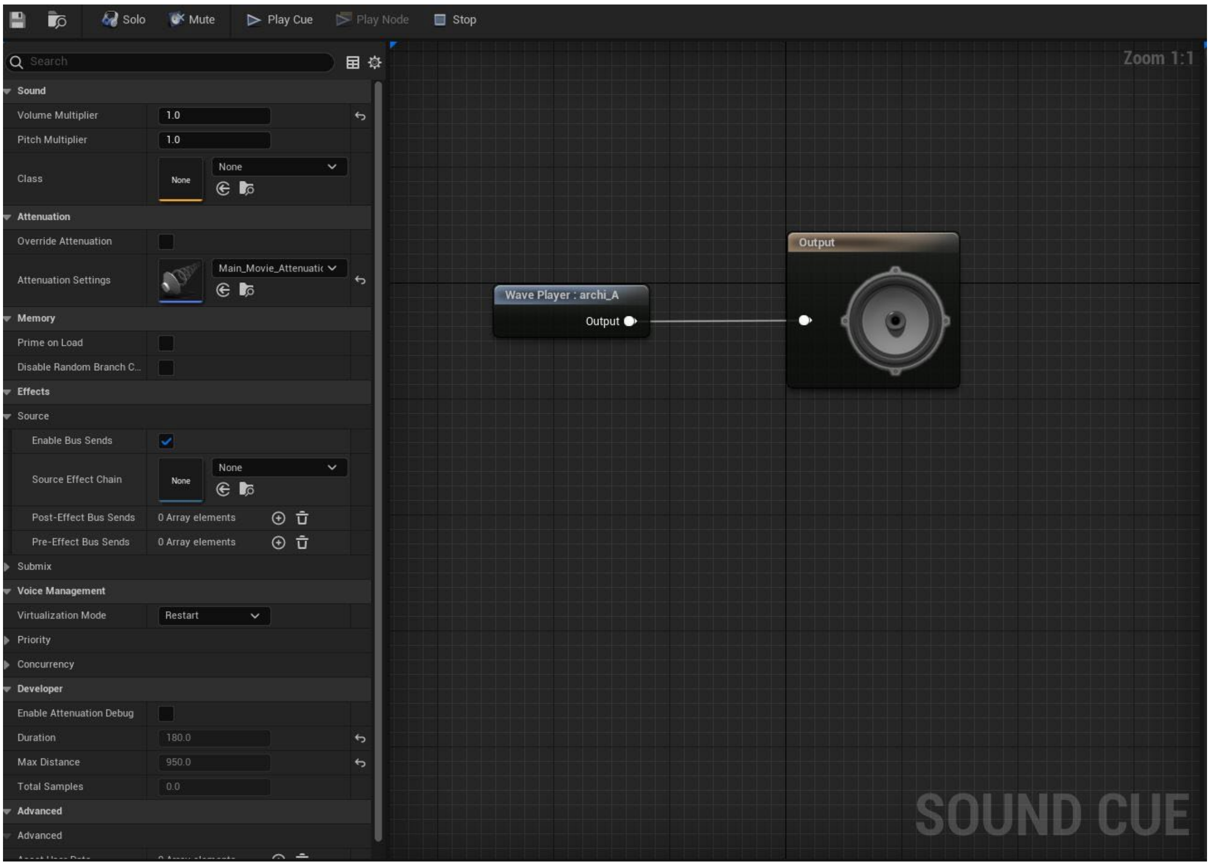


Figure 3. 54: Sound cue setting

This film employs two different sound attenuation settings. The first setting is used in the introduction menu when the Architect explains how to experience the movie (Figure 3.56). His voice can be heard clearly up to six meters away, after which it gradually fades. As Architect moves to a different scene more than six meters away from the audience's perspective, his voice level decreases slightly but remains audible. This allows the listener to identify the direction from which the Architect's voice is coming.

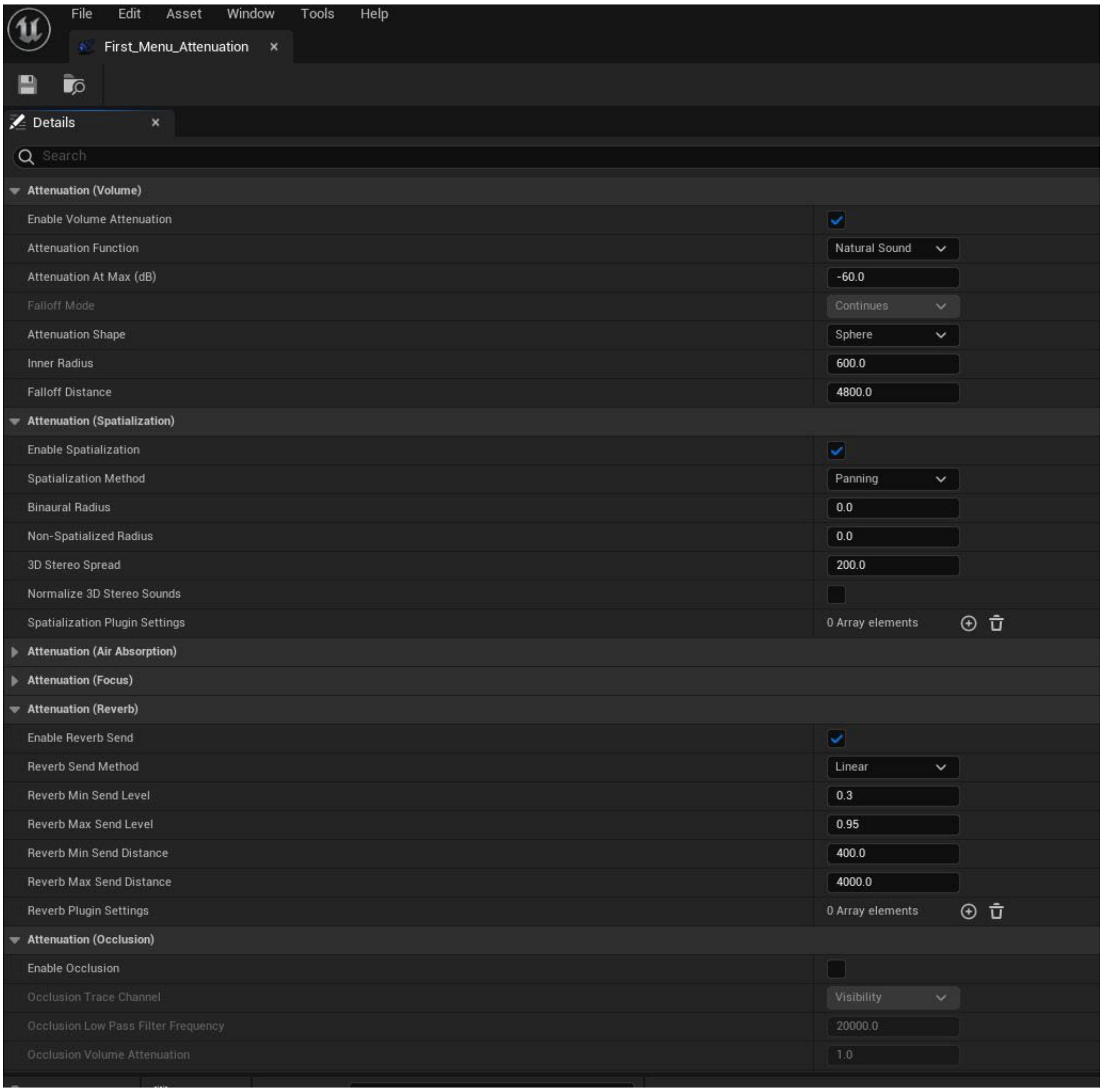


Figure 3. 55: Introduction Menu attenuation

The second attenuation setting (Figure 3.57) is used in the main movie to define the area where the characters' voices can be heard. In this setting, there is a 2.5-meter radius of clear sound, which begins to fade up to 7 meters, beyond which the sound is entirely disabled. This design ensures that a character's voice is only heard in their current area; if they move to another spot, the audience will no longer hear them.

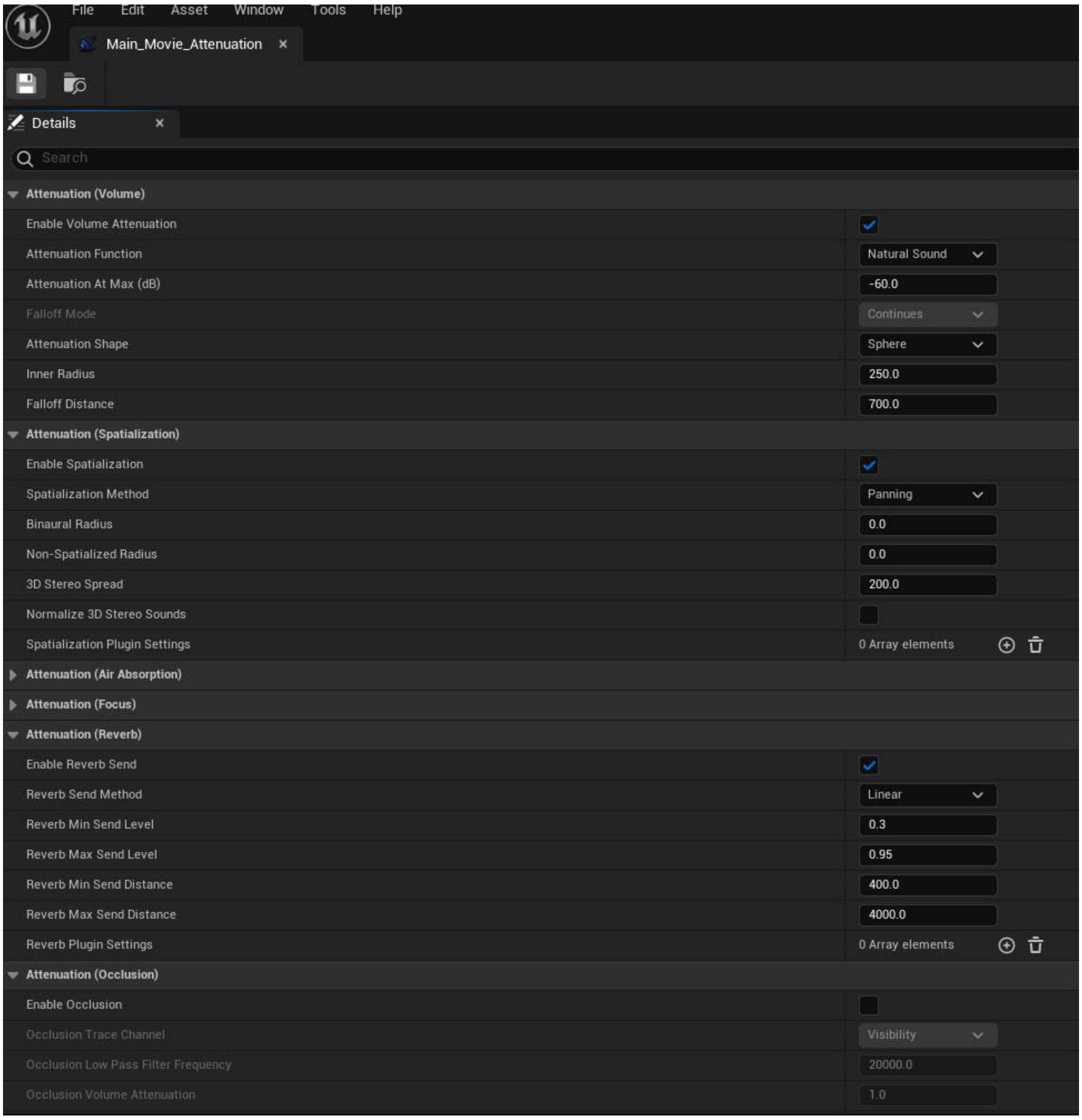


Figure 3. 56: Main Movie Attenuation

3.5.9. Motion-capture studio

The characters' motions are recorded at Cadman's mocap studio, which uses an optical passive technique to capture markers placed on the characters' bodies (Figure 3.58). The capture process is planned and completed in one day, divided into two four-hour sessions with three actors, each playing one of the characters. A shooting schedule[8] is created to organise the capture files based on the characters' journeys and the synchronisation method used to create concurrent timelines (see Figure 3.1. Story-map and section "Method for synchronising timelines and writing storylines" above).

A cut is applied to the recording whenever a character walks through a door and changes location. This strategy aids in the creation of the main movie sequence during the post-

[8] See Appendix XV – Shooting Schedule.

production stage. The file naming convention includes the character's name and the index of the three-minute period: A, B, or C, which corresponds to the three-minute periods that the character Architect spends in each location, and the number of the character's displacements during this period. For example, while Architect is in his third period (period C), the character Tom switches place twice. Thus, Tom's actions are recorded in three separate files labelled Tom-C1, Tom-C2, and Tom-C3.

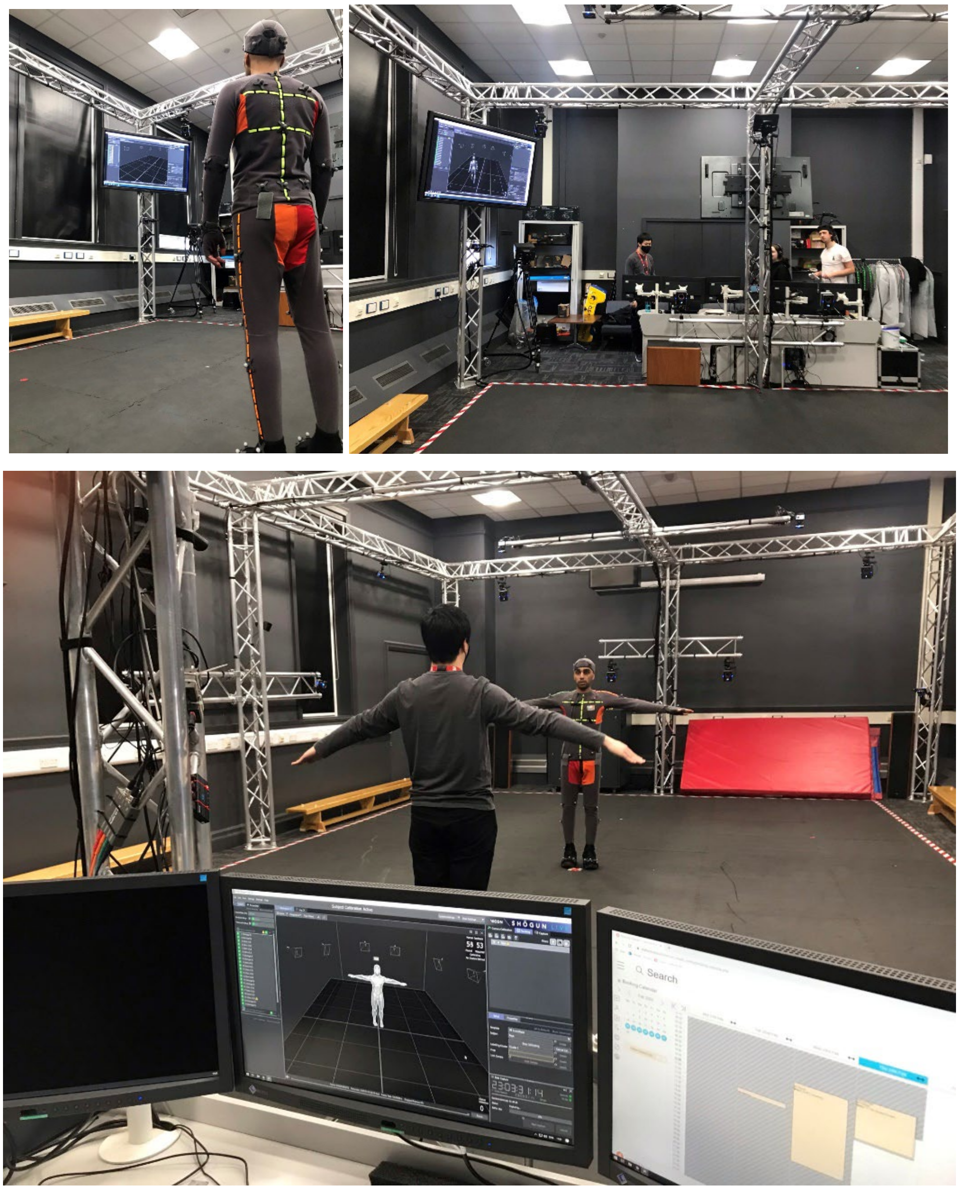


Figure 3. 57: Cadman's optical passive mocap studio

3.5.10. Designing and Rigging Metahuman Characters

The application Metahuman, which works as a plugin for Unreal Engine, is used to design the characters of the movie. The Metahuman Creator tool (Figure 3.59) is a web-based application connected to Epic Games' Bridge software. It allows Epic Games users to easily design 3D characters and import them into Unreal Engine under a free development license.

Figure 3. 58: designing three movie's characters by Metahuman Creator Tool.

Using this application, the designer can select a base character and modify its properties, including face, hair, and clothing. Character Tom is designed using these options, and an older version of this character is created as the Architect using the aging option. After designing the Metahuman character, one version is added to the Unreal Engine project, and another version is exported to Autodesk Maya to be rigged using Maya's Human IK tool (Figure 3.60).

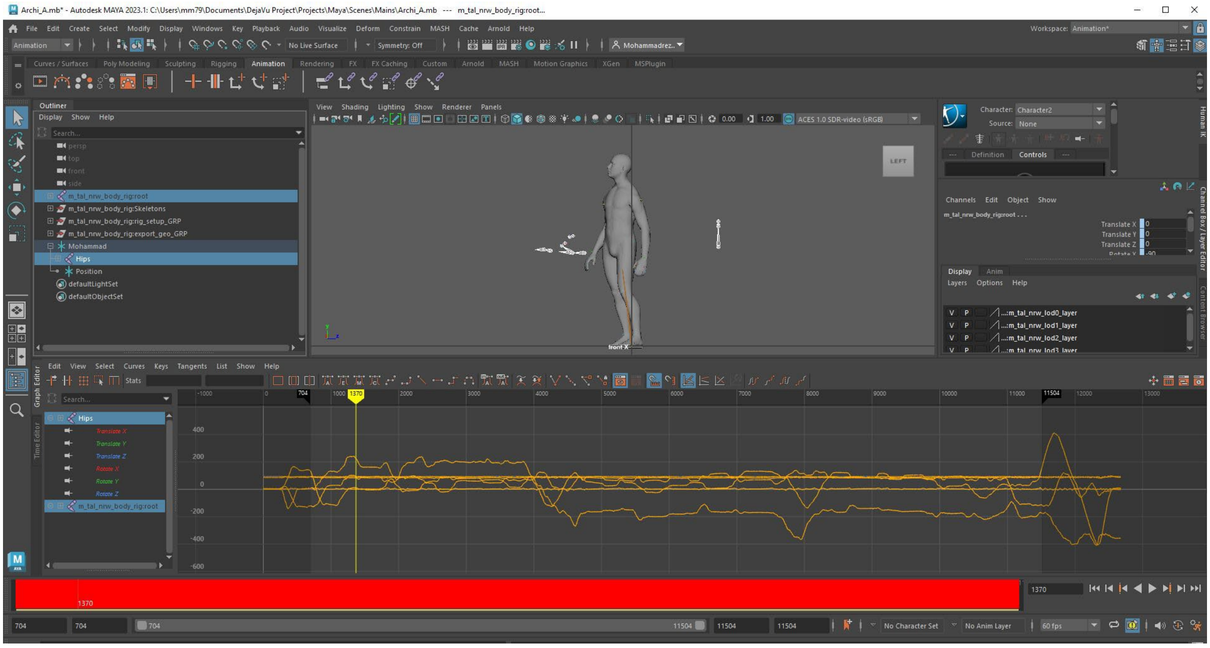


Figure 3. 59: Autodesk Maya

After importing the animation file into the Unreal Engine project, an extra level of refinement is applied to the animations using Metahuman Rig Control and Sequencer tools. These tools allow additional animation timelines to be added to character control and enable the refinement or enhancement of existing data.

During motion capture in Cadman's Mocap Studio, only body movements are captured due to the lack of equipment for recording hand gestures and facial expressions. Consequently, finger movements are added to the characters at this stage using the rigging tools provided for Metahuman characters within Unreal Engine software (Figure 3.63).

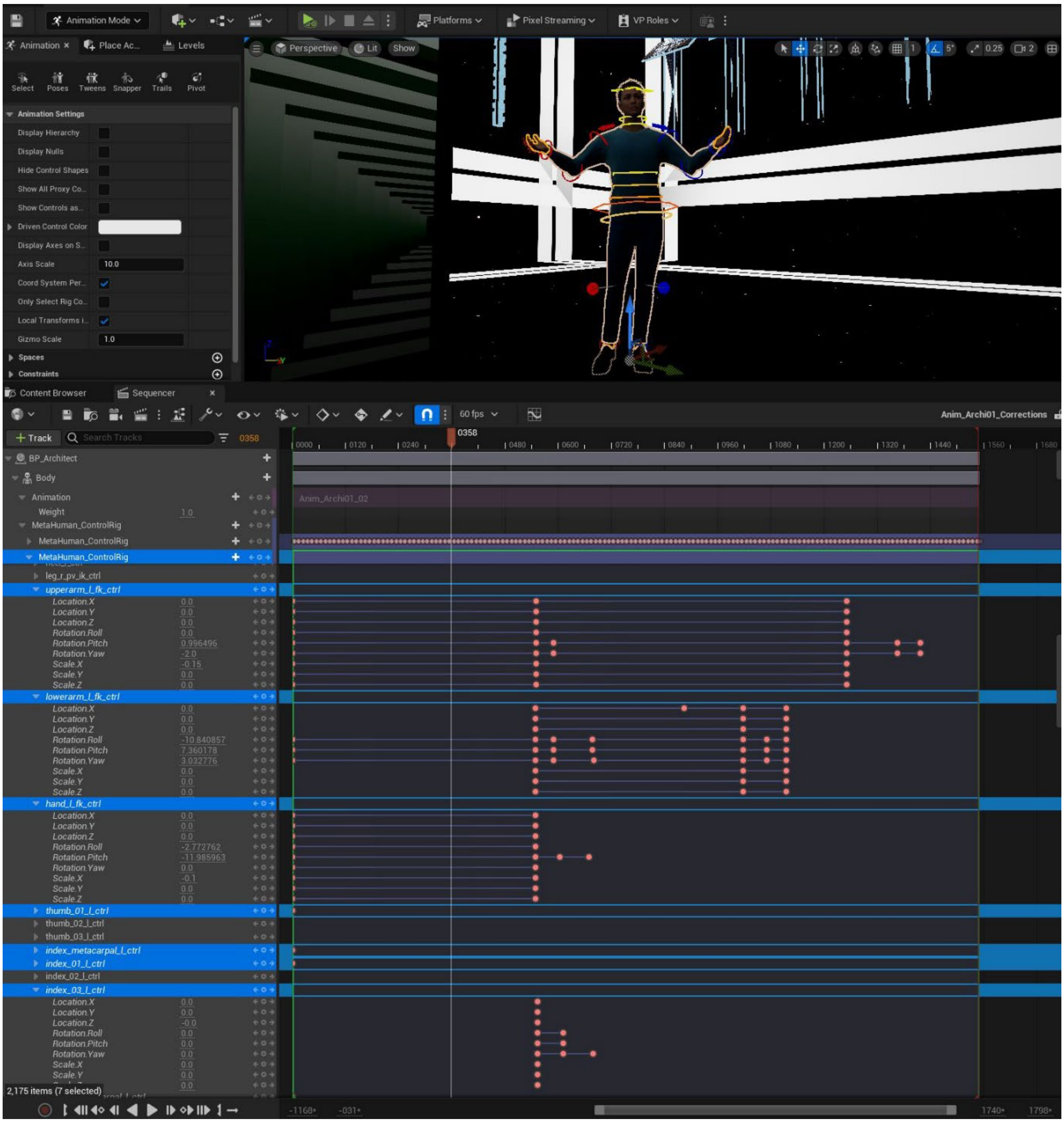


Figure 3. 60: A correction Sequence in Unreal Engine to refine Metahuman body rigs and add fingers' motions.

3.5.11. Facial recording

Facial expressions are recorded within the Unreal Engine project using the Take Recorder tool. This is done by connecting an Apple iPad via the Livelink option (Figure 3.64).

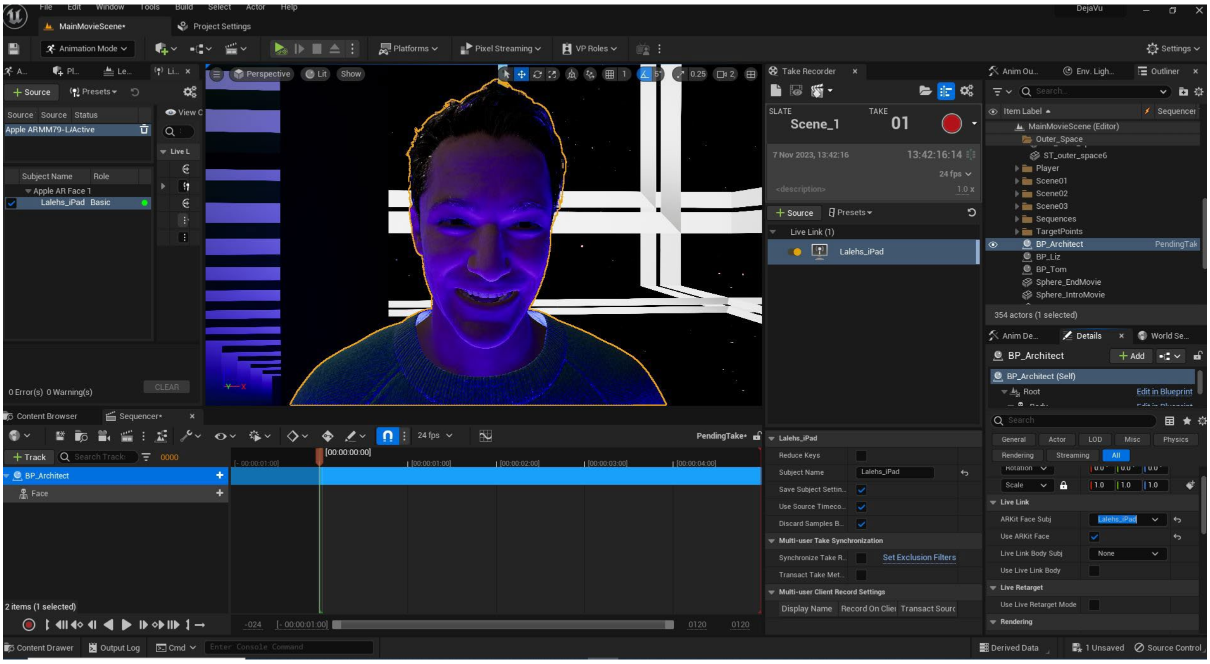


Figure 3. 61: Facial recording project

The application Live Link Face (Figure 3.65), designed by the Unreal Engine team for iOS and Android devices, is installed on an Apple iPad Pro. This device has a LiDAR scanner that allows for capturing a 3D model of the space and works with Live Link Face to detect facial expressions in high detail. These detailed facial expressions can then be used for characters with high-quality details in Unreal Engine (Figure 3.66).

Figure 3. 62: Live Link Face app

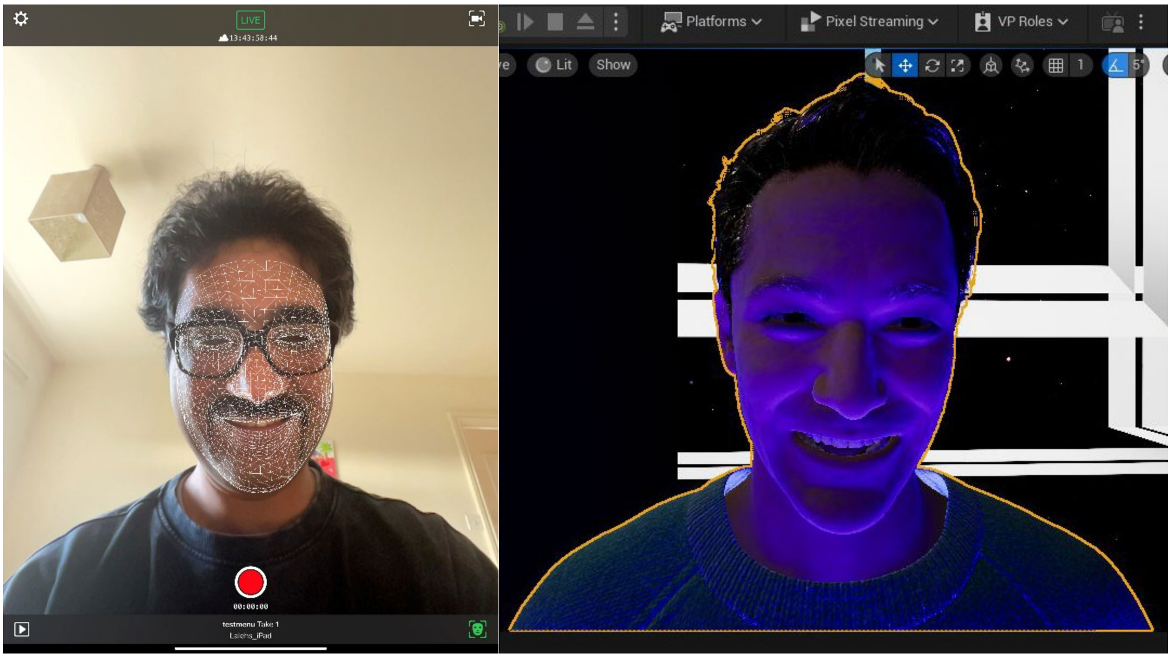


Figure 3. 63: Facial recording with Live Link Face app

Using the Take Recorder tool (Figure 3.69), which is a plugin for Unreal Engine, the data from the iPad device can be recorded in a sequence as an animation file in the format of UEAsset.

3.5.12. Sequencer tools: designing Timeline of the movie.

The naming convention used in the motion capture stage helps create a timeline for the main movie sequence (Figure 3.71). The sequencer tool in Unreal Engine allows the addition of multiple actors, including Metahuman characters' body and face animations, audio lines for spatial sound cues, and transformation keyframes for each actor to change their position and rotation as they move through doors and transition to different locations within the scene's cube.

To synchronise the timeline for the three different characters in the movie and pace their animation files, the method of synchronising storylines and writing characters' journey scripts (as explained above) is used. First, the animations for the character Architect are added to the timeline. Then, based on his interactions with the character Liz, her animation files are synchronised with the Architect's timeline. Finally, the interactions between Liz and Tom serve as the reference point for adding Tom's animation files in relation to the other characters' timelines.

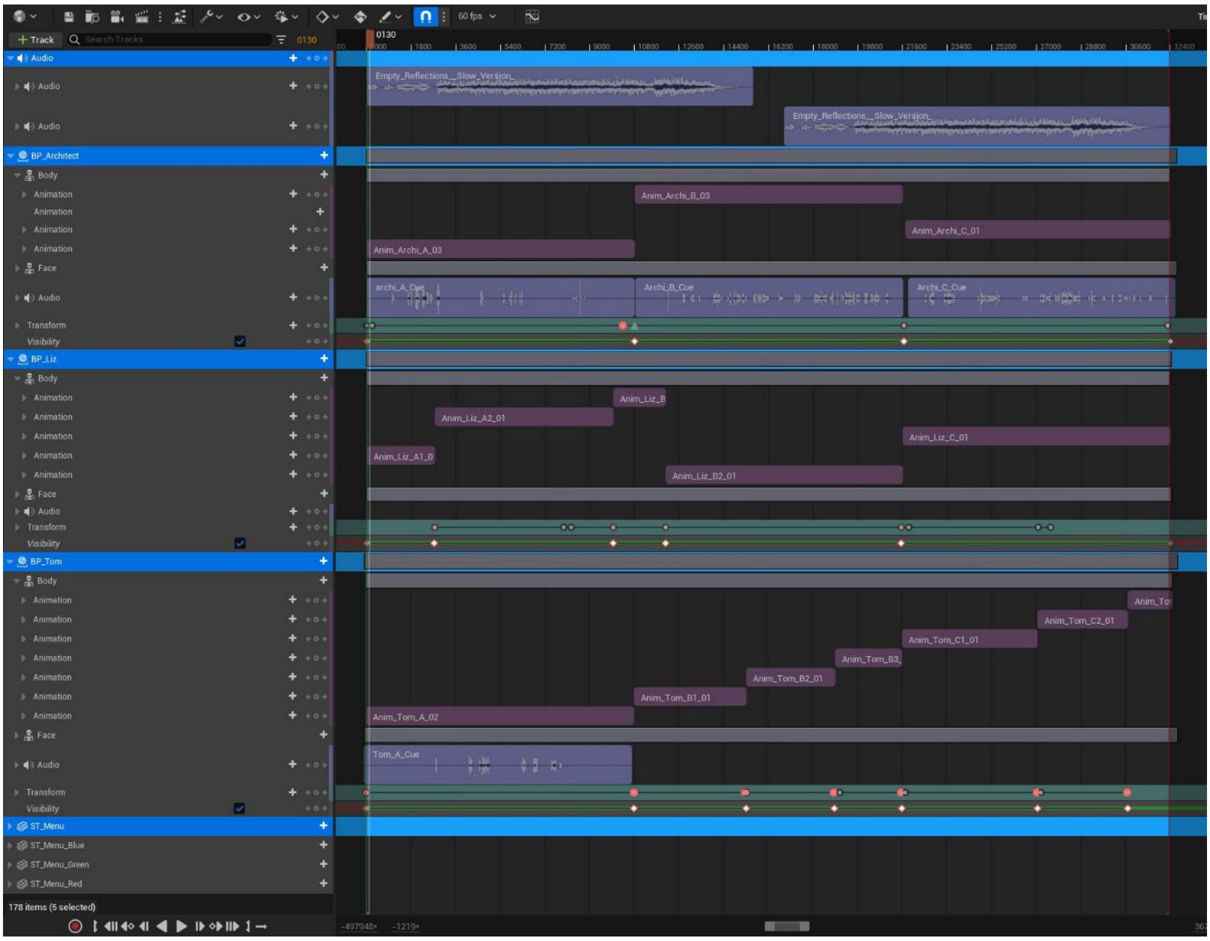


Figure 3. 64: Main Movie Sequence

3.5.13. Packaging

This VR project uses three Metahuman characters with medium quality (4K resolution for textures) and fifty-four minutes of animation at 60 frames per second (nine minutes of body motion capture and nine minutes of face animation for each character). Based on the advice from Unreal Engine documentation and Metahuman developers, it is decided to package the project as an executable file (.exe) for a Windows version of the VR application (PCVR) to ensure smoother performance.

The final export of the project package results in a 3.8 gigabyte folder, which is considered a medium average size for VR movie packages. A logo designed for the movie, symbolising the entanglement of three different storylines in red, blue, and green colours, is added to the package settings in the project (Figure 3.73).

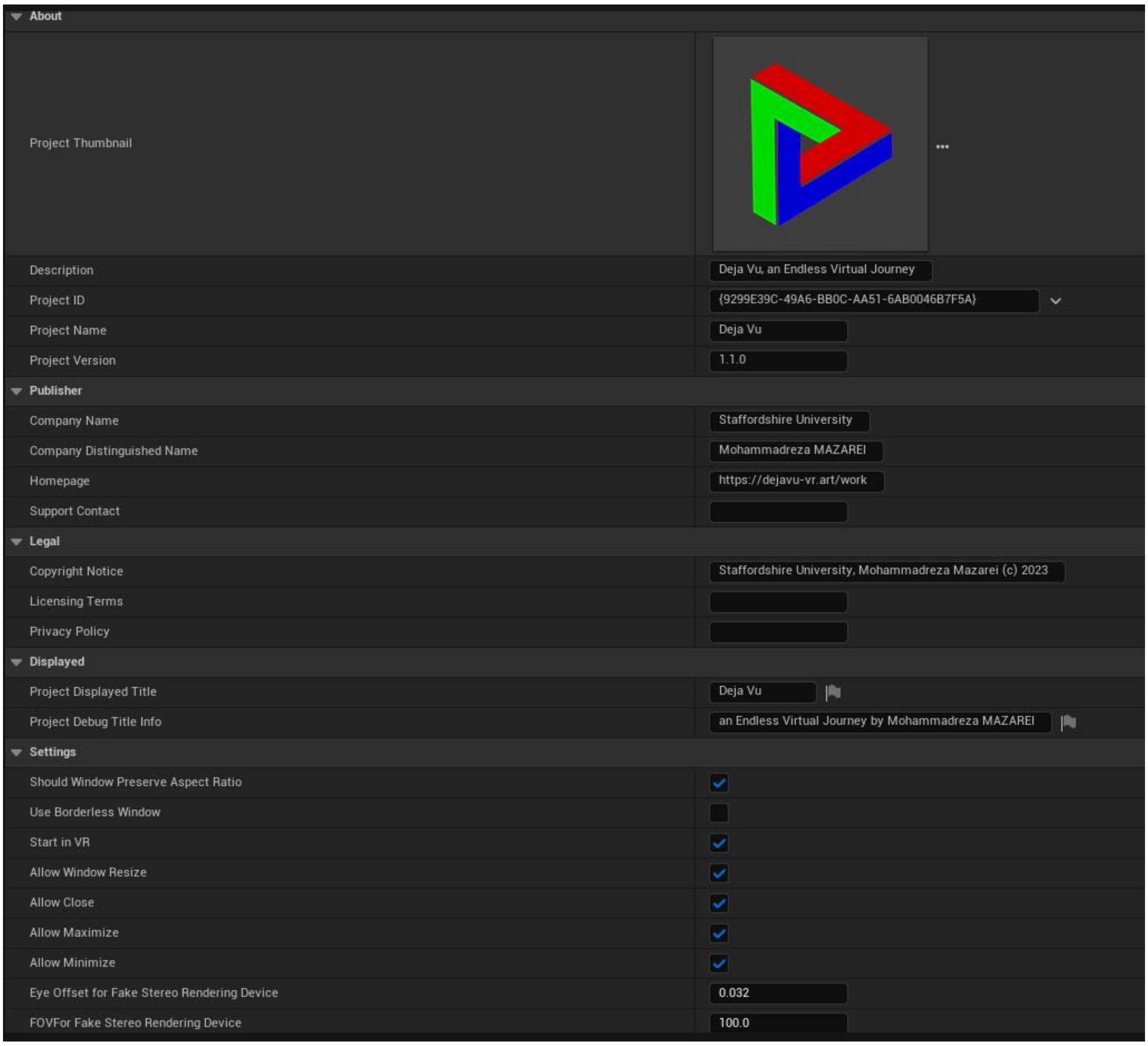


Figure 3. 65: Project's package settings

To provide users with a high-quality VR experience, the 'Engine Scalability Setting' for all shaders is set to 'Epic' quality (Figure 3.47). The designer initially tried the 'Cinematic' quality setting. The 'Epic' quality setting works well and has been tested successfully on different PCs.

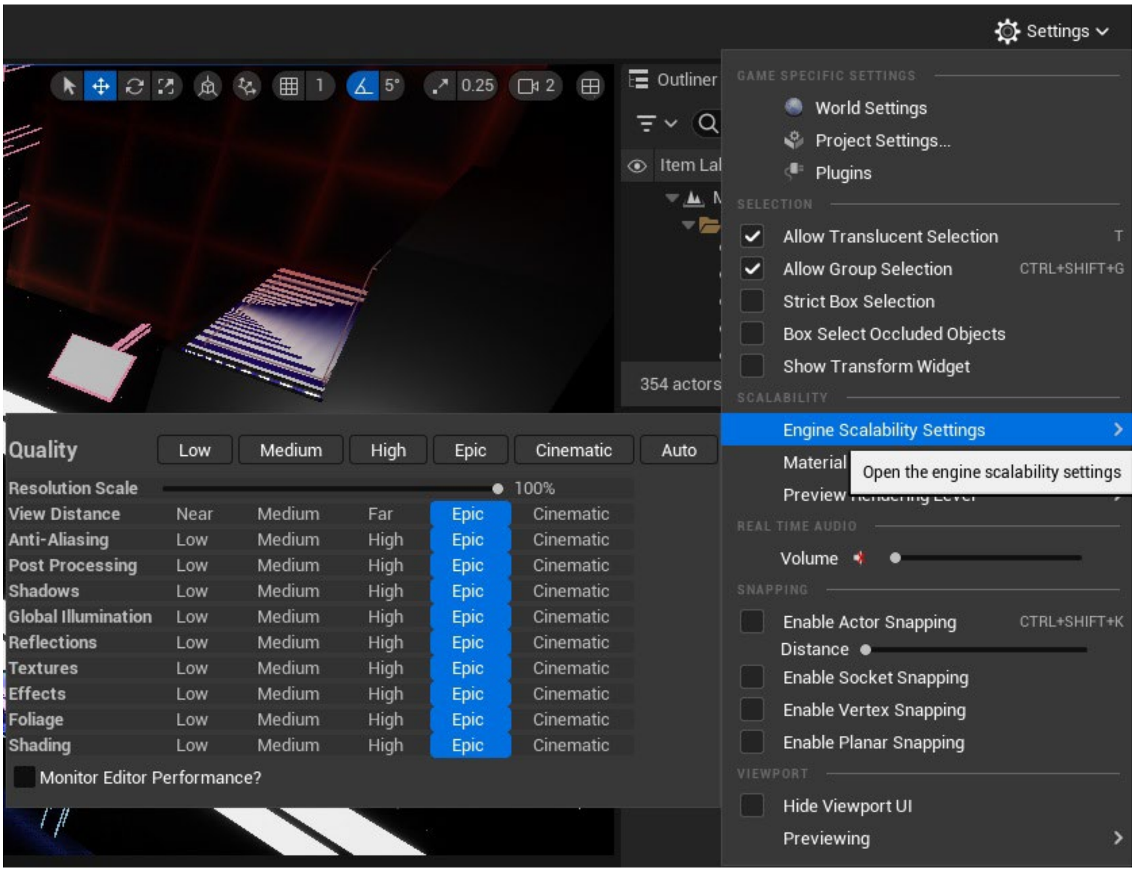


Figure 3. 66: Engine Scalability Setting.

Chapter Four: Methodology of Conducting Experiments

4.1. Method of research to develop a narrative framework

In this project, while developing a Deleuzian ontology for immersive open-world cinema, experiments are conducted to examine if the proposed storytelling methods work for interactive cinematic VR. Deleuze's theory applied to conventional cinema; however, it suggests two regime of camera movement, which provides different cinematic consciousness. Hence, this project initially scrutinises the difference in perception processes for VR film audiences replicating the position of the wanderer camera compared to 2D screen film viewers who follow the sensory-motor schema through a dictated camera viewpoint.

In this respect, the first study focuses on the properties of perception process for VR users, who can freely explore their surroundings and actively engage with unfolding narratives, in a comparative analysis with perceptual process of 2D screen viewers who are not experiencing an immersive image. With insights into VR audiences' perceptual processes and regarding the approach of proposed storytelling method to consider wanderer audiences as an element of cinematic narrative creation, further studies are designed to observe participants' interaction with a non-linear story and their reactions to different types of locomotion inside an immersive story world. In conclusion, the findings of these studies help to develop the creative practice of Déjà vu, which structured based on Deleuze's concepts, aiming to make it replicable to other practices in the realm of open-world cinematic VR.

4.2. Study on perception process.

The approach of studying perception process is to investigate the fundamental difference in audiences' positions toward dramatic incidents by observing variations in their emotional contributions to the narratives, whether it be empathy as a passive observer or a self-directed emotional experience like a real-life experience.

Several studies have been conducted by other researchers to explore the differences between immersive and non-immersive mediums. These studies have used subjective questionnaires to investigate how immersion and presence affect participants' emotional responses to immersive stimuli compared to neutral ones (Xue et al., 2021; Voigt-Antons et al., 2022; Somarathna et al., 2022). However, only a few studies have employed a comparative analysis on inductive data to find how immersion, the feeling of being present, and the emotions triggered by artworks are related (Kwastek, 2016; Dogramaci & Liptay, 2016). Some of these studies looked at the emotional responses of audiences to a VR film (Ding et al., 2018), while others focused on an immersive aesthetic approach to traditional 2D paintings, featuring a 360° spherical view with music and narration (Pizzolante, 2023).

This research uses the same common method of data collection to study the differences between VR and non-VR audiences, similar to methods used by previous researchers. Data is gathered by combining an objective questionnaire, which measures factors of virtual presence, with a subjective survey that explores participants' feelings and thoughts during and after the experiment. The research uses a standard cross-media questionnaire, the ICT-SOPI (Lessiter et al., 2001), for measuring virtual presence.[9] This questionnaire provides a comparison between various factors related to the sense of presence in a displayed environment across different mediums, which, in this case, are VR and 2D screens. Additionally, the semi-structured survey is designed based on the dual-processing model (Smith & M. Coster, 200, Smith & Collins, 2009) to stipulate dominant memory system in interpreting the phenomenon for each participant, whether association or rule-based.

The study applies a thematic analysis to qualitative and quantitative data to compare the level of presence and type of memory system and analyses to what extent each individual engaged intellectually or emotionally with narrative. Then, for each participant, the impact of using each type of memory system on the perception of the duration scrutinised. Within this method, the study stipulates similarities and differences trending among two cohorts of participants: VR audiences and 2D viewers, in their perception of time. It ultimately helps to find the unique characteristic of VR narrative in representation of time and its reflection on VR audiences' perception.

For this reason, the study distinguishes between the effects of passive viewing of content (transportation) and active analysis and reaction to changes in the environment (elaboration) in audiences' behaviours. Building on Bergson's (2002) perception theory, the research associates empathy with transportation and elaboration with a self-directed emotional experience.

This approach helps to justify the feeling of duration for creating analytic categories for analysing participants' behaviours. For instance, in this experiment, the variation in audiences' feelings about the duration of a two-minute shot ranged from someone feeling it lasted about thirty seconds to another one feels the change in surroundings lasted for five minutes.[10] Thus, categorising participants based on their perception of the experiment's duration helps to better analyse their behaviours regarding the factors that influenced their individual level of presence in a VR environment and the impact of their emotional contribution on interpreting story incidents.

To achieve this goal, the first test, "How Do You Feel It?" (2021), is designed with three different 360° footages with irregular durations: one is a time-lapse (showing a one-hour

[9] Find the questionnaire in appendix V -ICT-SOPI questionnaire – Modified Version.

[10] See participants' answers for perception study in appendix VI – ICT-SOPI questionnaire Result – First Experiment.

change in the environment in two minutes), one is a still frame, and the last is a time-lapse in reverse. This experimental design demonstrates the distinction in the perception of time between two groups: one group experiences this irregular timeline on a 2D screen, and the other is immersed inside the image. Their differences in feelings about the duration confirm that VR audiences who experience a real-life stimulus contribute to a self-directed set of emotions due to their immersive situation. In conclusion, this study validates using the feeling of duration as a measure to categorise participants based on their level of emotional engagement with the narratives, which is then used to analyse participants' behaviours in the subsequent study.

4.3. Study on narrative engagement and disorientation.

The approach of this project to develop VR narratives is based on the idea that the level of control given to VR audiences is closely linked with the emotions triggered by the narrative which impact on their interactions in following and responding to dramatic content.[11] Thus, in the second experiment within this research project, "The Man Who Disorientated in Time" (2022), the primary focus is on distinguishing behaviours related to emotional contribution to narratives from actions caused by the emotional arousal of being immersed in an image, which raised by the enjoyment from virtual presence.

In this experiment, using a rigorous methodology to record audiences' viewpoints, the research investigates engagement with various narrative elements in a VR environment. It aims to understand which dramatic incidents encourage exploration of the narrative and which elements primarily evoke joyfulness from the VR immersion.

By applying constructive grounded theory (Charmaz, 2008), the study compares and analyses participants' behaviours alongside their survey responses. This helps identify behaviours that show attempts to engage with the narrative versus purposeless exploration. In this context, the analysis of reactions to diegetic and non-diegetic cues, and the impact of camera motions, defines conditions for better narrative engagement in immersive storytelling.

This study is designed to justify the "Story-Without-End" framework, where concurrent timelines loop infinitely. Thus, the second experiment is consisting of a 360-degree film with a non-linear timeline (videos playing backward and forward) which is used to examine how immersion in an irregular time representation affects audience engagement with narratives. Experiencing such an immersive film requires participants to actively think and follow the narrative in real time, influencing their perception of duration.

[11] See the discussion in previous chapter under the title “VR story world”.

Following the previous study's findings, the analytic category for this study is set based on participants' perceived duration of the experience, subjectively categorised from feeling much shorter to much longer than actual time. Hence, the inductive analysis of participants' behaviours and feelings reveals how a non-linear timeline in a VR environment can either encourage or distract from narrative engagement. This approach of observing participants behaviours reacting to non-isomorphic storylines informs the design of more effective timeline for the creative practice, Déjà vu movie.

Finally, a separate study is conducted on second film, The Man Who Disorientated in Time (2002), that observes audiences' behaviours to stipulate which type of camera motion enhances narrative engagement and minimises distractions and the negative effects of disorientation. As a result, patterns for locomotion and teleportation are designed for the creative practice project, Déjà vu.

Chapter Five: Perceptual Process for VR Audiences

5.1. Study on Perception Process

5.1.1. Justification of Feeling of Duration as the Perception indicator.

This research is conducted to explore the connection between the feeling of duration and other factors influencing the perceptual process for VR audience. Initially, the study investigates differences in users' perceptions of duration across two different media formats, VR and 2D screen, concerning their perception from the duration of non-isomorphic shots. In this context, the mental aptitude of each user to conceptualise the changes in displayed environment and their orientation regarding the image plays a pivotal role in shaping the feeling of duration. Data gathered for this analysis through observing how participants articulate their experiences using a subjective measurement (a semi-structured survey) which indicates their effort to engage with the content and the emotional engagement with the story world.

In this context, subjective measurement aids in comprehending the extent to which participants present logical statements to explain novel situations. It also sheds light on how VR audiences analyse novel situations by retracing memories and the degree to which they employ rule-based (traceable analysis) or associative processing (intuitive feelings) to elaborate on their virtual experiences, which can be shown by their feeling about the duration of the experience. Comparing with 2D screen viewer, the study investigates the characteristic of VR medium in engaging audiences with novelty and its impact on perception process.

Considerably, as highlighted by Smith & Collins (2009), the utilisation of memory systems to interpret contents is not a sequential process; instead, both memory systems operate simultaneously. Therefore, when analysing the cognitive process of individuals, the research considers the dominant memory system, recognising that individuals employ both memory systems when encountering a novel situation. The associative process typically initiates the first encounter, and subsequently, based on cognitive capacity, individuals may transition to a rule-based process to retrieve memories and facts from prior experiences for analysing the situation. The duration of this transition varies for each participant and is influenced by both the media content and form and their cognitive capacity.

Through this approach, the research highlights the feeling of duration as a significant characteristic depicting differences in participants' overall quality between immersive and non-immersive narrative experiences. A comparative analysis regarding distinctions in the level of presence and reported feeling about the duration of experience among two cohorts of participants signifies the characteristics of the perception condition for an immersive experience against a non-immersive one. It explains how being immersed in a surrounding environment to read a story engages our consciousness in a natural way, similar to real-life experiences, and differs from perceiving narratives on a flat screen.

5.1.2. Thematic Analysis among VR Audiences.

In the subsequent analysis, various themes are explored among VR audiences to analyse the impact of each determinant on the perception of duration. The VR audiences is divided into two categories; the group who used rule-based processing and participants who apply association processing as the dominant memory system. Initially, the research compares the scores of their virtual presence, as defined by ITC-SOPI, with participants' answers to a semi-structured questionnaire to justify the categorisation based on the memory system.

This comparative analysis assists in finding the correlation between the level of objective presence, scored by the ITC questionnaire, and subjective presence, indicating the type of engagement with media content through the dominant memory. It also provides insights for the subsequent analysis which explores whether participants are more influenced by media characteristics or personal traits in shaping their perception of duration.

In this respect, a thematic analysis takes into account participants' age, gender to reveal the influence of user characteristics on the perception of duration. The analysis explores the correlation between participants' characteristics, cognitive capacity, and the impact of using background knowledge on shaping the perception of duration.

Given that most participants were non-experienced VR users, the research additionally applies all the process of analysis method only for non-experienced participants, to illuminate the VR experience rate and validate findings related to other determinants. This approach provides valuable insights into how the cognitive capacity of each audience, irrespective of their previous VR experience, influences the perception of duration in a novel experience using an immersive medium. It also helps further justify the connection between memory-retrieval processes and the feeling of duration.

Since the feeling of duration is a subjective measure for the perception process, participants are categorising into three groups: a) those feeling the duration is slower than the actual time, b) those feeling the duration aligns with the mechanical time of the experience, and c) those feeling the duration is faster than the actual time. This categorisation facilitates the analysis of different analytic categories for group participants based on media characteristics and contents, as well as participants' characteristics. The findings regarding the impact of various determinants on different category for feeling of duration generate memos describing the relationships among different factors and their effects on the perception of duration.

Concerning the influence of the body's awareness of its position within an immersive visual environment on the perception of time duration, two questions in semi-structured survey are queried regarding their perception of duration when comparing the first scene and the last scene (which is the same scene but tipped upside down) and the image that they remember from each scene. The study posits that an inverted upside-down position may induce a challenging condition for participants, leading them to perceive the duration of the last scene as longer and remember it harder.

Using this content analysing method, the research investigates the impact of virtual reality (VR) audience positioning on the subjective perception of time duration, as reported by participants.

5.1.3. Research Questions:

1. What are the variations in perception of immersive content using a VR headset versus watching on a 2D flat screen in terms of presence and feeling of duration?

2. How does the utilisation of different memory systems, association processing and/or rule-based processing, influence the individual's feeling of duration?

3. What relationships exist between the user's characteristics and their feeling of duration in virtual reality (VR) experiences?

4. To what extent the media characteristics like full-body immersion and body position effect the feeling about the duration of immersive content?

5.1.4. Determinants:

Using the ITC-SOPI questionnaire (Lessiter et. al., 2001), four qualifiers determine objective presence, including: “a) Engagement, b) Spatial Presence, c) Ecological Validity/Naturalness, and d) Negative Effects" (Ibid). However, as recommended by the questionnaire designer, some questions are modified or removed to suit the specific content of the research. Nevertheless, the questionnaire's structure and measuring determinants remain unchanged. [12]

The additional semi-structured survey comprises nine open-ended questions. This survey explores determinants related to how the virtual reality (VR) medium engages users with virtual content, influences their motivation, and the impact of their proprioceptive condition in remembering the virtual world and arousing emotions to engage with contents. Three determinants that are investigated through participants’ answers are:

a. Dominant memory system: The dominant type of memory system—rule-based or association—that users use to interpret incidents in their surroundings.
b. Feeling of Duration: The feelings participants report in the survey regarding the duration for each scene and the overall experience.

[12] Check the appendices III, IV and V for the ICT-SOPI questionnaire, which explain the process of modifying questionnaire based on experiment needs.

c. Proprioceptive condition: remembering image of a scene in two different conditions, and feeling about the duration of each scene, showcasing the impact of orientation of the VR space affecting participants' perception.

5.2. Samples and Procedure

5.2.1. Participants Sample:

For this study, forty-four new participants were recruited, distinct from those in the previous study, ranging in age from 25 to 77. First group consists of twenty-four participants wear VR headsets and engage with three distinct 360-degree videos. The second group is twenty participants who observe the same content on a 2D flat screen. A major part of the study is conducted during the COVID-19 lockdown period; thus, participant recruitment utilised the snowballing method[13], with invitations extended through social media platforms. It specifically targeted individuals with access to a VR headset for remote testing. Each participant received a consent letter detailing the test procedure, emphasising the importance of experiencing the videos in a quiet environment, and promptly responding to a post-viewing questionnaire.[14] The participants, consisting of 55% males and 45% females in both cohorts. Participants who used VR headset were primarily non-experienced VR users. Figure 4-1 illustrates the distribution of VR experience levels among the participant cohort. Participants in the second group mainly watch the movie on a large screen (28 inches and above). Figure 4-2 shows the variation of screen size among them.

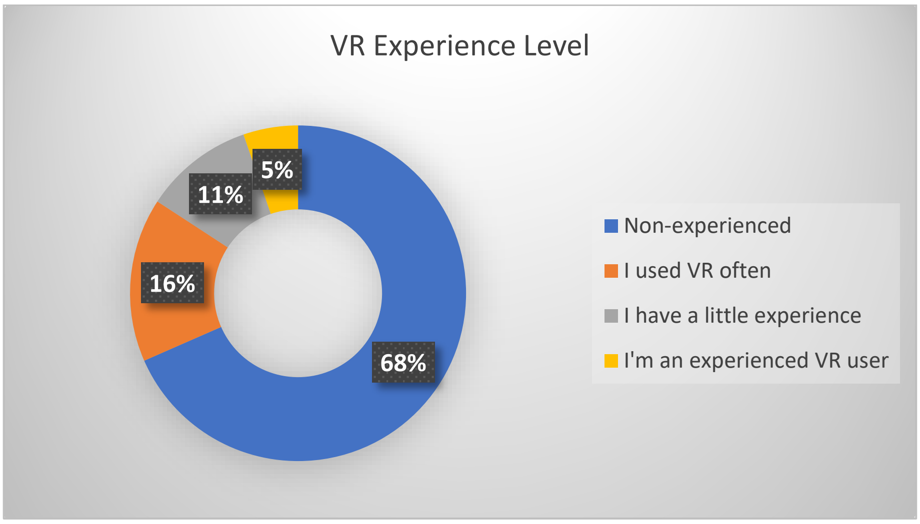


Figure 5. 1: Participants' characteristics: the level of experience for using the VR system.

[13] The snowballing methodology for selecting group participants in humanistic research involves starting with a small, initial group of participants who meet the study criteria. These participants then recruit additional participants from their network, who in turn recruit more participants, and so on. This method leverages existing social networks to access a broader, often hard-to-reach population, ensuring that the sample grows through referrals.

[14] See Appendix II -Participants Consent Letter.

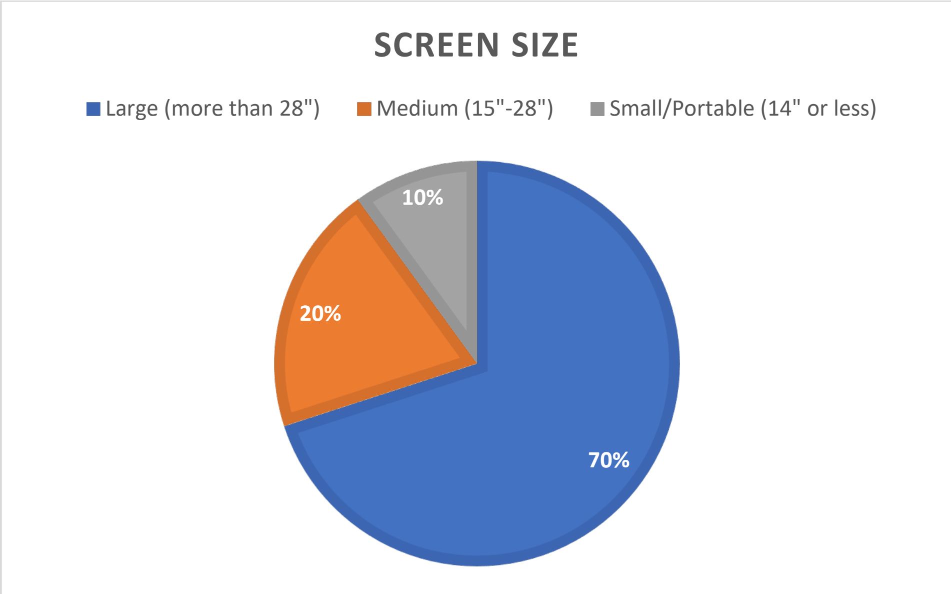


Figure 5. 2: The variation of screen size among participants who watch 360 contents on a 2D screen.

5.2.2. The Movie

For this research, the 360-degree video titled "How Do You Feel It?" (2021) is designed to offer a three-degree-of-freedom (3-DOF) seated virtual reality (VR) experience. It comprises two scenes in three shots: one scene involves fast-rolling footage of a sunrise (which, when played in reverse, appears as a sunset), and the other is an upside-down image of a sunrise with the same speed. The second shot features a still frame of a graveyard accompanied by sounds capturing various movements.

VR participants are granted to have the freedom to yaw, pitch, and roll their heads to explore their surroundings; however, any additional movement inside the virtual environment controlled by the VR content itself. Using a fixed camera ensured that there was no disorientation caused by camera movement, and that only the depiction of manipulated timelines, as narrative content, influenced the participants' feelings about the duration of experience. This condition helps to narrow the elements and assists the study by focusing on the feeling of duration created by experiencing immersive content and discarding speculative aspects.

The short 360-desgree movie depicted in three different scenes (please see figure 4-3, 4-4, 4--5) as follows:

Figure 5. 3: First scene; a fast-rolling sunset in reverse speed with a clock in the scene which works counterclockwise.

Figure 5. 4: Second scene; a still frame from a graveyard.

Figure 5. 5: Last scene; a fast-rolling sunrise tipped upside down.

5.3. Variables:

The variables influencing the feeling of duration fall into two categories: features of media content and participant characteristics. For each category, the variables are as follows:

5.3.1. Media Content Characteristics:

The research investigated the impact of media content by looking into;

a. The effect of full-body immersion in a natural phenomenon, (sunrise and sunset) at an unusual speed (fast-rolling) and a still frame with sounds of movements, on perception of duration for different scene.

b. The impact of the proprioceptive positions (normal, upside-down) of the immersive image on the perception of duration.

5.3.2. User Characteristics:

The study examines how background knowledge influences self-identification in the virtual environment and the generalisation of ideas about phenomena. The variables related to participants' cognitive capacity to recall background memories and the time spent elaborating on content are considered. Background knowledge can originate from previous VR experiences or real-life memories. Thus, the variables indicating cognitive capacity to engage with a virtual environment are:

a) Level of VR experience categorised as non-experienced, having little experience, casual VR user, and experienced user.

b) Age of the participants categorising them as young (below 30 years old), mid-age (30 to 50 years old), and old (above 50 years old).

5.4. Justification of ITC-SOPI Questionnaire

This research required a questionnaire specifically designed to account for the features of both media form and content, aiming to measure the objective presence of participants across two different mediums: VR and 2D screen. The objective presence in this study is assessed to understand how the VR system influences participants, making them feel spatially located within the presented environment compared to a 2D screen. For this purpose, the ITC-Sense of Presence Inventory (ITC-SOPI) (Lessiter et al., 2001) is utilised to gauge the effectiveness of the immersive content in fostering engagement and the communication methods employed by the media to convey narratives and establish a sense of presence within the virtual environment.

The questionnaire explores the impact of both media forms and the effects of content on the "perception-action link" (Ibid) between the user and the display. It investigates three factors linked to variations in media characteristics, whether related to its discourse or the narrative contents. Additionally, it considers how users' characteristics may influence the measurement of presence. As discussed by Lessiter et al. (2001), "presence is likely to be related not only to a user's sense of being located within a spatially contiguous physical environment but also to his/her personal evaluation of the appeal and the naturalness/believability of the content within the displayed environment" (Lessiter et al., 2001, p. 2).

In this quantitative measurement of presence, the first factor, "Spatial Presence," provides a score indicating the effectiveness of the experience in diverting participants from their physical location. The second factor, "Engagement," offers a measure of users' involvement and interest in the displayed content, considering the media format and its potential to enhance emotional arousal. The third factor, "Ecological Validity (Naturalness)," pertains to the believability and realism of the contents and story environment. It serves as an overall metric for the extent to which participants believe in the naturalness and solidity of the contents, momentarily forgetting the reality of their physical location throughout the entire experience. This factor is crucial in evaluating the impact of media in creating the sense of "being there" as an objective presence.

Additionally, the fourth factor involves self-reported "Adverse Effects" associated with the media form or content. This includes reports of headaches, eyestrain, tiredness, disorientation, and other negative effects. In this context, the level of engagement with the content is likely to influence the score of negative effects, directly related to users' characteristics. For instance, a user may score high on the first three factors, but if they find the content boring, they might give a higher score for negative effects as they get tired.

In such cases, as suggested by Lessiter et al. (2001), a supplementary survey would offer a more detailed explanation and allow for a comparative analysis to interpret participants' scores for each factor and their interrelation. They point out a limitation of the ITC-SOPI questionnaire, noting that it is a cross-media questionnaire designed for a broad range of media forms. Consequently, it avoids asking about the specific content provided for the experiment.

5.5. Credibility of quantitative data

In this study, the reliability and consistency of collected data is rigorously examined through a reliability analysis using Cronbach's alpha. A Cronbach's alpha value above 0.7 is generally considered acceptable, indicating good internal consistency and reliability of the items being measured. The formula for Cronbach's alpha is:

$$\alpha = \frac{N\bar{c}}{\bar{v} + (N-1)\bar{c}}$$

where:

- N is the number of items,
- $\bar{c}$ is the average of all covariances between items,
- $\bar{v}$ is the average variance.

Equation 5. 1: Cronbach Alpha's formula

The calculated Cronbach alpha value for the entire dataset yielded a substantial result of 0.751 for the cohort of participants who used VR headset and 0.709 for group of participants who watch the movie on 2D screen[15]. It suggests a high level of internal consistency among the collected variables. This coefficient indicates the extent to which the different components of the data consistently measure the same underlying construct.

5.6. Semi-structured Survey

Each question in this survey addresses a specific determinant of immersion. Considerably, it is avoided to address two issues in one question, as this may confuse response options and render participants' answers meaningless (Lessiter et al., 2001).

The questions and their corresponding subjects are as follows:

[15] See the Appendix VI – ICT_SOPI result- First Experiment.

Negative effects

1. Did you watch the movie to the end? If not, please explain when and why you stopped experiencing it.

Memory system

2. Describe the image you remember from the first scene.

Cognitive capacity

3. Did you observe any movement in the second scene? If yes, please describe it.

Emotional arousal (Memory System)

4. What feelings did you experience during the second scene?

Memory System

5. What was the last scene? A sunset or a sunrise?

6. List the elements you remember from the last scene.

Feeling of duration

7. How long was the duration of the first scene? Give a specific time.

8. Is the last scene longer than the first one?

Additional self-reporting

9. Would you like to add something about your experience?

5.6.1. Survey justification.

In reference to the dual-processing model introduced by Smith & M. Coster (2000) and Smith & Collins (2009), higher motivation and capacity to explore the virtual space would lead participants to employ rule-based processing over association processing for analysing movements. To explore this, participants are first asked if they watched the movie to the end, and if not, to explain why. Participants' responses will reveal negative effects that hinder their immersion in a virtual environment. This information can be compared with the ITC-SOPI score of adverse effects to analyse the impact of the media, whether it is related to the form causing motion sickness or the media contents. For example, answers indicating boredom or discomfort shed light on the media's impact, and explanations from participants reveal effects caused by media characteristics, demonstrating a relationship between content and form. For instance, a tipped image causing disorientation may result in adverse effects.

Additionally, the questionnaire includes specific questions (2, 5, 6) designed to analyse the type of memory-retrieving system participants used to establish their presence in the virtual environment. These questions focus on the distinctions between the first and last shots of the movie, both set in the same room but at different daytimes—sunset and sunrise. In the last shot, the room is empty, and the image is tipped upside down. Although the first shot displays the sunset in reverse, creating the illusion of a fast-motion sunrise, a table clock is present in the image during the first shot to indicate the reverse rolling.

Furthermore, the second and sixth questions prompt participants to list elements they remember from the first and last shots. If a participant mentions the clock and its reverse rolling, their response to question five (What was the last scene? A sunset or a sunrise?) reveals that they had sufficient time to discern their orientation regarding the spatial geometry (flipped upside down) and analyse movements in their surroundings. Consequently, a comparative analysis of participants' answers to these questions, comparing the first and last shots, can determine the extent to which each participant uses rule-based or associative processing to analyse the contents and comprehend the difference between the two scenes.

On the other hand, participants might describe the scene more emotionally and not recall the clock. They may rely on the first idea or feeling they remember from the experience to depict the images from the first and last shots. In such instances, the participant's response highlights the media's impact in evoking emotions and fostering emotional engagement with the virtual environment. Here, the participant predominantly uses association processing during the experience to identify their position and analyse their surroundings.

Alternatively, an individual can opt for rule-based processing when providing a more objective explanation of the images from the first and last scenes, focusing on visual elements and movements rather than describing the feelings associated with the experience. This choice can be substantiated by examining their response to question five, which reveals whether they recognised the reverse video playback. Acknowledging the distinction between the two shots can confirm their cognitive capacity and justify the use of rule-based processing. As stated by Smith & Collins (2009), the only rationale for associative processing results is a "gut feeling" or intuition. In contrast, rule-based processing requires a "sequential process of reasoning".

Furthermore, by prompting participants to describe the image of the last scene, which differs from the setting they encountered in the first scene, we can discern how they extrapolate from the unfamiliar situation of the tipped image and to what extent they adapt their memory of the first scene to comprehend the last one. Consequently, comparing participants' recollections of the first and last shots reveals variations in their cognitive capacity when engaging with VR media form. If they reproduce the image of the first scene, which represents a more familiar situation than the last one, it suggests they exerted less effort in generalizing and remembering the last scene due to insufficient cognitive capacity to employ rule-based processing.

Moreover, questions seven and eight inquire about participants' feelings regarding the duration of the first scene and then prompt a comparison between the durations of the first and last shots, despite both having the same duration. These questions provide insights into the influence of each memory system on shaping the perception of duration and the effect of body position on generating this feeling. Also, by examining participants' responses to other questions that elucidate their cognitive processes, their answers to these two questions establish a connection between the utilisation of the memory system and the perception of duration.

Additionally, question four, which inquiries about their feelings, provides additional information and reveals the scope and intensity of emotional arousal experienced in the virtual environment. participants' reports on their feelings in the graveyard offer a supplementary analytic category to explore the effect of background knowledge on using the memory-retrieving process and forming a generalized idea about the duration.

Additionally, to investigate the process of generalizing the graveyard scene, the second shot, question number three, prompts participants to describe the movement they observe in a still image. The image is displayed briefly with accompanying sounds of movements; however, the question is crafted in a way that might lead participants to form a visual memory of movement based on the sounds they heard. It can be argued that for a participant looking at a static image while hearing invisible movement, their response to this question gauges the extent to which they establish an emotional or intellectual connection with the content. In comparison with other questions, participants' answers to this question validate their use of the memory system by indicating their cognitive capacity to generalize their situation in an immersive environment.

5.7. Themes Table for studying VR audiences.

Theme	Data Collection Method	Analysis Technique	Variables / Aspects	Interpretations
Virtual Presence	ITC-SOPI Questionnaire	One-way Analysis of Variance (ANOVA)	Level of VR Experience	Significant differences in virtual presence based on varying levels of VR experience.
	ITC-SOPI Questionnaire and semi-structured survey	Correlation Analysis (Deductive)	Memory system	the correlation of using each memory system on the sense of presence during VR experiences.
Memory System	Semi-structured Survey	Content Analysis (Inductive)	Dominant Memory System (Rule-Based or Association)	Identification of prevalent memory systems influencing participants' interpretation of VR incidents

		Correlation Analysis (Deductive)	Feeling of Duration	Exploration of how memory systems contribute to the feeling of duration.
Participants Characteristics	Semi-structured Survey	Correlation Analysis (Deductive)	Age	Examination of age-related correlations with the feeling of duration in VR experiences.
		Correlation Analysis (Deductive)	Level of VR Experience	Insights into how participants' VR experience rate influences feeling of duration
Media Impact	ITC-SOPI questionnaire and semi-structured survey	Correlation analysis (Deductive)	Full-body Immersion (Media characteristic)	Relationship between full-body immersion and participants' sense of duration
	Semi-structured Survey	Content Analysis (Inductive)	Proprioceptive position (Media Content)	Exploration of how the position of immersive images influences the perception of duration.

Table 5. 1: Theme table for analysing data among participants who use VR headset.

5.8. Findings

5.8.1. Virtual presence among two cohorts of participants

For the 2D Screen cohort, Engagement scores range from 2.25 to 4.286, indicating a varying degree of involvement and interest. Also, Spatial Presence scores vary from 2.067 to 3.667, reflecting differences in the sense of being "in" the environment presented. Ecological Validity/Naturalness scores are between 3.25 and 5, suggesting a variation in how natural and believable the environment felt. However, Negative Effects scores, which could include discomfort or disorientation, range from 1.16667 to 2, showing generally low adverse effects.

Alternatively, for the VR Headset cohort, Engagement scores are slightly higher, ranging from 2.33 to 4.83, suggesting a more engaging experience with VR headsets. Spatial Presence scores are significantly higher, ranging from 2.46 to 4.86, indicating a stronger sense of being present within the virtual environment. Additionally, Ecological Validity/Naturalness scores also show a higher range, from 3.25 to 5, pointing to a more realistic experience. However, Negative Effects scores vary more widely, from 1.16 to 4.33, indicating that while some VR users experience minimal adverse effects, others encounter significant discomfort.

Overall, the VR Headset cohort report higher levels of Engagement, Spatial Presence, and Ecological Validity/Naturalness, suggesting a more immersive and realistic experience. However, this cohort also report a wider range and sometimes higher levels of Negative Effects, indicating a potential trade-off between immersion and comfort.

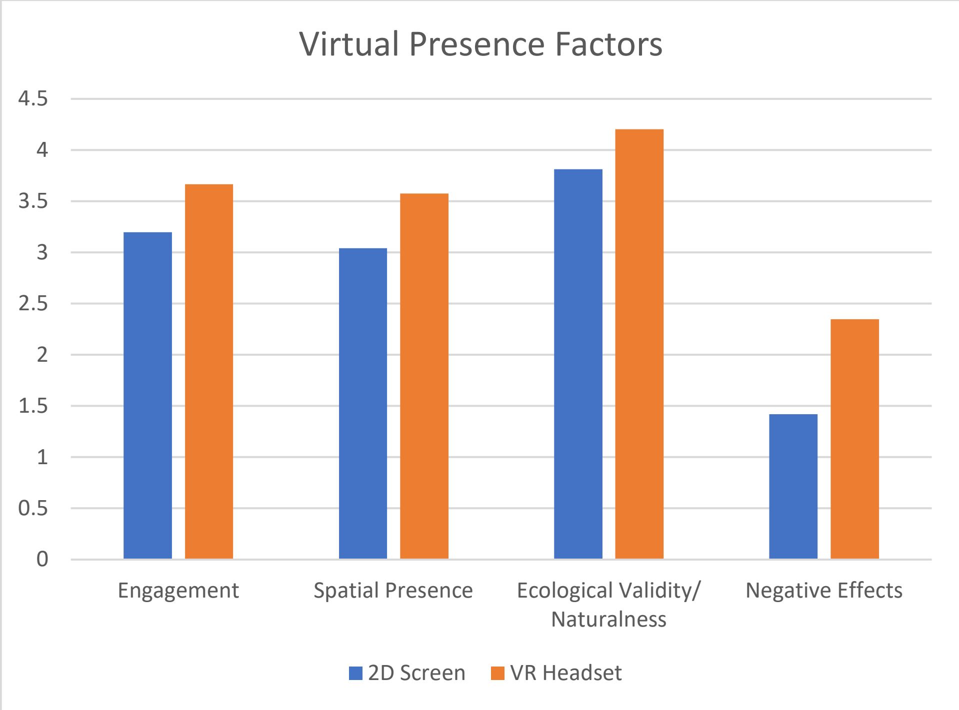


Figure 5. 6: Comparison of virtual presence factors among two groups of participants

5.8.2. Feeling of duration for two cohorts of participants

For 2D screen cohort the perceived duration is closer to the actual duration but was still overestimated. Lower spatial presence and engagement in this group might suggest a less immersive experience, yet the participants overestimated the duration to some extent, which aligns with studies suggesting that less engaging content can sometimes feel like it drags on longer than it does. Meanwhile, the ecological validity and negative effects were likely lower in this group due to the less immersive nature of a 2D screen, which may contribute to a more accurate perception of time compared to the VR headset group.

Alternatively, the VR headset cohort feels the duration to be significantly longer than the actual time, indicating a distorted perception of time. Higher engagement and spatial presence suggest a more immersive experience, which could cause participants to lose track of time—a phenomenon supported by research indicating that highly engaging and immersive activities can lead to an underestimation of time passed. However, the higher negative effects in the VR group, such as disorientation or discomfort, have contributed to a feeling of a prolonged experience, as discomfort can make time seem to pass more slowly for some participants.

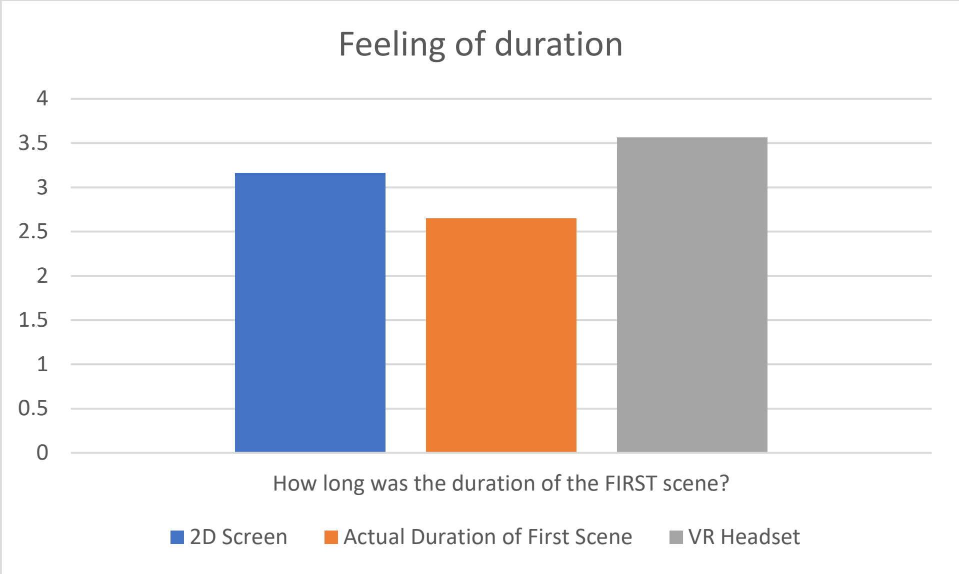


Figure 5. 7: Feeling of duration for two groups of participants in comparison with actual duration.

Given the provided graph (Figure 5-8) and considering the additional factors of engagement, spatial presence, ecological validity, and negative effects, it can be deduced that virtual presence likely plays a significant role in the feeling of the duration of an experience.

Comparing between the two groups, it appears that the VR headset group, with its inherent capability for higher engagement and spatial presence, potentially offers a more immersive experience that could influence the perception of time more significantly than watching the same content on a 2D screen. This difference in virtual presence suggests that VR technology can significantly impact the feeling of duration, making experiences feel shorter or longer based on the level of immersion and presence felt by the viewer. These findings underline the importance of considering individual differences, such as age and gender, and technical aspects, like VR experience level, in understanding how immersive technologies like VR headsets affect the perception of time and the overall experience of virtual environments.

5.8.3. Virtual Presence and Memory System in correlation with feeling of duration

The examination of VR participants' responses to the semi-structured survey and ITC-SOPI questionnaire revealed that individuals using rule-based processing exhibited slightly higher scores in spatial presence, engagement, and naturalness compared to those employing associative processing.

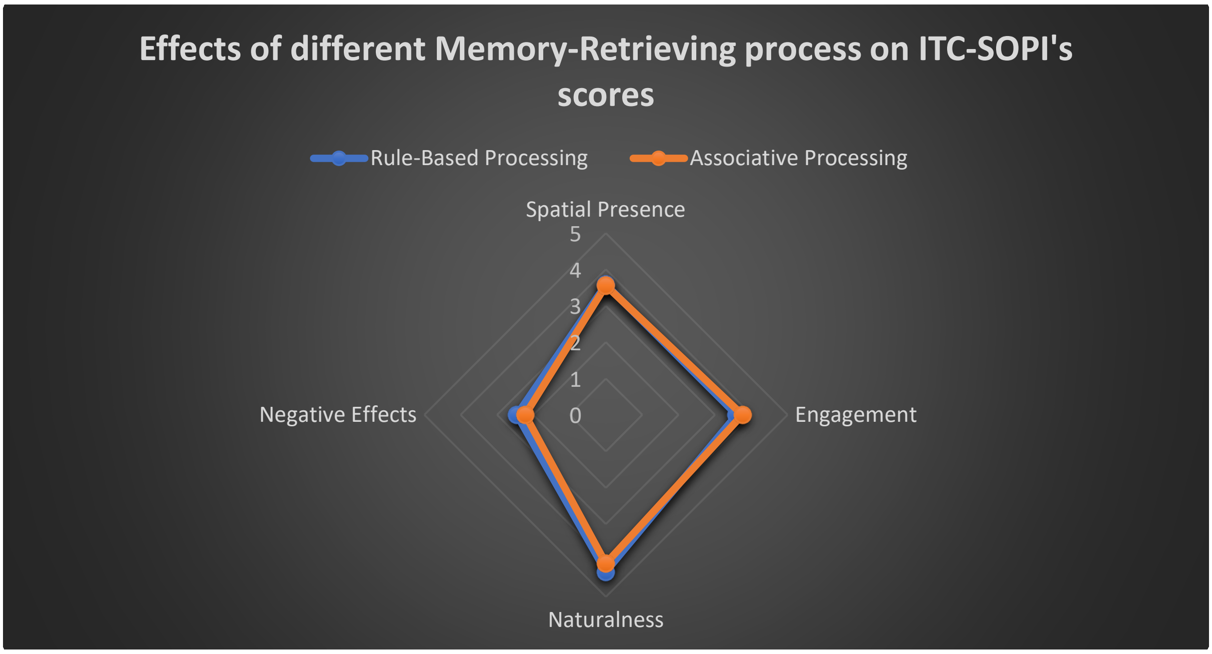


Figure 5. 8: Effects of different memory-retrieving process on virtual presence scores.

However, when comparing the level of objective presence with the feeling of duration, a significant trend emerges. Participants who perceive the duration slower than the actual time experience a higher sense of presence in the virtual environment. Conversely, those who feel the duration faster, report lower presence scores. This trend highlights a significant relationship between presence and the perception of duration, indicating that a more immersive experience in VR simulation is associated with accurately perceiving or feeling the duration as slower than the actual time.

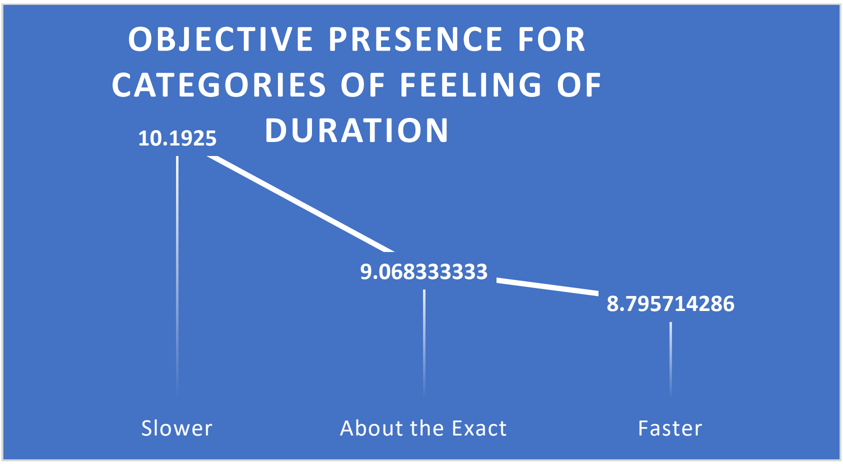


Figure 5. 9: Virtual presence for different category of feeling of duration.

Furthermore, a correlation analysis examines the contribution of memory systems to the perception of duration. The findings suggest that participants utilising rule-based processing tend to exhibit a more nuanced perception of duration compared to those relying on associative processing.

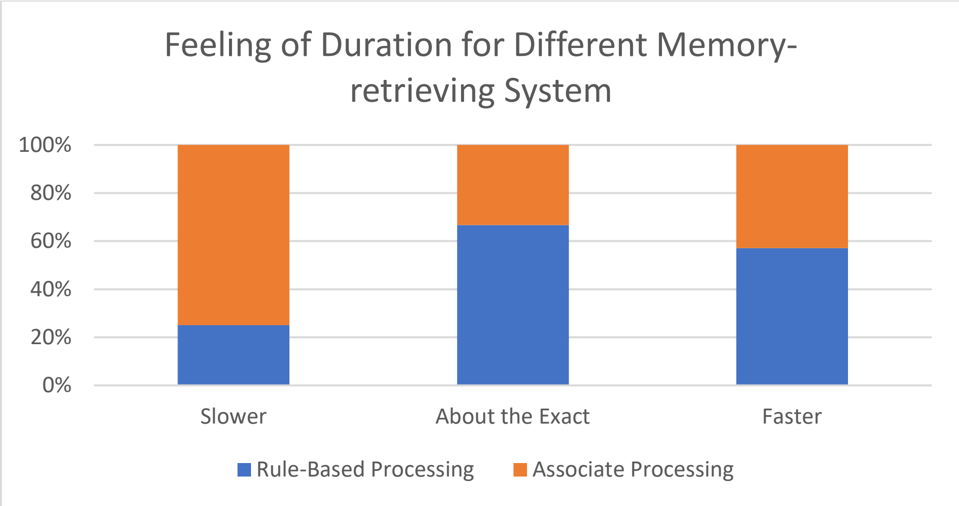


Figure 5. 10: Feeling of duration for different memory system.

Considering that the application of rule-based processing requires more time to analyse movements in the surroundings, the correlation analysis of objective presence, memory system, and the perception of duration primarily suggests that the feeling of duration can discern differences in the engagement with content based on the application of a memory system. In other words, feeling the duration as slower than the actual time may indicate that the VR audience employ associative processing, leading to a more joyful emotional engagement with the immersive environment and resulting in a higher level of presence. This finding essentially justifies the categorisation of participants based on their memory system to scrutinise various factors related to the characteristics of media, content, and the users themselves.

5.8.4. Participants Characteristics

The analysis of participants' characteristics initially considers age as a factor influencing the perception of duration in VR experiences, given its direct relation to cognitive capacity in applying rule-based processing. The correlation between age and memory system reveals that older individuals tend to employ rule-based processing. Aging is associated with a more extensive background knowledge, enabling participants to analyse situations more intellectually. Since the majority of participants, including those aged over fifty, are non-experienced, it can be inferred that participants made an effort to apply rule-based processing in a novel situation, such as experiencing a VR application, with their ability tie to possessing a richer background knowledge that typically comes with age.

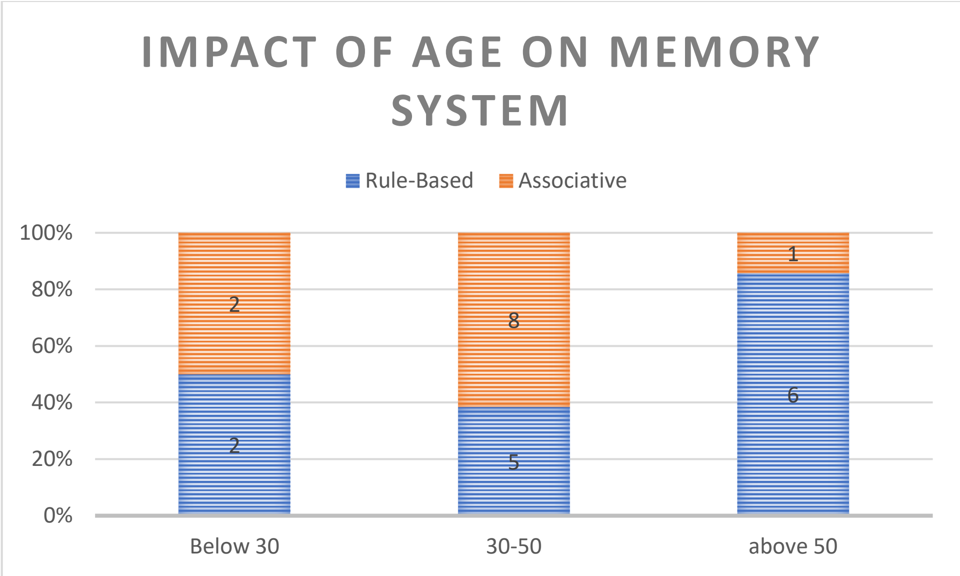


Figure 5. 11: Impact of age on using a memory system

On the other side, the correlation analysis uncovers a significant association between age and the perception of duration. This implies that being older and possessing a more extensive background knowledge contribute to a more precise feeling of duration. This finding indicates that age can be a determining factor in how individuals perceive time in virtual environments, with older individuals potentially having a more accurate grasp of temporal experiences.

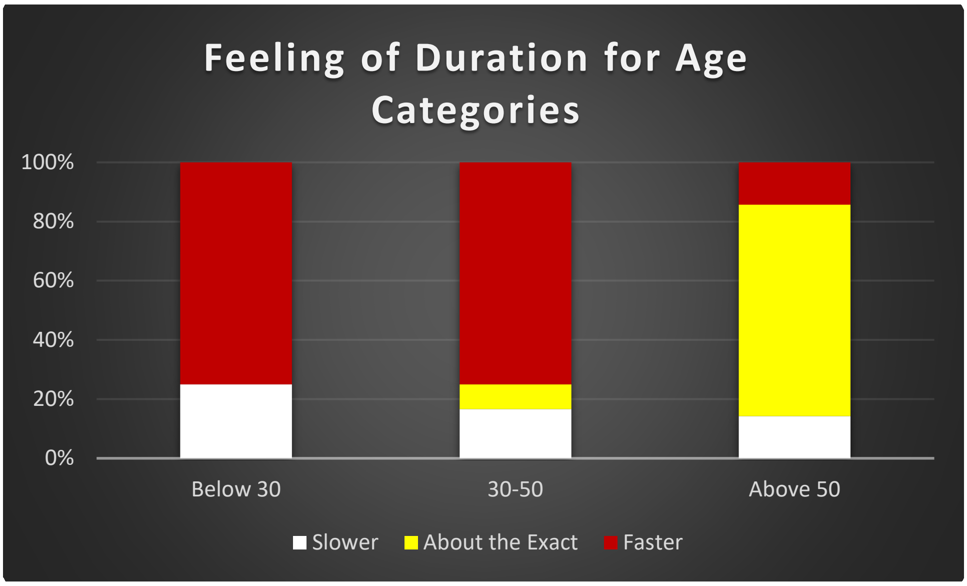


Figure 5. 12: Feeling of duration for different age category

Interestingly, the analysis of gender in conjunction with memory systems revealed a significant difference between male and female participants in their utilisation of memory systems. The findings indicate that female participants tend to employ more rule-based processing compared to their male counterparts in similar situations. It is noteworthy that a comprehensive examination of gender impact on VR experience requires a sizable cohort of participants, with an equal representation of each gender group, which is not the focus of this study. Nevertheless, the primary finding of this research confirms a distinction in the interpretation of immersive images among different gender categories.

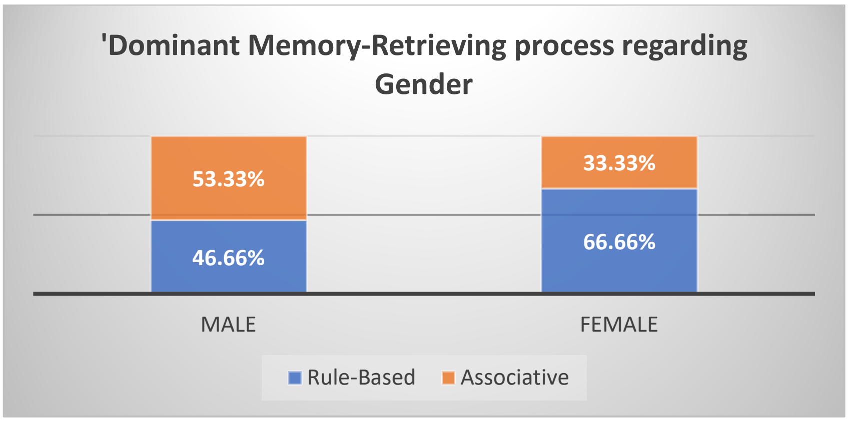


Figure 5. 13: dominant memory system regarding gender of participants.

5.8.5. Media Impact

A correlation analysis reveals a significant relationship between full-body immersion, a characteristic of the media, and participants' feeling of duration, as discussed earlier. This differentiation between experiencing an immersive image and a flat image illustrates that certain positions contribute to an extended sense of time. All participants in the VR headset cohort, except one, reported different perceptions of duration for the first and last images.

However, their responses challenge the assumption that placing audiences in an upside-down position would make them feel the duration as longer. Ninety percent of participants felt the first scene was longer. This may be attributed to the fact that the first scene was their initial exposure to VR stimuli as most of them were non-experienced VR users. It led them to a heightened intellectual effort to comprehend the novel situation. This heightened cognitive engagement likely contributed to the extended feeling of duration.

5.9. Discussion

The study finds a link between memory systems and media content, showing that engagement is directly related to the geometric and dynamic features of content. In simple terms, the immersive nature of VR content impacts audiences' perception regarding the speed of movements and position relative to events. It indicates the difference in perception process for VR medium in comparison to flat screen.

This finding suggests that VR content creators can influence audience perception by adjusting the dynamics and geometry of immersive shots. These adjustments can enhance content engagement and create powerful experiences for participants. It supports the idea that the perception process in VR can be intentionally shaped through careful design of external stimuli, as audiences naturally use a perception process to interpret immersive content as a new reality. This factor is considered in designing the setting of Déjà vu movie, putting different scenes on interior surfaces of a cube with various gravity directions. This design immerses audiences in a novel geometrical position, indicates that they are facing in a new layer of reality. Consequently, this design encourages them to face the novelty of experience with more intellectual engagement which enhance their presence in displayed environment, as the finding of this study shows.

Participants reported moments of uncertainty when attempting to locate narrative cues within the virtual environment. Rather than hindering engagement, this uncertainty appeared to sustain attention and encourage continued exploration, as participants actively searched for narrative coherence across different spatial and temporal layers. This finding directly informed the design of *Déjà Vu*, in which narrative information is deliberately distributed across the story-world rather than presented sequentially, supporting a form of engagement driven by curiosity and perceptual discovery rather than narrative instruction.

Moreover, the research findings indicate practical implications for VR content creators, urging them to allocate sufficient time for the target audience to immerse themselves in virtual environments. VR creators should carefully manipulate the timeline when come to create non-isomorphic durations for narratives. The potential negative effect of disorientation emphasises the need for designers to carefully consider the delicate balance between time representation and audiences' coordination in VR experiences.

Overall, this research suggests that the perception of time in virtual reality (VR) experiences is influenced by both individual characteristics and changes in the environment. The study examines how immersive content affects this perception and finds that specific positioning within a fully immersive experience creates a unique sense of time. It also highlights the difference between immersive and flat images, emphasising the role of media in shaping temporal experiences in VR. The findings confirm that the perception of time can provide insights into participants' memory systems and their engagement with VR content. It confirms that applying a rule-based memory system and having a more engagement score results in feeling the duration more akin to its mechanical time. However, more investigation needs to be conducted to find the variation between the effects of objective and subjective presence on feeling of duration distinguishing the VR joyfulness from narrative engagement.

In this respect, the subsequent research explores the effects of engagement of participants with narrative in opposition of their level of VR immersion by applying a rigorous methodology, advocating for real-time observation of participants in VR simulations. It aids to uncover how

VR storytellers can engage and lead audiences through immersive design, suggesting principles for creating immersive and interactive VR practices.

Chapter Six: VR Narrative Engagement

6.1. Methodology of Research

6.1.1. Research approach.

This investigation aims to uncover the relationship between narrative engagement and the feeling of duration by coding and analysing VR audiences' behaviours in an inductive manner. This research explores qualitative data to distinguish the subjective feeling of presence, which results from participants' efforts to unfold narratives, from the objective presence arising from the joy of experiencing full-body immersion. This approach aims to find a condition that could be considered as narrative engagement for VR films.

The study considers different factors impacting the quality of narrative engagement, both positive and negative, using real-time observations and participant reports. A rigorous methodology is employed to collect data, identifying users' engagement and its relation to their feelings during specific dramatic incidents. The research analyses the chains of participants' actions to determine the quality of narrative engagement and its relation to the individual's feeling of duration.

The research posits that the quality of subjective presence, encompassing emotional contribution to the narrative and the level of narrative engagement, is linked to the duration participants perceive at the conclusion of the experience. Participants are categorised into five groups based on their reported feelings about duration in the post-experience survey. By examining trends within each participant group, their responses to narratives, and the impact of disorientation, whether adverse or enjoyable, the outcomes of the study substantiate the feeling of duration as a viable measure for narrative engagement in immersive content.

This study also observes participants' reactions to a non-linear timeline and irregular representation of time in real-time. It provides insights into how designing dramatic durations and unusual timelines can encourage audience engagement in the unfolding narrative. Alternatively, it shows how non-uniform durations of immersive content can arouse enjoyable emotions and enhance the sense of objective presence within the immersive environment.

6.1.2. Research Methodology

In this study, the "Constructive Grounded Theory" method (Charmaz, 2008) is utilised to categorise and analyse participants' reactions and engagement in the narrative. As explained by Atkinson, Coffey, and Delmont (2003), grounded theory involves studying real-life events and experiences while exploring insights and potential analytical ideas about them.

Grounded theory, first suggested by Glaser & Strauss (1967), provides a theory or model from inductive data that explains real-world events. It can be a “discovery” (Glaser & Holton, 2004) of a new model without starting with an assumption or provide a “verification” (Strauss & Corbin, 1998) for a starting assumption. However, Charmaz (2008) suggests that the derived theory from inductive data offers an “interpretative portrayal” (Charmaz, 2014) of the world, not an exact picture of it. In her opinion, grounded theory is a construction, and its implication is throughout the process of analysis, not having an assumption for starting research.

In this respect, this study employs this method of analysis aims to construct a theory to detect participants' behaviours that indicate narrative engagement and subsequently analyse narrative engagement as opposed to immersion’s enjoyment. The constructive grounded theory helps this study to structure its data in alignment with the findings of previous research on perception processes among VR audiences. Hence, this research, complementary to prior studies on perception processes, portrays various aspects of VR narrative engagement and discovers its relationship with the "feeling of duration," so it can work as a qualitative measure of narrative engagement.

6.1.3. Advantages of using a Constructive Grounded Theory Method

Using a rigorous methodology to observe participants behaviours and employing a constructive grounded theory for analysing data offer several notable advantages:

a. Comprehensive Data: It involves the collection of both qualitative and quantitative data, providing a holistic view of participants' experiences.
b. Rich Insights: Through grounded theory analysis, rich and contextually relevant insights are extracted from the data and justified by a comparative analysis with quantitative data.
c. In-Depth Understanding: The methodology provides a rich database, both qualitative and quantitative, allows to delve deeply into participants' perceptions and their engagement with narrative elements.[16]

6.1.4. Comparison with Other Methodologies:

In comparison to other research methodologies used for measuring how individuals engage with a story in immersive media (Wolfe, et. al., 2022) (Brown, et, al., 2020) (Richarson, et, al., 2018) (MaCcrea, et, al., 2012), the approach of this project stands out due to its comprehensive data collection and grounded theory analysis. Unlike some other methods that primarily rely on quantitative data collected through devices like EEG and ECG, or through self-report questionnaires, and gather limited qualitative data by observing the audience reaction to specific instances during the experience, this research combines both qualitative and quantitative data to provide a more detailed understanding of the immersive experience. It primarily helps to determine which behaviours of the audience that can be considered as engagement with the narrative.

[16] See Appendix X - Codebook for Narrative Engagement.

6.1.5. Drawbacks of the Methodology

One notable drawback of this methodology is the extensive effort required for detailed data analysis. The meticulous coding of individual participant behaviours and the identification of trends within a large dataset can be time-consuming and may cause biases. However, the depth of understanding and the richness of insights obtained through this approach make it a worthwhile investment in the research.

6.1.6. Data Collection

The study gathers information from various sources to build a comprehensive and rich database of participants' experiences. The ITC-SOPI questionnaire measures factors related to participants' objective presence in virtual space, serving as a gauge to measure the joyfulness of the experience. Additionally, participants complete a survey with open-ended questions immediately after the virtual experience. The semi-structured survey delves into participants' memories, feelings, and reactions, exploring scenes, annoyances, interesting aspects, and perceived duration.

In the data collection process, video recording of participants during their immersive experience was deliberately excluded from the analytical dataset. While observing audience behaviour during the experience proved valuable, capturing video footage of participants wearing a head-mounted display was considered ethically and practically problematic. Immersion in a virtual environment places participants in a perceptually altered and potentially vulnerable state, and some individuals may feel uncomfortable or decline consent to being filmed while inhabiting what can be described as an additional layer of reality. Introducing video recording as a mandatory condition risked further limiting an already small pool of potential participants. Given the disorientating nature of the experience, each session required the researcher's physical presence to ensure participants' safety and comfort. For these reasons, systematic video documentation was not included as a formal source of analytical data, and this decision is acknowledged as a methodological limitation rather than an omission.

Nevertheless, observational insights were not disregarded entirely. During each session, the researcher noted unusual reactions, physical responses, verbal expressions, and moments of hesitation or surprise exhibited by participants throughout their engagement with the work. These observations were documented immediately after each session and incorporated into the *Viewpoint Description Form*, where they were considered alongside participants' verbal reflections and self-reported experiences. In this way, observational notes functioned as contextual and interpretive data rather than primary behavioural evidence, supporting qualitative analysis without compromising participant comfort or ethical integrity. This approach reflects the practice-based orientation of the research, prioritising lived experience, reflective interpretation, and narrative engagement over exhaustive behavioural capture.

Figure 6.1 illustrates the physical environment in which participants experienced the work. The image shows one participant—who provided explicit consent for public dissemination—engaging with the VR experience in a dedicated room located in the Mellor Building. The setup was configured to support a seated mode of interaction, ensuring participant comfort and stability throughout the experience. A high-performance PC was used to run the application smoothly, minimising technical interruptions and preserving continuity of immersion. This controlled setting allowed participants to engage with the virtual narrative without external distractions, supporting the study's focus on perceptual engagement and embodied presence within a cinematic VR framework.

Figure 6. 1: Participant experiences the practice "The Man Who Disorientated in Time 2022"

This dual approach in gathering both quantitative and qualitative data provides valuable insights for analysing participants' behaviours, which are observed in real-time in conjunction with their survey responses. Each participant's viewpoint is recorded via video, depicting their viewing area over time to assess narrative engagement with various types of content. This data is utilised to understand audience reactions to dramatic incidents and temporal reversals of video and sound display in a descriptive format in the Viewpoint form[17]. This form aids in establishing an analogy between diverse reactions to specific events and contributes to creating a taxonomy of reactions that reflects the quality of narrative comprehension.

6.1.7. Data Analysis

The qualitative analysis involves coding and thematic categorisation. Initial coding identifies patterns in participants' behaviours, viewpoint forms, and survey responses. After, categorising participants based on participants' feelings about duration, common themes

[17] Find the "Viewpoint Description form" sample in the appendices.

within each category, such as emotional engagement, remembered elements, and reactions to narrative elements, are identified. The study employs NVivo software for an inductive analysis of participants' responses and behaviours, writing memos to uncover common behaviours and compare trends between different categories of audiences[18].

6.1.8. Research questions.

1. What behaviours indicate narrative engagement for an immersive experience?

2. How does the perceived duration define the quality of narrative engagement?

3. What is the effect of non-linear story on engagement of VR audiences with narrative?

6.2. Sample and Procedure

6.2.1. Sample

6.2.1.1. The 360 movies, *The Man Who Disorientated in Time (2022)*

The experiment involves creating an eleven-minute immersive experience of a 360-degree movie with various camera movements. The deliberate intention is to reposition the audience within the immersive environment using these camera motions and correlate each motion type with a specific narrative incident. Narrative elements are introduced through frequent time-loops and playing 360-degree footage both forward and backward. In this scenario, audiences are compelled to explore their surroundings, identifying moving objects that signals the timeline direction, whether it is moving backward or progressing normally.

In this design, the quality of immersion and the enjoyment derives from the immersive experience, however, it is heightened by the audience's active involvement in interpreting the immersive image and discerning the representation of time; particularly, in connecting each camera movement with a specific timeline. Thus, the audience's efforts to anticipate camera motions prepare them to identify narrative progression and avoid losing track of moving objects which reflect the extent of their engagement with the narrative. Their track of viewpoint during the experience in comparison with self-reported survey responses illuminate the degree of their involvement in correlating camera movements and story's incidents in opposition of VR immersion joyfulness.

6.2.2. Production process:

6.2.2.1. Story

The film offers a virtual exploration of four distinct natural environments. Throughout the journey, the cameraman, operating the camera on the monopod, engages in a dialogue with the audience, delving into the nature of the shared reality they are experiencing. The initial

[18] Find the "Narrative Engagement Codebook" in the appendices.

setting unfolds on a hilltop walkway, featuring a variety of camera movements. Despite the visual dynamism, the timeline of this scene progresses straightforwardly. Viewers are exposed to "chroma transitions," video effects that facilitate seamless scene changes through walking. Towards the conclusion of this segment, glitch effects gradually manifest, increasing until the image undergoes a transformation, seamlessly transitioning the audience to the next narrative segment (Figure 6-1).

Figure 6. 2: First scene – the glitch effects

In the second segment, viewers encounter a reverse shot set against a misty hill. Subsequently, the video undergoes a mirroring effect, presenting two simultaneous timelines within a 360-degree environment (each encompassing 180 degrees of the surroundings). Termed a "mirroring transition," (Figure 6-2) this technique is employed to reverse the representation of time in the film multiple times. The transition involves introducing the same video in a reverse time direction until the initial video fades away, guiding viewers seamlessly into a new timeline. A glitch effect serves as the catalyst for transitioning to the next scene.

This cinematic technique installs an expectation in the audience – the appearance of a glitch in the video signals an imminent shift to a different environment, while the mirroring effects alarms a change in video display direction from forward to reverse or vice versa. This anticipation heightens the engagement of the viewers as they navigate through the film's narrative intricacies. The deliberate use of mirroring transitions and glitch effects serves to guide the audience through a dynamic and immersive experience, creating a connection between the film's form and its narrative content.

Figure 6. 3: Second scene – mirroring transition to change the direction of time

In the third segment, viewers are immersed in a time loop. The interplay between backward and forward movements in the video display is intertwined with the cameraman's corresponding actions. At times, the cameraman deliberately walks backward, yet the video is presented in reverse, portraying a regular movement, while the sounds are perceptible in the opposite direction (Figure 6-3). Mirroring transitions are employed to reverse the timeline of this sequence multiple times.

Figure 6. 4: Scene 03- the cameraman walks normally, but his voice is heard in reverse.

In this particular scene, the cameraman takes a seat on a bench beside a river (Figure 6-4), posing a thought-provoking question addressing the camera and seems to talk with audience directly: "Is it a pre-recorded video, or are you really sitting beside me? That is the question, the question of humankind, what is really real?" This intriguing act unfolds twice, each time in a distinct manner. However, due to several reversals and loops in the timeline, the audience undergoes the illusion of returning to the initial location and hearing the question repeated.

Figure 6. 5: Scene03 – two different seating places that mirrored to provide the illusion of repeating an incident.

In the final segment, the audience revisits the initial hill. This sequence unfolds with numerous cameras spinning around the cameraman. The camera spin, coupled with a spinning transition, transports the audience from a reversed timeline to a normal one (Figure 6-5). Within this scene, an interaction takes place between the cameraman and a passenger while the video is played in reverse order. Despite this visual reversal, the sounds are edited and played in a regular manner. Consequently, viewers witness the peculiar scenario of the cameraman and the passenger walking backward while speaking normally. This marks the first instance where the audience observes characters other than cameraman are behaving unusual. Later in the narrative, the same interaction between cameraman and passenger is repeated, this time in a normal timeline for both video and sound.

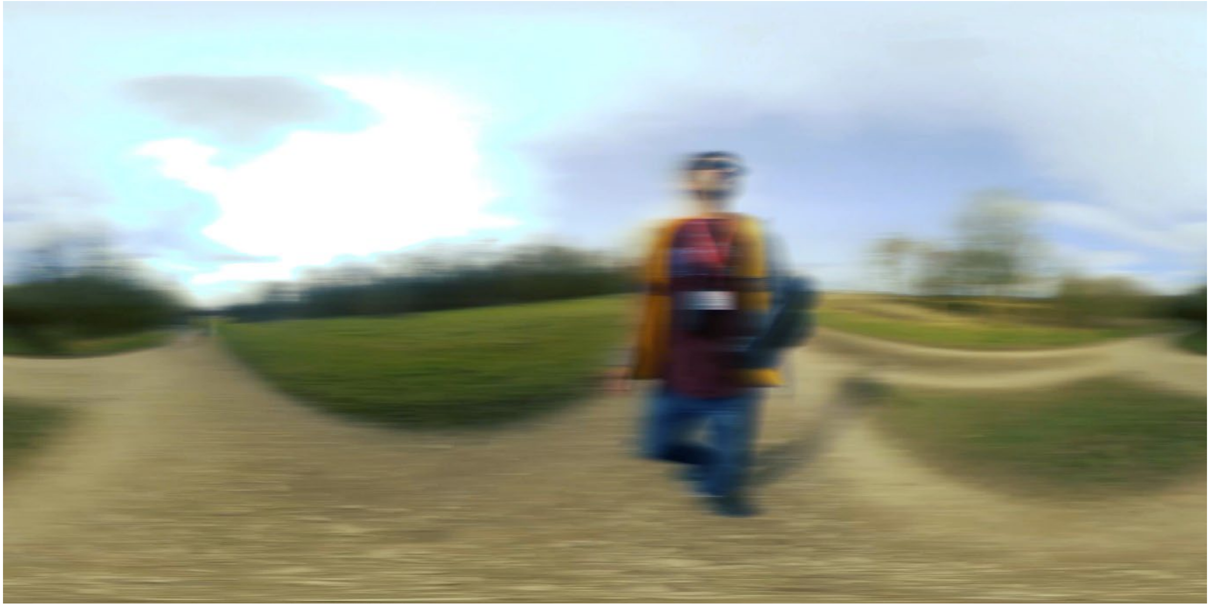


Figure 6. 6: Scene04- spinning camera motion mixed with spinning transition.

6.2.2.2. Shooting, and designing camera movements.

For filming, an "Insta360 One" camera is employed, offering 5.6k video quality paired with stereo sound. However, a drawback of this camera is its limited video quality, leading to occasional blurry images, particularly evident during certain camera movements when the camera initiates spinning, causing a reduction in picture quality due to motion blur effects. Despite this limitation, the lightweight nature of this compact camera facilitates the design of a broad spectrum of movements in various directions.

To address these considerations, four distinct conditions for the camera are devised, encompassing:

i. Still Camera: Applied when the cameraman is seated on a bench in the first, third, and fourth sequences.

ii. Straight Movement: Implemented when traversing walkways in all four segments.

iii. Change in Camera Level: Involves altering the camera's elevation from top to bottom and vice versa. The camera remains at a low level around the cameraman's foot or at a higher level on top of the cameraman's head for a duration before continuing to change the level.

iv. Camera Spinning: Encompasses spinning while the cameraman is positioned in the centre of the circle. Additionally, the cameraman yaws the monopod, effecting a 360-degree rotation for the camera in the first sequence and during the final scene while seated on a bench.

6.2.2.3. Video and Sound Editing

The movie is edited and colour-graded using Adobe Premiere Pro. Editing posed a significant challenge, particularly in designing transitions and cuts between immersive shots. To ensure a seamless viewing experience, continuity in the camera's movement direction is maintained across all cuts and transitions, preventing jarring jumps and preserving the audience's immersion.

Four distinct transitions are crafted utilising Adobe Premiere's immersive video effects: Glitches, Mirroring, Chroma Flash, and Spinning. Each transition is intentionally designed to align with specific concepts in the story:

i. Chroma Transition: Functions as a jump-cut, indicating the passage of time.

ii. Glitch Transition: Utilised to transport the audience to a different environment. Minor glitch effects precede the transition, serving as visual cues that signal an imminent change in the environment, preparing the audience for a shift in the immersive space.

iii. Mirroring Transition: Applied to reverse the time representation in the second and third scenes.

iv. Spinning Transition: Deployed in the first and fourth sequences, this transition is integrated with camera spinning to alter the direction of the video display.

These transitions, strategically are chosen and applied, contribute to the narrative flow and visual coherence of the film. The deliberate use of each transition type aligns with the storyline, providing a nuanced and purposeful visual experience for the audience while ensuring a smooth and engaging cinematic journey.

6.2.3. Participants cohort

The test is made accessible to the public for an immersive experience through a booking system. Participants engaged with the movie using an Oculus headset and were subsequently prompted to fill out a questionnaire and survey. The audience's perspective was captured through the "Oculus Cast" and recorded as an mp4 video, which was later utilised to document their behaviour in a descriptive format.

A total of thirty participants were invited to partake in the movie experience and to complete the survey. The participants are ranged in age from 18 to 54, with a majority (56%) falling within the 18 to 25 age bracket. Among the participants, 76% were male, one identified as non-binary, and six identified as female.

In terms of familiarity with virtual reality (VR) content, participants predominantly reported being non-experienced or having limited experience.

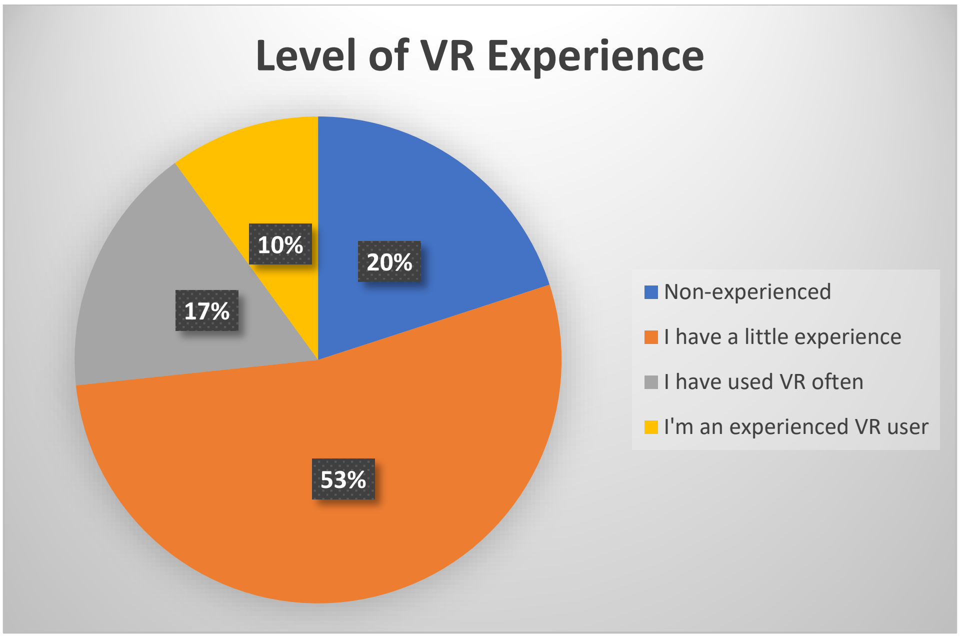


Figure 6. 7: Level of VR experience for participants.

6.3. Data

6.3.1. Reliability analysis for quantitative data

To assess the reliability of the quantitative data collected from a group of thirty participants, a "Cronbach alpha" (Bonett and Wright, 2015) is applied. This measurement focuses on four distinct factors measured by the ITC-SOPI questionnaire[19]. The calculated Cronbach's alpha of 0.778 suggests internal consistency and a high degree of reliability in a satisfactory level for the instrument.

The total alpha variance, a crucial indicator of score dispersion within the dataset, is determined to be 2271.06. This value reflects how much the investigated factors contribute to the overall reliability of the instrument, with a higher variance indicating greater reliability. Additionally, the sum of variance across the four factors is calculated to be 946.61, providing insights into their collective impact on the overall reliability of the instrument. Understanding the distribution of variance across factors offers valuable insights into their specific contributions to the reliability of the entire measurement tool.

6.3.2. Qualitative Data

6.3.2.1. Semi-structured Survey

The semi-structured survey, administers after the ITC-SOPI questionnaire, comprises nine questions focusing on participants' memories and feelings from the immersive movie experience.

[19] Find the reliability analysis sheet in the Appendix VII – ICT-SOPI Questionnaire Result – Second Experiment.

For the memory-related questions:

1. Describe an Image you remember from the experience.

Participants are prompted to describe a specific scene from the movie, emphasising details like people, objects, colours, lights, sounds, or dramatic incidents they recall.

2. List Elements in the scenes that you remember from your virtual journey:

Participants provide a comprehensive list of elements remembered from the entire experience, encompassing what they saw and heard.

3. Which Seating place is repeated during the experience?

A quiz-style question evaluates participants' engagement with the narrative by assessing their ability to recall seating places repeated during the journey.

These three questions serve to assess participants' memory engagement, offering insights into the type of memory system that is used, associative or rule-based, and how well they retained information over the experience period.

For the feelings-related questions:

1. what was the most interesting thing in your experience?

Participants reflect on the most interesting aspect of their experience.

2. what annoyed you during the experience?

Participants share any elements that annoyed them during the virtual journey.

3. What feeling you had experienced during the experience?

Participants directly express the range of feelings they experienced during the journey.

These questions contribute to an overall understanding of the experiential quality. When compared with quantitative measurements from the ITC-SOPI questionnaire and the description of viewpoint, they enhance the interpretation of factors influencing engagement and adverse effects.

An additional question specifically addresses the feeling of duration for whole experience. Researcher is instructing participants not to guess the movie's duration but to describe how long they felt the experience lasted.

In the end, two open-ended questions seek participants' opinions on whether they watched the movie to the end and invite them to add any additional comments on their experience. These questions provide personalised insights that, when compared with other responses, aid in a nuanced interpretation of feelings and engagement.

6.3.2.2. Viewpoint Description Form

Additionally, a Viewpoint Description Form, utilising video files recorded from each participant's perspective. This form outlines audience reactions to camera movements, transitions, effects, character interactions, and dramatic events.

The form provides a qualitative breakdown of the primary areas that participants focused on during their experience. It explores the interaction of participants with certain visual elements that are consistently present in the movie, such as the main character, the cameraman, and the monopod attached to the camera. Additionally, moving objects in the scene, like people and a river, can capture participants' attention. Thus, the audience's interest in moving objects is accounted for in each participant's list of main areas of interest.

Moreover, specific elements prompt sudden attraction during the experience, including dramatic incidents, moving objects, character interactions, dialogues, and sounds. Instances of sudden head motion and changes in viewpoint are detected and detailed in the form to identify such elements.

In this movie, narratives are unfolded by reversing the timeline for both video and sound. Audiences discern the abnormal situation through the actions and dialogues of the cameraman. An explanation of participants' behaviours describes observation trends at moments when the cameraman is (a) acting backward and speaking normally, (b) acting normal and speaking backward, (c) acting backward and speaking backward.

Focusing on the cameraman and reacting to his actions signifies increased engagement in the narrative and an effort to unravel it. Participants, as they engage more, become more curious about the cameraman's actions as the movie progresses. The cameraman, as the body beside the camera, preserves the identity of the storyteller throughout the movie. Manipulating the timeline places the cameraman in the role of a dramatic element, acting as a cue for reading the narrative.

Furthermore, an explanation provided which describes changes in participants behaviours over time as they unfold the narrative during the experience. Progressing in reading the narrative, the research investigates how participants concentrate more on the cameraman's voice and actions while exploring the surroundings to identify the cameraman in a spatial geometry that dynamically re-oriented by camera movement. Consequently, participants' reactions evolve over time as they find ways to adapt to camera movements and focus better on actions and reactions between the cameraman and other elements of the story world.

However, participants' engagement in the narrative can be justified by their survey responses. Comparing their remembered elements from the experience with their reactions to the cameraman's reverse and normal actions reveals the extent to which they successfully understand the entire story and interpret the deconstructed linear timeline.

6.4. Method of analysis:

6.4.1. Codes and memos

The first step in analysis involves initial coding, which is accomplished by identifying patterns of action and reaction in the viewpoint forms and the responses to open-ended questions from the audience. Both of these sources contribute data-driven codes, offering a preliminary analysis of how participants are responding to dramatic events.

The quiz question asked participants to recall how many seating places were repeated during the journey aim at gauging participants' understanding of the narrative quality. While the answers provide insights into the extent of participants' memory recall. The correct response involved identifying two different benches—one in the last scene at top a hill with a landscape and the other beside a river. Participant responses were categorised into three groups: (a) correct answers, (b) sensible answers, and (c) a larger group providing nonsensical responses. Some participants couldn't recall sitting somewhere during the experience, while others simply answered "benches." Nonsensical responses suggest participants may need more time and effort to analyse the surroundings while immersed in the movie. Conversely, those with correct or partly correct responses utilised a rule-based retrieving process, showcasing a better quality of narrative engagement.

Furthermore, participants' behaviours in tracking the cameraman's actions and sounds are observed to assess their ability to comprehend the narrative. The viewpoint form documents participants' reactions to the cameraman's reverse or forward walking and talking, his questions during the movie, and his interactions with others in the last scene. This behaviour analysis indicates the extent to which a participant follows the narrative and how successfully they synchronise with camera motions to focus on the relevant surrounding area during dramatic incidents.

In the second and third scenes, the cameraman walks and talks backward. The initial reverse walking occurs after two minutes, marking the first unusual situation for participants. In response to this dramatic incident: (a) some participants didn't recognise the action, exploring the surroundings while the cameraman was out of their field of view, (b) however, most of participants realised the cameraman's reverse walking and talking in the third scene. (c) many checked the cameraman's forward movement, indicating an attempt to confirm the reverse walking, (d) some stayed focused on the cameraman after realising the unusual situation, (e) others investigated the surrounding environment, perhaps seeking more reverse actions or assessing the impact of reversing the timeline on the peripheral environment. Although both groups d and e successfully understand the narrative, the former demonstrates a quicker ability to read and analyse narratives.

Moreover, different participants' reactions to normal walking and reverse talking creating a challenge between the credibility of visual information from the environment and the abnormal cameraman's voice. Participants fall into two groups: (a) those who show no interest in the cameraman's reverse speech and keep exploring surrounding and, (b) the group that focused on the cameraman, either briefly or until the end of the shot. Both cases are coded as participants who recognise the contradiction between sound and video display, indicating successful engagement with the dramatic incident.

The most impactful contradiction between video and sound timelines occurs in the last scene, after eight minutes being into the virtual journey. Participants encounter the cameraman and others walking in reverse, engaging in a normal conversation, saying "good morning." This plot point prompts audiences to reconsider the entire experience, marking the first interaction with another person in the movie who mirrors the cameraman's unusual behaviours. All participants, except those who ended the experience earlier, recognised this narrative element, and their reactions reflected the emotional impact. (a) Some participants concentrated on the cameraman while quickly checking the other persons in the scene. (b) Another group, having followed the cameraman until this point, expressed more interest in other people in the scene, resisting the camera's motion to observe everyone, including two ladies walking in reverse in the background. (c) Other participants switched their viewpoint between the cameraman and the person who said, "good morning." In all cases, participants are emotionally stirred; for some, like group (a), it brings confusion, while for others, especially groups (b) and (c), it sparks excitement to observe potential interactions between the cameraman and others in the environment.

Additionally, participants' responses to the cameraman's questions or monologues, evidenced by changes in their viewpoint, are coded in the viewpoint form. This interaction occurred mainly when the audience was seated on a bench beside the cameraman. (a) Some participants checked their seating place and their invisible body as soon as they sat on the bench, focusing on the same point when the cameraman asked, "are you really sitting beside me?" (b) Some looked at the front landscape in response to the cameraman saying, "it is beautiful, isn't it?" (c) A group consistently concentrated on the cameraman and did not change their viewpoint. (d) Another group showed no responses to the cameraman and continued exploring the surroundings. It can be inferred that participants who demonstrated interest in the cameraman's voice and allow his questions or monologues to guide their viewpoint exhibit better engagement in the narratives. The participants' behaviours reflect their curiosity in unfolding the narrative, as the cameraman serves as the sole source to reveal the story in this movie.

6.4.2. Provoked emotions

The narrative adopts an irregular temporal representation to induce confusion by creating a disparity between the video display's direction, sound, and manipulation of the movie's timeline. Meanwhile, background music predominantly induces a relaxed mental state in most scenes. The shooting locations showcase various natural settings, with the cameraman noting their beauty towards the end. Immersing oneself in this natural environment, accompanied by soothing music, can enhance relaxation effects. However, the maintenance of this calm state of mind depends on how effectively the audience copes with the camera's movements**.** In this respect, participants' emotions are coded based on their responses to questions about their feelings and the aspects of the experience that they found interesting or annoying.

6.4.3. Remembering elements.

Participants' recollections encompass a broad spectrum of elements, including objects, colours, character traits, interactions, sounds, and dramatic incidents. The responses from participants provide insights into the depth of their engagement with the virtual system. These answers illuminate how individuals attempted to remember their journey and gauge their success in discerning dramatic elements across different scenes. This information offers the researcher valuable insights into the extent of participants' narrative engagement, highlighting the involvement of various senses, such as sight and sound, in perceiving the virtual system.

In this regard, participants are categorised as; (a) One group of audience specifically recalled only the sounds and general atmospheres of the scenes. (b) Different group mentioned focusing on moving objects, as well as the actions and reactions of the cameraman and other characters in the movie. (c) Some participants expressed curiosity about the colours and lighting, (d) while another group remembered a list of various objects from the movie.

The initial analysis unveils a direct correlation between each group of participants and their perception of duration. This correlation suggests a connection between the memory retrieval process and the sense of duration, justifying the categorisation of participants based on their feelings toward duration.

6.4.4. Selecting Extract for Analysis

The codebook provided for narrative engagement, categorises all the relative data into (a) data gathered from the survey, which includes codes for remembering elements, enjoyable elements and annoying incidents, (b) an average of ITC-SOPI scores for five groups of participants categorised based on their feeling of duration, and (c) the codes that extracted by observing similar trends in audiences' behaviours in reaction to narratives. (d) Moreover, a list of the audience's feelings is coded into five categories of the feeling of duration.

6.4.5. Analytical categories

To classify participants' feelings about duration, the study establishes five qualitative states:

(a) Individuals who perceived the experience as much shorter than the actual time, assigning a number below five minutes.

(b) Participants who felt the duration is between five to nine minutes, still less than the film's actual time.

(c) Participants who provided a number close to the actual film time, ranging from ten to twelve minutes.

(d) Participants who felt the film duration is longer than the actual time, ranging from twelve to fifteen minutes.

(e) A group of participants who perceived the duration as more than fifteen minutes, termed the "much more" category.

6.5. Findings

6.5.1. Trends and similarities in each category

Four participants believe their virtual journey lasted between two to five minutes, and all of them have little or no prior experience with VR content. Throughout the experience, their focus is primarily on the cameraman, reacting to both his voice and gestures. These participants avoid making fast movements and consistently follow the cameraman, exploring a broader range of their surroundings while maintaining the camera attitude or staying fixated on the cameraman's position to prevent disorientation. In instances where they lose sight of the cameraman, particularly during transitions or changes in camera level, they diligently track the movements until re-establishing visual contact.

Guided by the cameraman, these participants actively read the story and identify dramatic components. In response to the cameraman's questions, they check their surroundings. They quickly recognise the backward timeline from the start and verify the movement direction by aligning it with the cameraman's position. Even when the cameraman interacts with other characters, these participants do not shift their viewpoint between characters but instead focus on one character.

Notably, these participants perceive the environment primarily through sounds, recalling sounds more vividly than visible items. They resist looking around and concentrate on the cameraman, except when direct to observe their surroundings or interact with others in the scene.

Survey results indicate that participants in this category had a more joyful and immersive experience. They report feelings of amazement, immersion, relaxation, and suspense. They enjoy the believability of the experience, appreciate the camera's motion blur in spinning movements, and find the transitions to different locations engaging. Importantly, none of them report any annoyances during their experience.

Another group of participants, numbering ten, perceive the duration as shorter than the actual time, estimating their experience to be between five to eight minutes. Seven of them have little experience, two are occasional VR users, and one is an experienced VR user. Their primary focus is on examining their surroundings, with occasional attention to the cameraman and reactions to his distinctive voices. Whenever they sit on a bench, their gaze remains fixed on the cameraman, and their remembered elements are limited to the visual components observed at that moment. Their curiosity leans more toward exploring surroundings than actively seeking dramatic elements or analysing dramatic movements in the scene, relying on the cameraman's movements to follow the story. Some find the realization of the reverse timeline to be an enjoyable aspect.

However, participants in this category experience disorientation due to constant exploration of their surroundings, rapid skimming speed, and the effort to quickly locate the cameraman upon entering a new scene. As the movie progresses, they adjust by focusing more on the cameraman, slowing down their movement speed to better align with camera movements. Nevertheless, they express annoyance at certain camera motions, particularly those hindering the exploration of surroundings, such as changing camera levels and spinning around the cameraman.

Feelings of annoyance, confusion, and dizziness predominated among participants in this category, indicating that exclusive focus on exploring surroundings had adverse effects on their experience.

Seven participants perceive the movie duration to be around ten to twelve minutes, closely aligning with the actual time of the movie. Among them, one has no experience, two have little experience, three are occasional VR users, and one is an experienced VR user. The commonality among them is a keen interest in exploring their surroundings to uncover dramatic elements, paying attention to the cameraman whenever they detect any unusual voice or action that could contribute to unfolding the narrative. They primarily navigate the narrative by following the cameraman but also identify narrative elements while skimming their surrounding environment.

These participants demonstrate a better understanding of the narrative when seated or moving in a straight direction alongside the cameraman. They engage more effectively with the cameraman during interaction moments, recalling elements observed at those points. They retain memories of various visual elements in the surroundings, details of the cameraman's attire and features, as well as interactions between characters and the cameraman's questions.

Most participants in this group align themselves with camera motion early on or develop strategies to avoid disorientation. Some increases their focus on the cameraman over time, slowing down their speed when skimming the surroundings to seek more narrative elements by following the cameraman. Upon entering a new scene, they consistently locate the cameraman. Less experienced users maintain their point of interest, avoiding head movements and allowing the camera to find the cameraman.

Survey responses reveal that careful exploration of the surroundings to understand the narrative intrigue them with the concept of unusual time representation in the movie. However, some experience contradictory emotions during narrative engagement, ranging from amazement, confusion, suspense, and immersion to sadness and dizziness. Experienced VR users generally have a more joyful experience, while those with little experience tolerate more adverse effects and negative feelings.

Experienced VR users particularly enjoy the unusual time representation that stimulated their senses. Most experienced users report being undisturbed during the experience, except for one who is annoyed by excessive camera spinning in the last scene. Surprisingly, one non-experienced user enjoys the spinning camera movement, even though it causes a headache due to the low picture quality.

Three participants perceive the experience to last approximately fifteen minutes, with two having little experience and one being an experienced VR user. Their focus during the immersive environment is primarily on searching for dramatic movements. They are drawn to the cameraman's voice and other characters in the scenes, recalling more general features from various environments and the overall ambience. Due to their experience, they remember additional details such as textures and colours, especially during moments of character interaction. All participants respond to the cameraman's questions and monologues, including reverse talking. Over time, they adapt to camera movements by intensifying their focus on the cameraman and slowing down their exploration speed.

While participants with little experience attempt to engage with the narrative, glitches and visual effects disrupt one participant's virtual presence, hindering their ability to follow the narrative and reducing overall engagement. Conversely, for the experienced participant, these visual effects brought joy, but the annoyance arise from camera spinning, leading to adverse effects in narrative comprehension. The spinning makes the experienced participant confused, requiring more effort to understand the unfolding events. Despite challenges, the concept of time renders the experience engaging and enjoyable for them. Participants in this category report feelings of confusion, floating, melancholy, and suspense.

Four participants perceive the duration to be significantly longer than the actual time. One estimate it at twenty minutes, two feel it was around half an hour, and one believes it lasted for forty minutes. All of them are non-experienced or have little experience in using VR content. Their focus is mainly on exploring their surroundings, and they retain some details like textures and colours from the scenes. While they occasionally miss some reverse timelines due to their extensive exploration, they consistently react to the cameraman's prompts by checking their invisible body, seating places, or landscapes.

Despite their lack of experience, participants in this category are particularly interested in the variety of natural environments, expressing enjoyment in the believability, naturalness, and full immersion of the experience. They initially skim their surroundings quickly but gradually slowed down their skimming speed over the course of the experience. Upon entering a new scene, their curiosity shift towards discovering the ambiance rather than immediately locating the cameraman. Two participants are keen on observing the sky, while another investigates all around the new scene initially. Although their primary interest is in exploring the surroundings, narrative elements captivate their attention, leading them to follow movements in the scene. The presence of a reverse timeline enhances their engagement in narrative reading, preventing aimless exploration of the diorama and adding joy to their overall experience.

6.5.2. Analysis of Findings

The findings suggest that identifying narrative elements crucial for unravelling the irregular timeline, regardless of participants' familiarity with using VR systems, enhances the enjoyment of the journey and mitigates the adverse effects of disorientation. However, the approach to reading the narrative, whether by following the cameraman as a guide or exploring the surroundings to uncover the narrative, influences the perception of duration. Those who solely follow the cameraman perceive the duration as much shorter than the actual time, while those who focus on unfolding the narrative through exploring feel it is longer than the actual time.

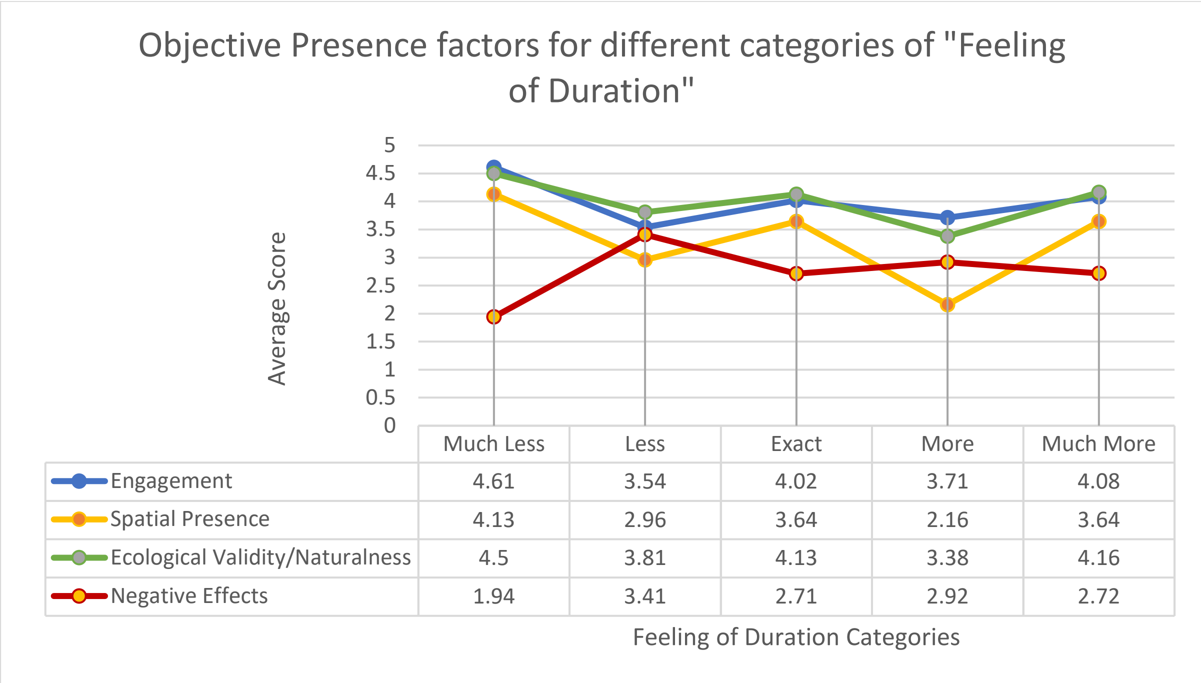
On the other hand, when participants employ both methods—following the cameraman's guidance and exploring surroundings only when prompted to focus on a specific narrative element—they perceive the duration as more accurately aligned with its actual time.

Disorientation primarily stems from aimless and rapid exploration of surroundings, particularly during camera movements such as level-changing and spinning. Scanning surroundings at a slower pace, maintaining the cameraman in the viewing area most of the time, and retaining the camera viewpoint's attitude when losing sight of the cameraman are actions that mitigate disorientation and simultaneously increase the sense of duration.

In this context, participants who purposefully explore surroundings at a slow pace, aligning themselves with different camera movements to prevent disorientation, perceive the duration as much longer than the actual time and experience less disorientation. Being more experienced in using VR content generally aids participants in matching themselves with camera movements. However, some experienced users who confidently explore the environment without focusing on the narrative experience adverse effects of disorientation, leading to feelings of dizziness. Disorientation induced by mismatched camera movements and the loss of narrative elements increases the perceived duration for experienced users but has the opposite effect for non-experienced users, decreasing their perceived duration. Therefore, it can be concluded that disorientation may impact the perceived duration based on the level of experience in using the VR system and success in unfolding the narratives.

Additionally, for participants with no experience using VR, engagement in unfolding the narrative is a critical factor that enhances the joyfulness of experiences and influences the perceived duration. If they can align themselves with camera movements to avoid disorientation and explore surroundings slowly, they find their journey more joyful and perceive a duration much longer than the actual time. These participants are more interested in exploring the natural environment surrounding them and enjoy the variety of virtual environments that appear believable to them. For them, unfolding a narrative element during aimless exploration of their surroundings increases their presence and directly impacts their perception of duration, making it longer than the actual duration.

6.5.3. Objective Presence



	Much Less	Less	Exact	More	Much More
Engagement	4.61	3.54	4.02	3.71	4.08
Spatial Presence	4.13	2.96	3.64	2.16	3.64
Ecological Validity/Naturalness	4.5	3.81	4.13	3.38	4.16
Negative Effects	1.94	3.41	2.71	2.92	2.72

Figure 6. 8: ITC-SOPI average scores for each category of "feeling of duration".

Comparing factors influencing objective presence with the perception of duration shows that higher engagement with the virtual system occurs when participants consistently follow the cameraman throughout the experience. This tends reduce the perceived duration, making it feel much shorter than the actual time. However, for non-experienced audiences interested in exploring their surroundings, camera movements can lead to disorientation, diminishing their engagement with the virtual system, spatial presence, and the perceived naturalness of the immersive environment.

On the flip side, successfully comprehending the narrative, regardless of the participant's level of VR experience, can mitigate disorientation and bring the perception of duration closer to the actual time. Therefore, the sense of duration appears to be linked to the level of narrative engagement, the adverse effects of disorientation, and the level of experience if it aids participants in synchronising with camera movements.

6.5.4. Motion sickness

Two participants experience motion sickness, leading them to end their virtual presence midway through the movie. Both participants are novices to VR, and it marked their first virtual experience.

In the case of Participant A, the experience is halted after six minutes. Throughout the encounter, Participant A is intrigued by the 360-degree video, swiftly scanning his surroundings. As indicated in his survey, the excitement stemmed from moving his head contrary to the camera's direction, resulting in dizziness, and prompting him to stop the experience. Participant A displays no notable reactions to the narrative and only recollected the ambient features of different scenes, such as fog, sunlight, and the sound of the river. Despite feeling the duration of his experience for only two minutes, he falls into the category of participants who aimlessly explore their surroundings, perceiving the duration as less than the actual time. The key distinction is that he is failed to synchronise with the camera movement, leading to motion sickness and an early termination of the experience.

Alternatively, Participant B undergoes a different experience but still encounters motion sickness, ending the experience at 4:25 minute while feeling it lasted around five minutes. Unlike Participant A, Participant B perceives the experience as longer than the actual time. Matching with camera movements and transitioning to new scenes pose challenges for Participant B from the outset. Despite attempting to focus on the cameraman to unfold the narrative and avoid disorientation, entering a new scene or losing the cameraman due to camera movements make Participant B confused, prompting him quick head movements to locate the cameraman. These rapid head movements induce dizziness and headaches, starting with the initial camera level change and spinning movements. Participant B falls into the group of participants who feel the duration is more than actual due to their inability to read the narrative effectively owing to the impact of camera movements. Comparing Participants, A and B confirms that the variance in reactions to camera movements influences the perception of duration.

6.5.5. Table of Findings

Participant Group	VR Experience Level	Involvement Approach	Disorientation Factors	Narrative Engagement
Group 1: Much Shorter than Actual (2-5 minutes)	Little/No Experience	Following Cameraman	No disorientation reported due to focusing on the cameraman and avoiding rapid movements.	Participants in this group enjoyed the VR immersion, however thy did not engaged in narrative properly.
Group 2: Shorter than Actual (5-9 minutes)	Mixed Experience	Exploring Surroundings Occasionally	Some disorientation due to occasional rapid exploration but mitigated by focusing on the cameraman at key moments.	These participants couldn't find narrative cues in their surrounding properly.

Group 3: Close to Actual Time (10-12 minutes)	Mixed Experience	Balancing Cameraman and Surroundings	No significant disorientation reported; careful exploration and balance with cameraman's guidance helped maintain orientation.	Participants in this group highly engaged in unfolding narratives.
Group 4: Longer than Actual Time (12-15 minutes)	Mixed Experience	Focus on Cameraman, Slower Exploration	Disoriented due to certain camera movements (Level-Changes and Spinning), leading to feelings of dizziness and confusion.	These participants adjusted their focus to the cameraman and slowed down their exploration, this prevents them to find the narrative elements.
Group 5: Much Longer than Actual (15+ minutes)	Little/No Experience	Extensive Exploration	High levels of disorientation reported due to extensive exploration; however, it led to enjoyment rather than discomfort.	Participants focused on exploring natural environments extensively and enjoyed their objective presence. They didn't show any interest to engage with cameraman and explore dramatic elements.

Table 6. 1: findings of VR narrative engagement for different category of feeling of duration.

6.6. Discussion

The study aims to explore whether increased involvement in narrative virtual reality (VR) transform the observer from a passive viewer into an active participant in the story. The key distinction emerged between the enjoyment derived from an immersive VR system, fostering objective presence, and the enjoyment stemming from narrative engagement, which reflects subjective presence through active participation in unfolding story.

Some participants derive pleasure from the immersive quality of the VR system, experiencing altered perceptions of time. However, a closer look at their narrative engagement reveals a lack of active involvement in deciphering story elements, suggesting their enjoyment is primarily sensory rather than narrative driven. This distinction becomes apparent when comparing participants who solely enjoy immersion and not following the narratives, show a notable difference in perceived duration compared to those who report both high enjoyment and narrative engagement.

Conversely, the group reports high enjoyment and narrative engagement, aligning perceived duration with actual time of film. This indicates that their pleasure is not solely tied to immersive quality but is intertwined with actively contributing to and deciphering the narrative elements.

This result indicates a correlation between heightened narrative engagement and a higher sense of presence, leading to a more accurate perception of time. While objective presence offers a sensory encounter, depth of enjoyment is linked to active participation in the narrative. As the narrative engagement elevates the overall quality of the VR experience, it reduces the awareness of the physical world, and blurring boundaries between the observer and the observed in virtual world, concluding the observer feels itself in the same present time as observed.

Thus, it can be said that due to freedom to explore and unfold the narratives, the user's cognitive and emotional investment in the story world increases, and result in shifting from a passive observer to an active participant, a subjective character within the story world. Hence, better narrative engagement for VR audiences offered by an agency in exploring the narrative, causes to experience filmic emotions authentically self-directed. In other words, the immersive nature of VR storytelling allows users to contribute actively to the narrative, fostering a sense of agency and emotional involvement by allowing them to explore the surrounding freely.

Moreover, the unusual timeline of the film is one of the factors that encourages participants to pay attention to the narrative. Observations of participants' behaviours reveal that they all recall the moment of cameraman interaction with other passenger while walking backward and speaking in a normal manner. This becomes a memorable moment for all of participants, contributing to their overall enjoyment of the experience, regardless of whether they actively follow the story or solely enjoy their immersion in VR environment.

This evidence suggests that the ability to incorporate non-isomorphic movements in an immersive scene, creating an impression for a real-life simulation. It is a crucial factor in motivating VR film audiences to engage with the narrative. This principle is employed in the design of the creative practice "Déjà vu" and the narrative structure "story-without-end," where simultaneous timelines of incidents and an irregular spatial design with varying gravity directions are introduced.

Building on this, the findings demonstrate that interactive cinematic VR does not require reciprocal interaction, such as real-time responses from AI characters in immersive games like *Lone Echo* (2021), or performer–audience exchange in immersive theatre, to generate a sense of being an integral part of the environment. While such reciprocal systems are central to engagement in immersive games and theatrical formats, the evidence from this study suggests that a comparable sense of presence can emerge in interactive cinematic VR through perceptual alignment and self-directed exploration alone. Limited agency, such as the ability to move, orient attention, and choose where to look, was sufficient for participants to feel embedded within the story-world without assuming control over narrative progression.

Within this context, *Déjà Vu* differentiates itself from other interactive cinematic VR films by extending this sense of engagement through its temporal design. Rather than relying solely on spatial exploration or guided attention, the work introduces a non-linear temporal representation in which multiple timelines coexist. As confirmed by the findings, this structure sustains curiosity and motivates continued exploration, allowing narrative understanding to emerge gradually through perception and movement. In doing so, *Déjà Vu* proposes an expanded model for interactive cinematic VR, where temporal indeterminacy functions as an additional mechanism for reinforcing presence, engagement, and the feeling of “being able to act” within the cinematic environment.

In conclusion, the study emphasises the transformative potential of narrative engagement in VR, showing that increased engagement enhances the perception of present time and leads to a subjective shift in the observer's role. VR storytelling's immersive and interactive nature empowers users to actively shape and experience the narrative, blurring the line between virtual and real worlds. This has significant implications for the future of storytelling in VR, fostering a profound emotional connection with virtual story worlds.

Chapter Seven: Disorientation

7.1. Research approach

Despite the fact that the 360 film, The Man Who Disorientated in Time (2022), is presented as a three-Points of Freedom (3-PoF) virtual reality (VR) experience, the camera movements generate motion across all six Points of Freedom (PoF) (Up/Down, Forward/Back, Left/Right, Pitch, Yaw, Roll). In this instance, the external world's orientation undergoes constant dynamic changes, intentionally preventing the observer from discerning the 3D dimension axes (x, y, z). Therefore, the sensation of becoming disoriented in this immersive experience is induced by the camera's continuous efforts to alter the audience's position and geometry of the immersive image.

However, the camera movements signal a change in narrative world as each kind of movement is related to a specific dramatic incident inside the immersive image. Thus, the extent to which participants engage with unfolding narratives depends on how they match themselves with camera motions. Subsequently, it influences whether this disoriented state is perceived as a pleasant or bothersome emotion, eliciting excitement or causing motion sickness. In this scenario, the audience’s effort to predict and match with each type of camera motion shows whether each motion is suitable for locomotion of a virtual body inside an immersive narrative world, or it causes adverse effects and loss of dramatic incidents.

7.2. Research questions

The research questions are as follows:

1. How does the audience find their orientation for each camera motion by match themselves with camera movement to avoid disorientation and find narratives?
2. How does each type of camera motion lead the viewpoint of the audience?
3. How does adding a guide person (cameraman) in the image reduce disorientation and help audiences to have a better narrative engagement?

7.3. Data Gathering

The research utilises both qualitative data derived from participants' behaviours and quantitative metrics obtained through the ITC-SOPI questionnaire, which measures the impact of adverse effects. Following the previous study’s methodology, qualitative data is acquired through an inductive coding process, analysing participants' reactions to various camera motions and cameraman actions during the experience.

The initial step involves tracking and coding the reactions of audiences to see how it evolves over time. Thus, participants' responses to the survey are considered to provide a more comprehensive understanding of each audience's behaviours. Following the initial analysis, all the data is then deduced to analyse the impact of camera motion on the reactions of participants, who are grouped based on their feelings about the duration and their level of experience in using VR systems.

In this context, the description derived from participants' reactions to various camera movements includes the following:

I. An explanation of how participants responded, either by aligning with or resisting, when the camera began to spin around the cameraman or twirl around its center.

II. An exploration of the pattern of scanning the surroundings when the camera's level changes. This involves examining how participants react to the camera's movement when transitioning from a low level to a higher level and vice versa. It also considers how they skim their surroundings when the camera remains at a low level, near the cameraman's foot, or at a higher level above the cameraman's head.

III. A depiction of the participants' interaction with the cameraman during moments of sitting on the bench, which occurred five times throughout the movie and when he is walking in straight line holding camera steady beside him. In these instances, the cameraman typically addresses the camera, speaks to the participants, and poses questions to them. Consequently, this section also elucidates participants' reactions to the questions posed by the cameraman.

IV. Another vital factor influencing the quality of participants' experience is their response to transitions and cuts, which involve moving from one immersive environment to another. In this movie, transitions occur frequently, signaling the audience to shift to a new scene or move into a different timeline, whether it involves a reversal or returning to the normal direction. Participants' behaviors upon entering a new spatial setting serve as an indicator of their skill to reorient themselves in an immersive movie. The viewpoint form documents the evolution of participants' reactions and changes in their behaviours over time as they navigate a new spatial location. This analysis aims to understand how participants improve their approach to finding orientation while the camera is still in motion.

The transition period is strategically designed to prepare the audience for entering a new immersive shot geometry, whether it leads to a mirrored timeline or an entirely new location. In both cases, the camera maintains its motion direction during the transition, avoiding any motion disorder for participants and preventing the loss of coordination that might result from a sudden change in movement direction.

In this context, the increasing confidence of participants during transition periods, as they position themselves within a new immersive shot, reflects their adeptness in handling camera motion and avoiding feelings of disorientation. Furthermore, insights from participants' responses to survey questions and the adverse effects scores recorded using the ITC-SOPI questionnaire contribute to justifying these participants' efforts.

V. As the immersive movie unfolded and participants spent more time engrossed in the story world, they developed a method for scanning their 360-degree surroundings. Participants engage in this scanning for various reasons: to determine their position, check the cameraman's position concerning movement direction when walking backward, scrutinise dramatic elements in the scene, or follow an object that captures their interest. At times, the cameraman prompts exploration by posing questions, and participants may also follow the direction of the cameraman's gaze. Various factors influence participants to look around.

Thus, towards the end of the form, which outlines the audience's perspective throughout the experience, there is a section that elaborates on participants' trends in scanning their surroundings. This section offers a broad overview of how participants develop their methods for experiencing the movie. This explanation serves to justify, in comparison with other sections of the form, participants' behaviours in finding their orientation and comprehending the narratives[20].

7.4. Method of Analysis

7.4.1. Codes and Memos

Regarding the disorienting impact of camera motions, survey data that has been coded with positive markers indicates the pleasurable feelings associated with disorientation or the negative effects arising from a loss of dramatic events. Viewpoint forms are employed to code diverse reactions from participants to various camera motions. Subsequently, these codes are interpreted to identify patterns in how participants align themselves with camera movements, track dramatic incidents, and tend to explore the immersive environment.

Based on the viewpoint form, matching with camera motion is categorised into several groups[21]:

(a) One specific group of participants consistently scans their surroundings rapidly throughout the experience.

(b) Some participants who initially engaged in fast scanning showed a tendency to slow down their speed as they became more familiar with camera movements.

(c) Another group of participants increasingly focused on the cameraman over time. This group used the cameraman as a reference point to orient themselves, leading to better narrative comprehension.

[20] Check Appendix X – Codebook for Narrative Engagement.
[21] Check Appendix XI - Codebook for Guiding Methods.

(d) A different group of participants tended to explore their surroundings more actively during the experience. This group found ways to synchronise with motions, enhancing their ability to scan larger areas over time.

(e) Some participants struggled to cope with camera motions and either paused or terminated their experience, particularly during moments when the camera was spinning.

(f) Another group of participants aligned with camera motion by freezing their heads whenever the camera started to spin or move up and down, altering its level. As they are reported in their surveys, some of them have closed their eye at those moments.

Considerable, each participant can be categorised with two or three codes. As a result, the collection of codes for each participant illustrates the extent to which they succeeded in aligning with camera motion and enhancing their overall enjoyment of the experience.

Additionally, participants' reactions to mirroring transitions are classified into several codes:

(a) For a group of participants, toggling between two mirrored pictures occurs either quickly or slowly. As participants become accustomed to mirrored images, they tend to slow down their head movement, enabling them to read the images and prepare for the shift from the current timeline to a reversed one.

(b) Another group of participants smoothly glides their viewpoint from one picture to the other.

(c) Some participants, who enjoy exploring their surroundings throughout the experience, specifically check all 360 degrees in the mirrored environment to locate the other edge of the mirror behind them.

(d) A distinct group of participants, when confronted with a mirrored image, identify the edge of the mirror and maintain a steady viewpoint, allowing them to simultaneously observe the cameraman and his mirrored counterpart.

(e) Finally, a group of participants fail to recognise the mirroring, as they do not watch the cameraman during mirroring transitions. Consequently, they experience jump cuts, leading to the termination of the experience for one participant who suffered from dizziness in one instance.

Another set of codes pertains to the interpretation of participants' points of interest throughout the experience. Participants exhibit one or more points of interest:

(a) For many participants, the cameraman is the primary focus consistently visible in their viewing area. However, in some cases, participants never fixate their viewpoint on the cameraman.

(b) Some participants are interested in exploring their surroundings even when the cameraman is speaking to them.

(c) For others, people in the scene capture more attention than the cameraman.

(d) Some participants find the black point indicating the camera's connection to the monopod as an intriguing object. In various instances, participants check this black point to ascertain their coordination in relation to the cameraman and the surrounding environment, especially during transitions to new scenes or when the camera spins around the cameraman.

(e) Another group of participants shows significant interest in the river in the second scene, the riverside walkway. This scene involves several mirroring transitions altering the timeline's direction. This group utilises the river as a reference point to determine their movement's direction and position concerning the cameraman, whose moving direction undergoes repeated changes.

Each individual participant is categorised into different codes, aiding in the analysis of how they became successful to situate themselves within the virtual world throughout the experience.

Another behaviour indicative of participants' ability to coordinate themselves within the virtual world and avoid disorientation is their effort to re-orient themselves upon entering a new scene. In this category of participants' behaviours:

(a) Most participants attempted to locate the cameraman as they entered the new scene.

(b) Some checked the monopod position and found the cameraman by tracing it to the cameraman's hands.

(c) Another group of participants checked the sky upon entering a new environment and then found the cameraman.

(d) Some participants kept their heads stationary, allowing the camera motion to guide them in finding the cameraman. Once found, most participants maintained the cameraman in their viewing area.

(f) Others, after locating the cameraman, proceeded to survey all new surroundings and coordinate themselves in the new environment.

(g) Finally, some participants swiftly scanned the entire new scene without focusing on the cameraman.

7.4.2. Selecting extract for analysis

The study's data are organised in a codebook (Codebook for Disorientation), which encompasses:

(a) Trends in participants' reactions to four types of camera movement: changing level, spinning, and straight movement. The process of matching these movements varied for each participant.

(b) Another set of codes represents the participant's success in matching the camera motion, indicating whether they resisted or followed the track of the camera movement.

(c) The ITC-SOPI scores for each participant are extracted to support the analysis of the positive or negative effects of camera motion and participants' efforts to adapt to these motions.

(d) It is important to note that participants' efforts to match with the camera occur over time. Thus, another group of codes pertains to the matching process for each individual.

(e) Another crucial factor in analysing the effects of camera movement in inducing disorientation is the level of VR experience for each participant, measured through their responses to survey questions about their knowledge of VR filmmaking and their experience in using VR content before this experiment.

7.4.3. Method of analysis

To investigate the impact of camera motion in guiding audiences through the virtual journey, the initial step involved analysing the influence of camera movement on experiencing disorientation for each individual participant. This analysis is subsequently justified by comparing it with their ITC-SOPI scores and their level of experience in using VR contents. This case-by-case examination offers an overview of each participant's experience quality concerning camera motions. Additionally, it provides an analysis of the methods they employ to overcome any adverse effects and comprehend the narrative when led by a cameraman.

In the next phase, the codes derived from participants' reactions to camera motions are analysed alongside those from other participants, considering their category of feeling duration. This comparative analysis aims to identify patterns in participants' matching processes by comparing behaviours within each category. The goal is to unveil relationships between disorientation, the ability to identify dramatic incidents, and ultimately enhance narrative engagement.

7.5. Findings and analysis

7.5.1. Camera’s Level-Change:

Participants who experience a much shorter perceived duration exhibit a tendency to focus on the cameraman while the camera level is changing, monitoring the camera rotation to explore the surroundings at an elevated level. This behaviour is also observes in participants with a shorter perceived duration, but in their case, they are less inclined to explore the surroundings at a higher level. Interestingly, these participants report a higher level of disorientation during camera level changes, as indicated by their scores on the ITC-SOPI questionnaire.

Participants who are reporting a duration close to the actual time of the experience maintain their focus on the camera to keep the cameraman at the centre of their attention during camera level changes. However, they engage in exploring a broad range of surroundings, both when the camera is at a higher and lower level. In contrast, participants with a longer perceived duration opt not to focus on the cameraman during level changes. Instead, they explore a wide range of surroundings, leading to adverse effects such as nuances and dizziness, as reported in their survey responses.

Furthermore, participants who perceive the duration of the experience as much longer than its actual time keep track of the camera during level changes and explore to a wide range of surroundings, primarily at a high level above the cameraman.

Comparing participant behaviours during camera level changes with their level of experience reveal that tracking camera rotation, focusing on the cameraman during level changes, and exploring the surroundings at a higher level are predominantly observed in less experienced or minimally experienced VR users. In contrast, participants with greater VR experience exhibit more confidence in exploring the surroundings during camera movements, leading to increased disorientation.

The findings suggest that gradual changes in VR user height result in disorientation, irrespective of their level of experience with the VR system. In such instances, concentrating on a stable object, such as the cameraman, serves as a reference point, aiding users in identifying position changes. This focus helps users reorient themselves within the surroundings, providing an opportunity to synchronise with the new height level and fully engage with the immersive image.

7.5.2. Spinning or Twirling Camera Motion:

Participants with a much shorter perception of duration generally follow the spinning camera, aiming to keep the cameraman at the centre of their viewpoint or directing their gaze downwards to the monopod attachment point. When other passengers appeared in the frame, they resist the camera's spinning to focus on an elderly man interacting with the cameraman. Similar approaches are observed among participants reporting an exact duration perception. This method of camera motion is identified as the most bothersome aspect of the experience based on survey responses, and only focusing on cameraman helped participants manage and alleviate the adverse effects of motion sickness.

Conversely, participants with shorter and longer duration perceptions often resist the camera rotation, turning their heads in the opposite direction to follow dramatic incidents in the scene.

Reports from participants in these categories indicate dizziness and difficulty in following the narrative, suggesting that efforts to engage with the story are hindered by the spinning camera, resulting in an unsuccessful attempt to synchronise with this type of camera motion.

Participants perceiving a much longer duration than actual time display varied behaviours regarding the spinning camera. Some follow the camera's rotation, keeping the cameraman at the centre, while others resist the motion, opting to explore their surroundings. Survey responses indicate that their exploration is aimless, akin to enjoying a roller coaster game in a theme park. Thus, it can be concluded that spinning cameras diminish narrative comprehension and induce motion sickness unless users successfully align themselves with the rotation. However, if users aim to enjoy a simulation of a theme park ride, spinning can be a source of enjoyment.

When comparing VR experience levels with audience behaviour during spinning motion, increased experience correlates with greater confidence in resisting camera rotation and exploring surroundings during such movements. Many experienced VR users note that spinning cameras distracted them, leading to a break in virtual presence. Conversely, less experienced users tend to align more with the camera's rotation and focus on the cameraman during the motion, with some experiencing high levels of dizziness, prompting them to halt the experience midway.

Interestingly, participants with higher experience levels, when uncomfortable with camera spinning and institution that enter a new scene, look downward to check their invisible body, represented by a monopod, as a method to synchronise with the camera motion. In situations where VR audiences need to follow and scrutinise narrative elements, spinning around the virtual body significantly diminishes virtual presence and induces motion sickness. However, for users seeking to enjoy virtual stimuli and experience irregular, non-isomorphic content, spinning can enhance the joy of the experience.

7.5.3. Straight Camera Movement:

The camera predominantly moves in a straight line, and participants across different categories of perceived duration and varying levels of experience exhibit similar behaviours in response to this camera motion. This movement allow audiences to explore their surroundings more extensively. Participants also observe the cameraman's walking direction in conjunction with the forward movement of the camera to determine whether the cameraman is moving forward or backward, helping them understand the video display's direction.

For participants with a much longer feeling of duration, this straight camera movement serve as an opportunity to focus on and follow specific objects within the scene. They report feeling the duration became longer, as they are highlighting in their survey the details of particular elements in the scene that captured their attention during the straight movement of camera.

7.5.4. Still Camera:

When the cameraman is seated and holds the camera still beside him, addressing the viewer and discussing their experience or the beauty of the landscape. Participants' reactions are varied regarding their category of feeling of duration. Those who felt the duration is close to the actual time and are more engaged with the narrative tend to focus on the cameraman during these moments. They are less interested in exploring the surroundings, only checking the landscape when prompted by the cameraman. On the contrary, participants who feel the duration is different from the actual time—whether shorter, longer, or much shorter and longer—explore their surroundings more extensively during these still camera moments.

Considering their level of experience, it appears that the still camera provides participants with lower levels of experience the opportunity to explore their environment comprehensively. Therefore, it can be concluded that the still camera plays a crucial role, particularly for audiences with lower levels of experience, by helping them situate their virtual body within the virtual environment. This allows them to identify themselves as part of the environment, especially when a transition happens between two different scenes help them to find themselves within the new environment, and when the cameraman directly communicate with them bring them more believability for the immersive content.

7.5.5. Table of Findings

Camera Movement Type	Audiences’ Behaviours	Impact on Narrative Engagement
Still Camera	Participants who felt the duration close to actual time focused on the cameraman.	Provides a stable reference, particularly useful for participants with lower VR experience.
	Participants with different perceived durations explored their surroundings more extensively during still moments.	Helps less experienced users situate their virtual body within the environment.
Straight Movement	Participants utilised this movement to explore surroundings more extensively.	Focusing on specific objects within the scene, enhancing attention to detail.
Spinning/Twirling Camera	Non-Experienced participants with shorter duration perceptions followed the camera to keep the cameraman in view or looked downward.	Suitable for enjoying irregular virtual stimuli but not for narrative comprehension.

	Participants with longer duration perceptions showed varied behaviour: some followed, others resisted. Experienced users showed more confidence in resisting the spin but felt distracted.	Resistance to spinning often led to dizziness and difficulty in following the narrative. It causes motion sickness and dizziness, distracting and reducing narrative comprehension unless well-aligned.
Camera Level Change	non-experience participants who perceived duration shorter focused on the cameraman, exploring surroundings at elevated levels.	Stable references like the cameraman help in reorienting and reducing adverse effects. Concentrating on a stable object aid in managing changes in height and maintaining engagement.
	Participants who explored surroundings more broadly, leading to dizziness. Experienced users exhibited confidence but increased disorientation with level changes.	Gradual height changes cause disorientation regardless of VR experience level.

Table 7. 1: Finding for impact of camera motions on disorientation and narrative engagement

7.6. Discussions

7.6.1. Designing locomotion techniques for narrative experiences in VR environment.

Given the observed disorientation during camera motions, design interventions should focus on providing users with a stable reference point, such as the cameraman. Implementing techniques that encourage users to centre their attention on a consistent element in the scene, possibly through subtle visual cues or audio prompts, could aid in reorienting users and reducing adverse effects. For users with varying levels of VR experience, a tiered approach to locomotion design may be beneficial. Novice users may benefit from guided experiences that encourage focus on a central point, while experienced users might engage more seamlessly with dynamic environments during camera movements.

To address the challenges associated with spinning camera motion, designing locomotion techniques that offer users control and predictability becomes imperative. Implementing user-controlled adjustments to the speed or intensity of the spinning motion could cater to individual preferences and mitigate discomfort.

For narrative-driven experiences, the challenge lies in maintaining a delicate balance between narrative comprehension and the thrill of the VR environment. Designing locomotion techniques that dynamically adapt to the narrative's pace, allowing users to choose between immersive exploration and a more controlled experience, can be a promising avenue.

The findings also suggest that straight camera movement provides users with an opportune time to survey their surroundings. Locomotion design strategies should leverage this by incorporating naturalistic movements that align with the narrative, allowing users to explore without inducing disorientation. Techniques such as gradual acceleration and deceleration during movement transitions could contribute to a smoother experience.

Furthermore, incorporating user agency during straight camera movements, such as providing optional points of interest or interactions along the trajectory, may enhance engagement and prevent monotony. For users with lower VR experience, creating opportunities for them to explore their virtual environment during the static scenes can foster a sense of presence and connection. Furthermore, techniques that encourage users to interact with the cameraman or elements in the scene could enhance the overall narrative experience. These principles are considered in design of locomotion in Déjà vu film. Audiences experience a real walking as the sole locomotion techniques and are able to explore all around the scene, interact with object inside the film’s setting and follow the story’s characters.

A recurring finding across participant responses was the experience of disorientation, particularly during transitions between temporal layers and spatial viewpoints. Rather than diminishing narrative engagement, this disorientation appeared to function as a productive condition, heightening attention and motivating exploration. Participants often described a desire to “understand what happened” or to locate narrative fragments elsewhere in the environment, suggesting that uncertainty became a driver of curiosity rather than disengagement. This observation supports the central design premise of *Déjà Vu*: that narrative engagement in cinematic VR can be sustained through perceptual ambiguity and spatial distribution of storylines. By resisting linear exposition and instead offering an exploratory form of representation, the work encourages audiences to actively navigate the story-world, transforming disorientation into an experiential mechanism that deepens narrative involvement.

7.6.2. The Role of the Cameraman as a "Guide Person" in VR Narratives

In immersive cinema, the role of the cameraman is often approached with the intention of minimising their presence within the scene to create a seamless and unobtrusive viewing experience. However, the findings of this research suggest a paradigm shift, proposing that in 360-degree films, the cameraman can be transformed into a "guide person" within the virtual environment, playing a crucial role in enhancing the audience's narrative engagement and mitigating disorientation.

Traditionally, in cinema, the cameraman operates as a ghostly figure behind the camera, hidden from the audience's view. In contrast, in 360-degree films, the cameraman's presence could be acknowledged and utilised as a reference point. Participants in this study demonstrates a tendency to focus on the cameraman, using them as a stable element in the immersive environment. This behaviour is particularly evident during camera level changes, where concentration on the cameraman help users reorient themselves within the surroundings. Additionally, when the virtual camera spins or twirls, the cameraman serves as a point of reference, helping users align themselves with the camera's movement and, consequently, reducing feelings of disorientation.

Also, the concept of a guide person can go beyond mere spatial orientation. The study highlights that the cameraman can act as a narrative guide, directing the audience's attention to specific elements within the scene. By using the cameraman as a focal point, users are better able to follow the story, identify key narrative elements, and enhance their overall engagement.

The moments when the cameraman hold the camera still and communicate directly with the audience emerged as significant points for exploration. Participants, especially those with lower VR experience, take advantage of this communication with cameraman. Despite they are aware that it is a pre-recoded video, they answer cameraman’s questions and react to his guidance to explore their surroundings. This suggests that the cameraman serves as a valuable tool for users to situate themselves within the virtual environment and understand their position in relation to the narrative. Thus, VR filmmakers can capitalise on the cameraman's role as a guide person to enhance the audience's experience. Techniques that emphasise the cameraman's presence, such as direct communication with the audience or strategic positioning within the scene, can be employed to foster a sense of connection, reduce disorientation, and guide users through the narrative.

This concept is explored through the design of the Déjà vu project, where the inclusion of a guide person aims to assist audiences in navigating the virtual space with varied gravity directions, enhancing their understanding of dramatic events occurring in different locations. The Architect, a character introduces himself as the virtual world's designer, serves as the guide person in this scenario. In the opening scene, he acquaints audiences with the spatial design and provides instructions for manoeuvring within the story-world. Throughout the movie, the Architect fulfils a dual role, interacting with other characters while also acknowledging the audience's presence on the film set. He addresses viewers at various points in the story, offering information about specific story elements, explaining dramatic incidents, and detailing the story world's design. According to the findings of this research, the Architect's role contributes to improved narrative engagement.

In this context, using this method, designers can employ a character to guide audiences on how to navigate the story-world, directing their attention to key elements for a more nuanced understanding of the narrative and suggesting interactions that contribute to a more enjoyable and interactive experience as free agents.

Conclusion

1. Review

This doctoral project offers an original approach to designing storytelling methods for interactive cinematic VR, setting new standards in narrative engagement and interactive storytelling. Through the lens of Gilles Deleuze's ontology of cinema and Henri Bergson's philosophy of perception, this research redefines the principles of cinematic narrative within the VR medium. The research also offers an evaluation system for narrative engagement by articulating perception process for VR audiences regarding their feeling of duration. The project's novelty lies in several key areas, each contributing to the development of a cohesive and immersive VR narrative experience.

2. Project’s Achievements

a. Novel Approach to Storytelling in VR

The core innovation of this project is the conceptualisation and implementation of a novel approach to "open-world storytelling" in VR. Unlike traditional linear narratives and current open world VR film, this model offers a new perspective on distribution of cinematic events across a three-dimensional space. This method diverges from conventional VR film viewers, positioning the viewers not just as passive observers but as active participants who their exploration within the narrative shapes the story consistency; thus, creating a unique narrative engagement framework tailored for VR.

In this context, a significant contribution of this research is the proposed definition of interaction within cinematic VR, distinct from game interaction. Interaction is seen as an exploration of space-time blocks within an endless story, allowing viewers to craft their own narrative paths and interpretations through establishing a personal regime of “befores and afters”. This concept is vital in maintaining narrative coherence while granting users the freedom to explore, thus ensuring a balanced and engaging storytelling experience.

The project offers new tools and methodologies for VR filmmakers by redefining traditional cinematic concepts within the VR context. These include:

i. The wanderer audience, who applies an interactive montage in real-time.
ii. The storyteller, who designs a regime of dramatic incidents as spatial shots structured an open-world cinema.
iii. The out-of-field of hearing, which creates a mental image that encourages audience exploration.

These redefinitions help bridge the gap between classical cinematic techniques and modern VR storytelling, providing a solid foundation for future research and creative practices in this emerging field.

Additionally, the concept of the virtual body and its role in perceiving virtual duration is central to this research. By understanding how virtual bodies navigate and interact within the VR space, the project establishes a framework for designing locomotion techniques and storyline's synchronisation methods that enhance narrative engagement. This approach ensures that viewers can maintain a sense of orientation and continuity within the VR narrative, thereby enhancing the overall immersive experience.

b. Measuring Narrative Engagement

Another original aspect of this project is the methodology for measuring narrative engagement through the perception of duration. By applying Bergson's theory of perception and the feeling of duration, this research offers a novel gauge for understanding audience engagement in VR narratives. This methodology offers robust and replicable tools for future research in VR storytelling, enabling a deeper understanding of how viewers experience and interact with immersive narratives.

The findings from the studies conducted within this project demonstrate that the perception of time in VR is crucial for narrative engagement. The studies highlight valuable insights into the perceptual conditions of VR users and shows principles for designing and synchronising concurrent timelines in an open story world to provide VR audiences with better level of immersion and emotional involvement.

c. Innovative Narrative Frameworks and the Creative Practice of Déjà Vu

The project introduces a novel narrative framework, Story-Without-End, that integrates Deleuze's concepts of the rhizome, fold and assemblage in an open story world that reflect the regime of movement-image and time-image with VR technology. This integration allows for a more dynamic and fluid storytelling approach, where viewers can navigate through a narrative that is not strictly linear but unfolds in response to their interactions. This framework supports the creation of complex, multi-layered stories that can adapt to the viewer's choices, enhancing the depth and engagement of VR narratives. By allowing for infinite exploration and interaction within the story-world, this structure provides a unique and engaging storytelling experience that encourages active viewer participation.

In this regard, the development of the creative practice "Déjà Vu" stands as a testament to the project's innovative narrative structure for open-world cinematic VR. This practice applies the findings from three extensive studies, emphasising the importance of defining virtual body and virtual duration conditions to create a cohesive VR experience. The "Déjà Vu" project showcases the original method of synchronising concurrent timelines within a 3D story-world, enabling viewers to experience multiple narrative layers simultaneously.

3. Project boundaries

The thesis lays a foundation for understanding and designing immersive cinematic VR experiences by integrating Deleuze's and Bergson's philosophical concepts. However, the boundaries of this research can be expanded as multidisciplinary research by incorporating insights from cognitive science and psychology. For instance, future studies could explore how cognitive load and sensory processing impact user engagement and presence in VR. Through using EEG devices to observe participants emotional reactions in real-time, and integrating psychological theories on memory, emotion, and attention, future investigation could provide a deeper understanding of how users interact with and interpret VR narratives. In this perspective, this research can be a foundation for developing more nuanced and effective design principles that enhance the immersive experience.

Furthermore, studying perception and its relationship with body can be extended by examining other philosophical and theoretical perspectives. Incorporating theories from phenomenology, such as those by Maurice Merleau-Ponty (1908-61), could offer valuable insights into the embodied experience of VR users. Additionally, incorporating latest media studies theories and use-cases for Artificial Intelligence (AI) in immersive storytelling could help analysing the cultural and societal implications of VR storytelling.

Overall, the multidisciplinary nature of Interactive VR storytelling could bring different aspects to expand this research project and lead to the creation of more engaging, inclusive, and impactful VR experiences, pushing the boundaries of what is possible in immersive storytelling. Pursuing further research on perceptual process of VR audiences in any of these aspects also will benefit the improvement of the evaluation system suggested for narrative engagement in this project.

4. Potentials for More Development

4.1. Suggestions for Future Research

The methodologies and findings from this project can offer a valuable framework for studying audience perception in other immersive medium such as Mixed reality (MR) and Augmented Reality (AR). For instance, in MR, virtual events are augmented into the physical world, creating a dynamic interaction between virtual and actual timelines.

As MR technologies immerse users in a world of multiple layers of realities, the impact on audience perception of their identity in relation to layered realities is noteworthy. Experiencing different pre-recorded timelines in the surroundings influences the user's understanding of real-time and may affect their cognitive ability to distinguish incidents happening in the present time in the actual world. Therefore, an investigation could be conducted to apply the proposed method of measuring consciousness, observing participants' efforts to distinguish virtual objects from actual realities in a situation with several timelines of events layered through an MR device. This integration can result in audiences experiencing multiple timelines concurrently, which can significantly affect their perception processes.

One potential avenue for developing this research project involves testing the hypothesis that setting the "feeling of duration" as an indicator of "narrative engagement" for a mixed reality condition is valid. The methodologies developed in this project, particularly the focus on the feeling of duration and narrative engagement, can be applied to this study. For example, the result benefits the advertising sector of the immersive industry by offering an accurate evaluation system for user engagement, simply by asking participants about their perception of the duration at the end of the advert clip. Understanding how audiences perceive and interact with these concurrent timelines can help in designing more coherent and engaging MR experiences.

Future research can also explore how the cognitive and emotional engagement of audiences can be enhanced in all kinds of immersive applications. By studying how different narrative structures and interaction patterns influence audience perception and engagement, researchers can develop more effective storytelling techniques that cater to diverse user needs and preferences. This can lead to the creation of more personalised and emotionally resonant immersive experiences. An area for potential research lies in investigating the impact of virtual environment design with irregular gravity directions on audience engagement with the narrative by observing their behaviours and scanning their emotional responses in real-time using EEG devices.

The findings from this research also highlight the need for ethical regulations in immersive storytelling, particularly in MR applications. As immersive technologies continue to evolve, it is essential to establish guidelines that ensure the safety and well-being of users. This includes addressing issues such as disorientation, motion sickness, and the psychological impact of prolonged immersion in virtual environments. The methodologies developed in this project can help in defining these ethical regulations, providing a framework for responsible and user-cantered design in immersive storytelling regarding the adverse effect of immersion on perceptual process and cognitive abilities.

4.2. Practical development

4.2.1. A Discussion on Identity, Location and Interaction in Déjà vu Movie

In the context of a virtual reality (VR) experience, the primary impact of full-body immersion in a virtual layer of reality is the immediate need to reconstruct an individual's identity which determines by the means for of perceiving changes in the surroundings. Consequently, identity becomes intertwined with the duration of movements that proceed changes in a given location.

Furthermore, this identity is modified and shaped through time by the abilities for interactions with the surrounding environment, which is initially triggered by the perception of the duration for the changes in the location.

In essence, the design of durations, whether they follow a regular or irregular pattern, plays a pivotal role in storytelling within a virtual immersive environment. Additionally, empowering users with the agency to manipulate these durations emerges as a critical factor influencing audience engagement and shaping their interaction with the narrative.

On the contrary, in traditional cinema, the relationship between location and narrative is reciprocal, with the narrative influencing the set design for the location of a dramatic incident and the location's boundaries shaping modifications to the story, characters' actions, and camera motions. However, this dynamic takes on a different form in immersive media. In immersive media, such as virtual reality (VR), the location is a computer-generated 3D environment designated for the pre-scripted story. This means that storytellers can intricately define the details of set design within the script. In this context, virtual locations gain significance for storytelling by representing geographical and dynamic features that have no real-world equivalent. These features profoundly impact audience interpretation of the story.

Therefore, unlike conventional cinema where the set designer chooses and designs a specific location to enhance the story, in VR cinema, artists focus on designing the 3D space to incorporate unrealistic dynamics and geometrical properties, enhancing the immersive experience for users. This creative process plays a crucial role in designing the virtual environment for the Déjà vu project. In this project, it is considered that making all locations observable at all times, by placing them on the interior surface of a cube, affects the audience's interpretation of the story and their identity as a part of story-world.

Moreover, in the design of the virtual environment for the Déjà vu movie, the consideration is given to providing three different gravity directions dynamically. This involvement of audiences in finding their spatial position within the virtual world aims to reduce the negative effects of disorientation, requiring continuous intellectual effort to redefine their position with the surrounding changes.

Furthermore, VR experiences are categorised into two main types: Location-Based Experiences (LBE) and Non-Location-Based Experiences. This categorisation determines whether the virtual experience demands on-site participation or can be experienced from any physical room. Location-based experiences necessitate specific props positioned at designated locations, while non-location-based experiences primarily involve virtual elements without the need for physical counterparts. These experiences can be encountered in various modes, including a seated experience, a standing experience with teleportation techniques for locomotion within the virtual environment, or a room-scale experience requiring a specific size of an empty room for real-walking, supplemented by teleportation techniques for movement within the environment. Each of these situations for designing the location of a VR experience has a distinct impact on the perception and self-identification of users, resulting in varying levels of narrative engagement and interaction.

In this context, the Déjà vu project presents a Non-Location-Based Experience, immersing audiences in a fully virtual environment that can be encountered in any physical room. However, by introducing a substitutional reality involving the addition of a physical chair to the movie's props and compelling audiences to physically navigate the story-world, the experience demands a specific design of the physical location. Thus "Déjà vu" challenging the concept of location-based experiences, rendering a semi-location-based experience that can be experiencing in any physical space; however, demand a space arrangement.

This research shows that self-identification and interacting with a story's location is what sets cinematic VR storytelling apart from traditional cinema. It concludes in a different approach to the concept of location in cinematic VR from that in conventional films. In this regard, the development of creative practice Deja' vu presents a semi-location based substitutional reality by connecting the physical space with the virtual world and challenge the concept of location for cinematic VR. This approach allows for the development of a mixed reality version of Deja vu that can either rely on a specific location or be experienced without being tied to any location. The project holds developmental potential through the incorporation of Mixed Reality (MR) technology.

4.2.2. Mixed Reality for Designing Substitutional Reality

MR technology, an emerging immersive technology, facilitates the blending of virtual worlds with actual locations, challenging the conventional concept of location in the design of location-based experiences. MR technology redefines this concept by proposing both portable location-based experiences and local non-location-based experiences. In a scenario where virtual objects which representing the narrative can be assigned to particular physical counterparts (e.g., TVs, windows, chairs) in any physical room, a substitutional reality is created, offering a location-based experience as it requires a physical room with specific objects. However, it is also portable, as it is accessible in any room with those objects. Simultaneously, this substitutional reality qualifies as a local non-location-based experience, as users experience various formats of locomotion based on the size of their room and the arrangement of physical objects inside their physical space.

In this context, the design of the virtual space for the Déjà vu movie can be adapted for MR devices, allowing audiences to choose physical counterparts for chairs and doors in the scene and position three parallel universes on their room's walls or ceiling. This alteration leads to a distinct interpretation of the story due to the changes applied to the movie's location.

4.2.3. Updatable Cinematic VR using NFTs and Generative AI

Significantly, within the narrative structure of Déjà vu's story-world, spatial shots are tied to the characters' journeys. Viewers can simultaneously observe all spaces, with shots separated by the characters' movements between different locations. The imposition of a cinematic cut occurs when a character enters or exits a location through a door, as characters serve as narrative threads essential for maintaining the story world's consistency. Consequently, their momentary disappearance signals a disruption in the connection between parts of the story-world, creating a "block of disappearance" that remains unobservable in the depth-of-field and does not imply any out-of-field of presence.

In the context of this project, further research and creative design can be conducted to engage wanderer audiences in the realisation of these blocks of disappearance, transforming the story-world into a reprogrammable environment-image and resulting in an updatable interactive VR movie. Audiences' collaboration can be facilitated by introducing a mechanism for minting NFTs to purchase virtual space and compose their stories, which can subsequently be generated using AI art generators[22]. This approach holds the potential to incorporate NFT and generative AI technologies in advancing an updatable version of Déjà vu, developed collaboratively with its users.

4.2.4. Marketing strategy for parallel universes

Breaking down an infinite story into three simultaneous timelines and placing these parallel universes on the interior surface of a cube, making them observable but not audible, opens up opportunities for marketing this story world through the sale of transportation abilities. For instance, a user can enter one of the three parallel universes as a starting point and experience that storyline for free of charge. However, to transport to the other two locations, a fee is required. The absence of audible character voices in the two other spaces, despite the visibility of their journeys between locations, underscores the interwoven nature of the three storylines and encourages audiences to purchase access to the additional locations.

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[22] Large language models that trained on millions of data points are used to create AI art generators. This data is used by these models to process a request and generate the desired response. AI art generators can then accept written or visual suggestions and generate new text, images, or audio clips for marketing materials, music videos, and professional websites, among other mediums. Recent development in AI art generator offers text to 3D modelling and animation creation language models which currently under development by capital companies like Autodesk, and Adobe as well as startups like Spline.ai. (For more information look at <https://spline.design/ai>)

In this context, the design of Déjà vu's space and the proposed structure of the story, Story-Without-End, present a novel strategy to incentivise audiences for in-app purchases. This approach can be replicated for other VR cinematic experiences that incorporate the principles derived from this practice-based research.

4.2.5. Ethical considerations

The ethical considerations surrounding the proposed method to develop the Déjà vu project are complex and require careful examination. A key ethical issue is related to user engagement strategies, particularly the use of in-app purchases to unlock additional locations in the virtual story-world. While monetising access is not inherently unethical, it is crucial to ensure transparency, so users are fully aware of the financial implications. The project should avoid exploitative practices that could unintentionally harm users financially.

The use of blockchain technology to mint Non-Fungible Tokens (NFTs) for purchasing virtual space also raises ethical concerns, particularly regarding environmental impact. Blockchain processes, especially in cryptocurrency, have significant environmental costs. It is important for the project to assess and try to reduce the ecological footprint of NFT transactions to align with broader sustainability goals.

The "story-without-end" structure and the exploration of three concurrent timelines within the narrative framework may affect users' cognitive and emotional experiences. Ethical considerations include the potential psychological effects of navigating complex storylines and the need for clear informed consent, possibly including age restrictions like a PGA rating.

If the project uses Artificial Intelligence (AI) models for generating content and integrating user-generated stories, it introduces ethical concerns related to data privacy and the responsible use of AI. Robust safeguards must be in place to protect user-generated content, ensuring adherence to ethical standards and avoiding unintended biases or misuses.

In conclusion, the ethical aspects of the Déjà vu project involve user engagement, financial transactions, technological innovation, and the responsible use of AI and blockchain technologies. Balancing innovation with transparency, user consent, and environmental sustainability will be crucial for creating an ethically sound and immersive virtual experience for users.

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Appendices

Appendix I- Full Ethics Form – Approved

RESEARCH ETHICS

STAFFORDSHIRE UNIVERSITY

Full Ethical Review Form

Full ethical review must be used for research involving above minimal risk and therefore necessitating a more thorough ethical review prior to approval. Further guidance on projects which involve above minimal risk is provided within the University's Ethical Review Policy.

Relevant professional body ethical guidelines should be consulted when completing this form.

Please seek guidance from the School Ethics Coordinator if you are uncertain about any ethical issues arisingfrom this application.

There is an obligation on the researcher and supervisor (if applicable) to bring to the attention of the School Ethics Coordinator any issues with ethical implications not identified by this form.

PART A: TO BE COMPLETED BY RESEARCHER

Name of Researcher:	Mohammadreza Mazarei
School:	Digital, Technology and Art

Student/Course Details (If Applicable)		
Student ID Number:	12026460	
Name of Supervisor(s)/Module Tutor:	Dr Mel LEE/ Dr Sharon COLECLOUGH	
PhD/MPhil project: ☒		
Taught Postgraduate Project/Assignment: Undergraduate Project/Assignment:	Award Title: Module Title:	

Project Title:	Interactive Storytelling for Virtual Reality Medium by Real Walking insideVirtual Story World		
Expected Start Date:	24th May 2021	Expected End Date:	July 2023

Application Checklist Have the following documents been supplied alongside this application?	Yes	N/A
Participant information sheet(s) in language appropriate to the recipient	☒	☐
Participant consent form(s) in language appropriate to the recipient	☒	☐
Letter/s of invitation to participants in language appropriate to the recipient	☒	☐

Questionnaires (only attach questionnaires that have NOT been validated previously)	☒	☐
Health related projects only: Letters giving permission for access to participants orconfirming that full LREC ethical approval is not required	☐	☒
Other relevant information (e.g. tests or product information)	☐	☒

NHS Research	YES	N/A
Will the research involve any of the following:		
• NHS patients	☐	☒
• NHS staff or premises	☐	☒
• Confidential patient information	☐	☒
• Material consisting of or containing human cells	☐	☒
• Patients who are cared for in private and voluntary sector nursing homes	☐	☒
• Exposure to ionizing radiation	☐	☒
• Medical devices that are not CE-marked or CE-marked medical devices that have beenmodified or are being used for a new purpose	☐	☒
• Investigational medicinal products	☐	☒
• Practicing midwives conducting a clinical trial	☐	☒
• Protected information from the Human Fertilization and Embryology Authority register.	☐	☒
If the research will involve any of the above, an IPR (Independent Peer Review) application should be completed INSTEAD of a full ethical review. Please contact the Chair if the IPR panelfor advice.		
The HRA (Health Research Authority) provide a tool to help identify if projects need NHS RECapproval: http://www.hra-decisiontools.org.uk/ethics/index.html		

Submission Guidance (for completion by School):

1. Project Outline

Please provide a brief paragraph indicating answers to the following questions where relevant:

i) The aims and objectives of the project.
ii) Its rationale and justification.
iii) The research question or specific hypotheses to be tested.
iv) The background to the project.
v) Where the research is to be carried out.
vi) Names of other individuals or organisations involved in the project.
vii) Whether other approvals have been gained or are to be sought.

The project's aim is to find a structure for immersive Stories in which audiences are freed from the camera viewpointand can wander inside the virtual story-world. The main difference appears in the perception’s condition for audiences. The "cinematographic consciousness" (Deleuze, 1986), which formed by the state of “Being with” the camera, shifts to a “natural consciousness” (Bergson, 2002) which is dependent on the state of “Interacting with” the virtual story-world as a perceiver with “natural perception” (Deleuze, 1986)

Therefore, the research aims to find the interaction patterns and guiding methods that help designers impose their aesthetic values to the story by leading audiences to watch the exact dramatic events and interact appropriately. Deleuze's (1986, 1989) approach helps the research find ways for designing the dramatic movements of charactersand props inside the virtual story-world in a way that the wanderer perceiver guide to have a comprehensive experience.

Firstly, the process of a natural perception in “immersing” inside the virtual environment and “transporting” into the story-world should be observed. In so doing, the first practice designed to find and measure variables for immersionand transportation.

This project uses Gille Deleuze's approach to cinema, articulated in the books; Cinema1: movement-image 1986, Cinema2: Time Image, 1989. In this approach, the relationship between the feeling of duration and the dramatic movements is an essential factor in perceiving a story. In this project's case, in which we have a wanderer audience experiencing the pre-recorded virtual story-world in real-time, the Deleuzian approach helps find good determinants of a natural perception inside the virtual world. Considering the feeling of duration as a property of natural perception helps estimate the sufficient duration for designing the dramatic events. It helps different audiences properly immerse themselves in a virtual environment and interpret the dramatic events with enough time.

Therefore, in the first practice, the research tries to find the correlation of “feeling of duration” regarding the gender, age, the rate of previous experience in using VR application and the type of engagement (the level of emotional and intellectual engagement).

In analysing the process of natural perception, the research uses Henri Bergson (2002), which discusses making a "general idea" to identify ourselves in a novel situation. The "Dual-Processing Model" (Smith & Decoster, 2000) benefits the research finds the type of audience's engagement with the virtual environment and to what extent theyuse their emotional or intellectual capacity to interpret the novelty.

Then, another practice designed to examine different interaction patterns considers the "feelings of indetermination" (Bergson, 2002) as the variable of measuring the validity and impacts of interaction with the virtual environment.

This practice aims to test how the feeling of indetermination can be raised by interaction pattern. In so doing, the practice aims to give audiences various kind of interaction with the virtual environment including; different types of locomotion (using a controller or free walking), different type of choosing (option A/B that give audiences in the specific nods of the story the possibility of choosing the following sequence between several options or giving audiences the ability to manipulate the timeline of the movie by using forward, backward, slow-motion and fast- motion options)

In interactive storytelling studies (e.g. Smed et al., 2019), the significant elements that distinguish an interactive movie from a game are generating the story, which is in real-time in games, while the chain of events in a movie is pre-recorded. Audiences have a real-time experience of virtual contents and observe the result of their choices.

There is no win/lose ending option in an interactive movie, but climax and catharsis resulting from emotional or cognitive engagement (Rothe et al., 2019). The concept that a designer (moviemaker) set as the story's theme provides audiences with a subjective connection to help them have correct interaction with the contents. However, despite the interaction pattern of a movie, the story's determination is pre-scripted, and interaction only raises the feeling of indetermination.

The approach tested in this practice is based on Henri Bergson's theory about the reality and possibility articulated in the book "Creative Mind: An Introduction to Metaphysics". He argues that our understanding of present and past impacts our feeling of "free will". The present is the duration that connects us to a specific time in the past, and our feeling of the present is the duration which this connection creates.

On the other hand, what we consider as the past is how we retrieve our memories to create our understanding of the reality we are experiencing at present. These memories can be manipulated by our brain intentionally and make a different perception of reality. Thus, to control this "intuitional judgment" (Smith & Decoster, 2000), we must change the order of thinking about the possibility and reality of events.

The habitual function of the mind is to think about the possibility of something before it becomes real (Bergson, 2002). However, whenever we change the order and prioritise the reality, we can observe an event in a new way and then make it possible by tracing a different causality in the past. In this situation, our understanding of reality depends on the interpretation, which could reconstitute different interpretation of the chain of events when we are retrieving memories. Bergson says this way of thinking raises the feeling of indetermination.

Therefore, the research uses this approach to create a practice divided into two parts. First, audiences choose option A/B to proceed with the story, and in the second part, they can manipulate the timeline of the movie using different buttons to backwards or forward. However, the story's determination is still inevitable as the practice's central concept. The feeling of indetermination would be measured in each part, qualitatively and quantitively, by EEG devices, eye-tracking pose-estimation during the experience, and a short interview afterwards. A behavioural analysing approach (Bouvier et al., 2014) uses to measure their “feeling of indetermination” raises by interaction comparing the impact of other variables, including the level of presence and level of emotional and cognitive engagement.

Practices are short (around 10 to 15 minutes) interactive or non-interactive VR movies that examine “feeling of duration” and “feeling of indetermination” and their correlations, using questionnaires, surveys and short interviews after the experience and eye-tracking, pose-estimation and EEG data gathering during the experiencing of practice. Overall, the research tries to find the answers to these questions:

1. How natural perception works inside the virtual story world?
2. What are the tools of storytelling in an interactive VR movie with wanderer audiences?
3. How interaction results in a better feeling of indetermination?

The researcher has permission to use the questionnaire just for educational purpose and should send a copy of the answers (without personal information) to the company in return. Also, the i2 media research ltd would be acknowledged in the publications of results that use their questionnaire as a term of use.

2. Research Procedure

Please provide a summary of the procedures that will be followed when carrying out the research projectunder the following headings.

a) The design of the project (including, where appropriate, issues of statistical power):

The procedure is firstly experiencing a VR movie and then answering an on-line questionnaire or taking part in an interview. The movies are a non-interactive one for the first practice and an interactive one for the second practice. The questionnaire is in three parts and asks the feelings and thoughts of participants during and after the experience.The first two parts of the questionnaire (Part A and B) uses the framework of a set industry recognized questionnaire.The ICT-SOPI questionnaire, by "i2Media Research Ltd." is used with the full consent of the company, and is used forpart A and B of the process. The ICT-SOPI is a standard five-point Likert questionnaire that gives a quantitative measurement for the presence in Virtual Environments. The researcher uses this questionnaire to compare the level of presence as a correlation for the feeling of duration.

The third part (Part C) is an open-ended structured questionnaire that asks audiences short descriptions about their memories and feelings from different scenes, their analysis of events and the feeling of duration for a specific scene.(for more details, please read the appendix "Questionnaire theoretical structure and research breakdown")

The interviews are unstructured, one-to-one surveys about audiences' emotional experience and the images they remember from that experience. The reason for their choices and the satisfaction from the results of their choice are asked.

b) The procedures to be followed:

For the non-interactive practice, a short VR movie of ten minutes includes a sequence containing three different scenes is provided. Due to Covid-19 guidance, the movie distributes on the YouTube platform, which is easy to access and allows the participant to watch at home. The invitation letter will be published on social networks, LinkedIn, Facebook and Twitter, or sent to participants directly via email, including a link to a page that contains consent agreement, disclaimer information and instruction for filling in the questionnaire. it includes a YouTube link to watch the movie and an anonymous link leads the participant to the questionnaire on a Qualtrics page under the Staffordshire University domain. Based on the Qualtrics calculation, the questionnaire takes ten minutes to complete.

The interactive VR practice is an experience consisting of a eleven minutes real walk inside the virtual story-world. Audiences are invited to the VR room-scale 'pods' based in (S113), Mellor Building, Stoke Campus.

Data is gathered using HTC VIVE eye-tracking and pose estimation kits, alongside EEG devices. Face-covering and social distancing is mandatory, and every room utilized will be used for one participant or participants from the samehousehold. A full clean of all equipment and materials will take place after each individuals participation in compliance with Covid regulations.

After experiencing the interactive practice, participants are asked to independently attend a short one to oneinterview.

c) The participation of people or animals in the project:

The participants of the research are all human.

d) How the design of the project and the procedures followed are likely to assess the research question ortest the hypothesis in question or establish some significant result:

In the first practice (non-interactive one), the first and last scenes are a time-laps of a sunrise and sunsets, which rolls in around three minutes. The participants experience this fast change in the time inside a room by change in the luminance. The goal is to immerse participants in an unusual day-time duration and observe their understanding from the actual duration. The second scene is a still-frame of a graveyard, but the participants hear the sound of movements around them. The aim is to observe the impact of eyesight and hearing in the feeling of duration.

Participants can walk freely in the interactive practice, change the movie's speed, use the backward and forward button, and transport in different spaces by their choice. Finally, by touching a wall inside the virtual environment with a physical counterpart in the room, they finish the experience.

The research objective is to identify users' engagement and to qualify their dynamic behaviours from their traces ofinteractions. (trace-based approach proposed by Bouvier et al. 2014). The history of participants' actions are collected in real-time from their interactions with the story-world. Through this approach, the relationship between engagement and impact of different types of interaction (choosing between options A/B, manipulating the virtual contents, travelling in time, locomotion in space) are analysed continuously to find out how the feeling of indetermination raises relates to the joyfulness of interaction and enhance the presence.

The participants leave from virtual space whenever they touch the first virtual object (a wall in this case). Participants use their natural perception to identify the reality they immerse. In the habitual human mind function, the credibilityof eyesight and hearing information is validated using touching sense (Eckstien et al., 2019). So the impact of haptic feedback on virtual presence is examined.

e) Availability of facilities/resources/equipment to enable the project to be carried out:

Staffordshire University Media Center will provide the equipment required to make the VR movies. Adobe software and plugins provided by University will be used for the editing and post-production stage. A dedicated, password protected machine, provided for the researcher by the PGR group will be utilised to produce the moviesand save all the data securely. All data will be password protected. Other facilities, including Motion-capture studio, VR room, Greenroom, will be used by the researcher for shooting and testing the footages.

f) Procedures that will be followed if any adverse event occurs: In the first testing procedure, the movieis watched from the participant's home so any adverse The main adverse effects will not become immediately apparent unless stated on the questionnaire. Advice on what to do in the course of an adverse event is provided on the consent form.

A First aid kit will be present at every location and any emergencies will immediately be reported to localemergency services, Producer and Director. A trained First Aider will be available on site during the VR experience test. In the event of any adverse occurrence the VR interaction will be stopped, and medical assistance sought. The corresponding questionnaire page (within Qualtrics) is modified to withdraw the

incomplete questionnaire after one day.

3. Participant Recruitment & Characteristics

Please provide clear information regarding the recruitment of participants and their appropriateness tothe project:

*(**NB:** Student researchers must also ascertain from their Supervisor whether or not they require a criminal record check through the Disclosure and Barring Service (DBS) in order to enable this project to proceed. If this is the case the application must make clear whether or not it has been undertaken. Any data collection or other activities requiring this clearance must not begin until it has been obtained.)*

b) How participants will be identified, approached or recruited:

A 'Snowballing' approach across social media, will be used to attract participants to the project.

c) Whether there are any inclusion or exclusion criteria, together with their justification:

Alongside the variety of age and gender, the participants' rate/experience of using VR technologies is a critical factor in selecting the participants.
It will be necessary to observe the effects of previous VR experience in the feeling of duration and interaction withthe virtual environment in comparison to those of people with no VR experience.

d) The age range of participants; the gender balance of participants; and the participants' state of health:

The age of participants is limited to eighteen years and above. Gender information is important to establish howdifferent genders react to the VR experience.
The VR experience may cause some health issues. Information on what to do in the event of health issues has beenprovided on the consent form, alongside a 'disclaimer' informing participants of the risks of using VR technologies .

e) Whether there is any inducement to participate in the study:

No, there is no inducement to encourage participants to take part in this research.

f) How participants will be informed about the right to withdraw from participation the study (and whether time limits will be established during which a participant can request for their data to bewithdrawn from the study):

The participants are informed via a consent agreement notification that they can stop the experience andwithdraw from the study at any point throughout the process, without requiring any reason.

Also, participants can ask for their information to be removed from the database of research until one month after their participation date by contacting the researcher via the email address provided in theconsent letter.

In case of any complaint, participants can contact the email address of Dr Tim Horne, Director of Researchat Staffordshire University, details are also provided in the consent letter.

g) Whether the project involves any special groups requiring some additional justification or permission(e.g. children and young people under 18 years of age, those with a learning disability or cognitive impairment, patients, people in custody, people engaged in illegal activities (e.g. drug taking), or individuals in a dependent or unequal relationship):

No, the project does not involve any specific group.

h) Will informed consent be obtained from research participants? Yes ☒

NoPlease give details of who will obtain content and how this will be

undertaken.

The consent form, is published on the web via this link (https://vrpracticeone.myportfolio.com/). The consent form is
published in both English and Persian and states that the participant declare their consent to take part in the research by clicking on the link of the movie.

4. Information and Data

Please provide answers to the following questions regarding the handling and storage of information anddata:

a) How will research data be stored (manually or electronically)?

The data will be stored electronically on the researcher's OnDrive cloud space, under Staffordshire University's domain and the dedicated PC provided for the researcher at the University. All devices are password protected withthe password known only to the researcher.

b) How is protection given to the participants (e.g. by being made anonymous through coding and with aparticipant identifier code being kept separately and securely)?

The questionnaire and surveys do not ask the identity information from participants (their name, surname, date of birth, address) to improve participants' anonymity. Other information, which includes the participants internet IP and location will remain confidential and retained within the Qualtrics platform and only analysed on the dedicated PC.

c) What assurance will be given to the participant about the confidentiality of this data and the securityof its storage?

The consent agreement is a two-sided agreement that assures the participants of the privacy of their information.

The consent form also contains a copy of the GDPR statement and a weblink for further information.

d) Is assurance given to the participant that they cannot be identified from any publication or dissemination of the results of the project?

As part of the consent agreement, participants are assured that all personal data will be anonymous from any publication or dissemination of the results.

e) Who will have access to this data, and for what purposes?

The researcher (Mohammadreza MAZAREI) has access to data for analysis. . The supervisory team (Dr Mel LEE & DrSharon COLECLOUGH) has access to data to qualify the results and the research procedures.

f) How will the data be stored, for how long, and how will it be discarded? ☐

The data would be stored in the OneDrive cloud space and dedicated PC and will be retained for a further six years in compliance with university regulations upon completion of the PhD study.

5. Risk, Harm and Other Ethical Considerations

Please provide an estimate of the perceived benefits or outcomes of the project weighed against thepossible harms caused to the participants.

Please identify any potential risks or hazards that might be caused to participants or the researcher, inaddition to any discomfort, distress or inconvenience to them, together with any ethical problems or considerations that the researcher considers to be important or difficult in the proposed project.

The project's main adverse effect that may cause participants to leave the experience is motion sickness caused by experiencing the VR environment (primarily for non-experienced audiences). Therefore, in the consent form, the researcher recommends participants stop the experience at any time they feel nauseous or dizzy. The participant isasked to comment that they have experienced motion sickness within the questionairre.

In this research, the consequences of shifting in the perceptual condition, from cinematographic to natural, will be investigated along with the new possibilities to lead the audience's interpretation. The side effects of such an experience may remain after removing the VR headset (Wiley, 2003). Immersing an audience inside a story-world, alayer of designed reality, while he/she engage in interpreting the new reality by his/her natural perceptual process, may cause problems in recognition between virtual and actual world. Therefore, the investigated practices would also involve the designing of signs to help audiences distinguish the virtual world from the real.

In so doing, the consent letter has the role of an agreement with the audiences to make them aware that they shouldsuspend their senses' credibility during the experience, while they are wearing a VR headset. The use of, non- isomorphic events and inorganic objects demonstrate the virtual nature of the story-world.

Please explain how any potential risks or hazards will be dealt with, along with any justificatory statements. This information should highlight any remaining ethical considerations and to respond to

them in a way which may assist the Research Ethics Committee in arriving at some judgement upon theproposal.

All participation is on a voluntary basis and each participant is made aware of the voluntary nature of their involvement prior to taking part in this research, and they can stop experiencing the VR video at any time that they feel uncomfortable.

Has a risk assessment been completed for this project Yes ☒ N/A

6. Supporting Information

Please attach the consent form, information sheet, and questionnaire/interview questions to this application. Further guidance on the design and content of consent forms and information sheets can befound on the University's Research Ethics website.

Researcher Declaration

I undertake to carry out the project described above in accordance with ethical principles. I have completedthe application in good faith. I accept that providing false information constitutes scientific fraud and will be subject to appropriate disciplinary procedures.

Signature of Researcher:	Mohammadreza MAZAREI	Date:	09 Apr 2021

NB: Any departure from the protocol for this research project may mean that the ethical approval decision made by the School Ethics Coordinator is no longer valid and a new ethics proposal will have to be submitted. It is the responsibility of a student researcher to discuss proposed changes to the agreed protocol with their project supervisor as soon as possible so that a revised /new ethics application can be submitted. Research based on any revised / new protocol **MUST** not proceed unless and until the protocol has ethical approval.

Next Step:

STUDENTS: Please submit this form (and supporting documentation) for consideration by your Supervisor/ Module Tutor.

STAFF: Please submit this form for consideration by your Head of Department of a Senior Researcher inthe School. This form should then be forwarded to the Research Administrators in RIIS (ethics@staffs.ac.uk) who will arrange for it to be considered by two independent members of the School's College of Ethical Reviewers

PART B: TO BE COMPLETED BY SUPERVISOR/MODULE TUTOR (If student) OR Head of Department/ Senior Researcher (if staff)

I have examined this proposal and confirm that the rationale and methodology is appropriateand that it can proceed to the stage of ethical consideration.	☒
I have checked and approved the key documents required for this proposal (e.g. consent form,information sheet, questionnaire and interview schedule).	☒

Signature of Supervisor/ Head of Department/	M.J.Lee MJLee	Date:	29/04/21

Senior Researcher:	L Reynolds		09/11/2021

Next Step:

Please submit this form to the Research Administrators in RIIS (ethics@staffs.ac.uk).

PART C: TO BE COMPLETED BY THE SCHOOL ETHICS COORDINATOR

This research proposal has been considered by two members of the School's College of Ethical Reviewers and **RECEIVED** ethical approval.	X ☐

This research proposal has been considered by two members of the School's College of Ethical Reviewers and was REFUSED ethical approval on grounds detailed below: This form has been revised and approved with minor changes byProf. Elhadj Benkhelifa. All the changes have been applied, as suggested. Please approve. **Recommendation (delete as appropriate)**: Approve/ Amendments required/ Reject	☐

Signed (School Ethical Coordinator)	Agata Lulkowska	Date	9th Nov 2021

Appendix II- Participants Consent Agreement

Dear Participant!

In this research, you will experience an experimental 360 video, which is ten minutes long. You will experience it through the use of an Oculus VR headset (click HERE for more details).

Upon completion of viewing the video, or stopping it at any time for any reason, you will be asked to fill out a questionnaire and participate in a short interview. It approximately 10 minutes to answer all of the questions. The research aims to analyse data concerning your personal experience of immersion in a virtual environment. The data gathered will be used to design an interactive VR practice utilised within a PhD study.

By clicking on the button below, you will be transferred to a page to declare your consent to voluntarily experience a 360-degree movie (The Man Who Disoriented in Time!) and to share your thoughts and feelings captured through a questionnaire.

In return, the research team will keep your information anonymous to anyone except theresearcher (Mohammadreza Mazarei) and research supervisors (Dr. Mel Lee and Dr.

Lionel Jayaraj). You will not be identified in any publication or dissemination of the project results.

Your data will be stored digitally, for at least five years in a safe cloud drive under Staffordshire University's domain and on a personal hard drive only accessible by the researcher. After this period, all your data will be removed from the research materialsstorage.

The only use of the information is to measure your immersion quality in a VR space, andrelevant factors that impact your experience. Your responses will be analysed and

used for future publications about immersion in virtual reality for the good of the PhD research project at Staffordshire University, titled; "Interactive Storytelling Inside VR Medium by Real Walking Inside Virtual Story World," pursued by Mohammadreza Mazarei.

To ensure a comprehensive result, you must answer the questionnaire immediately after experiencing the movie. For the sake of the research, the research team cannot explain any details about the video and the questions in advance.

However, you are free to stop the VR experience at any time for any reason. If you feel any sickness, like nausea or dizziness, and a high heartbeat rate during the experience, it is highly recommended to stop the video and remove the VR headset immediately.

You are free to withdraw your participation in the research at any time and ask to withdraw your information from the research storage without giving a reason, up to onemonth after your participation date. You can declare your withdrawal by sending an email to; mohammadreza.mazarei@research.staffs.ac.uk.

In case of any complaint, please contact Dr Tim Horne, Director of Research at Staffordshire University; email: tim.horne@staffs.ac.uk. phone: 01782 295722. Address:E258, Cadman Building, Staffordshire University, College Road, Stoke-on-Trent, ST4 2DE

Data Protection Statement (Staffordshire University Protocol)

Your data is securely held on a server at the university, which has in place all the securitymeasures required.

The data you enter into the system will be treated confidentially and with respect. The data will not be disclosed to any external organisations except where an external body isa party to the recruitment process, e.g. funded appointments. The application data will be held within the e-recruitment system for up to twelve months before being deleted. Should you be successful in obtaining employment with Staffordshire University, the university will use your personal data for the purpose of employee personnel administration and any legitimate issues relating to your employment with the university. In doing so, the university will observe, at all times, the data protection principles embodied in the General Data Protection Regulations 2018 (GDPR).

Staffordshire University will seek your explicit permission should it intend to process anysensitive personal data for any reason other than Equal Opportunity purposes or exercising a legal right or obligation required by law. Sensitive data includes your racial or ethnic origin, sexual orientation, political beliefs, trade union membership, religious beliefs, physical or mental health and criminal offences.

For further information regarding the University's Data Protection Statement, please visit: http://www.staffs.ac.uk/gdpr

GDPR Statement

Your data will be processed in accordance with the General Data Protection Regulation2018 (GDPR). The data controller for this project will be Staffordshire University. The University will process your personal data for the purpose of the research outlined above. The legal basis for processing your personal data for research purposes under GDPR is a 'task in the public interest' You can provide your consent for the use of your personal data in this study by completing the consent form that has been provided to

you. You have the right to access information held about you. Your right of access can be exercised in accordance with the General Data Protection Regulation. You also haveother rights including rights of correction, erasure, objection, and data portability.

Questions, comments and requests about your personal data can also be sent to the Staffordshire University Data Protection Officer. If you wish to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk

Disclaimer

Using a VR headset to immerse yourself in a virtual world may cause motion sickness.Some users may feel nauseous and dizzy. For some users, it may cause a higher heartbeat rate and blood pressure. These sicknesses come from the mismatch that your brain feels between the eyesight information and your body's physical condition. Therefore, it is highly recommended that you consider your health condition before experiencing the movie (The Man Who Disorientated in Time!) with a VR headset. It isnecessary to stop the experience at any moment that you have any bad feelings.

After completing the virtual journey, you may experience a cognitive delay in recognitionof the non-VR world. Therefore, the researcher will ask you to take a break after finishing your virtual experience and before starting the questionnaire. The researcher disclaims any responsibility for any unexpected mental and physical health condition after experiencing the movie, The Man Who Disorientated in Time.

If you need support or are feeling emotionally distressed, the followingorganizations offer advice and support:

For English language participants:

1. Staffordshire University Student well-being

   If you would like to access mental well-being support at Staffordshire University, you can simply fill out the online appointment form in order to arrange an assessment appointment with our student wellbeing team.

   If you have any difficulties filling out the form or have any queries, contact the admin team by telephone on 01782 294976 or by emailing studentwellbeing@staffs.ac.uk. They are open Monday to Friday, 8.45 am – 5 pm, except for public holidays.

   If you are seeking support outside the opening hours, see Emergency and 24-hour support.

2. Samaritans

   Samaritans are available for anyone struggling to cope and provide a safe place to talk24 hours a day.

   Phone: 116 123

   Email: jo@samaritans.org

3. Shout

   Shout is a 24/7 text service, free on all major mobile networks, for anyone struggling tocope and in need of immediate help.

   Text SHOUT to 85258

Click to write the question text

Your Full Name

Email Address

Hereby, I declare my consent to participate in the PhD project research through experiencing a 360 movie, The Man who disorientated in Time, by a VR headset and sharing my brain's frequencies by an EEG headset.

- ○ I consent, I wish to participate
- ○ I do not consent, I do not wish to participate

Appendix III- ICT-SOPI Questionnaire- Original Version

Please read the instructions below before continuing

Instructions:

We are interested in finding out what you feel about the experience you have just had in the 'DISPLAYED ENVIRONMENT'. We use the term 'displayed environment' here, and throughout this questionnaire, to refer to the virtual world that you have just encountered. Some of the questions refer to the 'CONTENT' of the displayed environment. By this we mean the scenes or events, or whatever you could see, hear, or sense happening within the displayed environment. The displayed environment and its content are different from the 'REAL WORLD': the world you live in from day-to-day. Please refer back to this page if you are unsure about the meaning of any question.

There are three parts to this questionnaire, PART A and PART B and PART C. PART A asks about your thoughts and feelings <u>once the displayed environment was over</u>. PART B refers to your thoughts and feelings <u>while you were experiencing</u> the displayed environment and PART C contains both types. Please do not spend too much time on any one question. Your first response is usually the best. For each question, choose the answer CLOSEST to your own.

Please remember that there are no right or wrong answers – we are simply interested in YOUR thoughts and feelings about the displayed environment. Please do not discuss the questionnaire with anyone who may also complete it as this may affect your answers or theirs. We should be grateful if you would also complete the 'Background Information' overleaf.

All of your responses will be treated confidentially.

PART A

Please indicate HOW MUCH YOU AGREE OR DISAGREE with each of the following statements by circling just ONE of the numbers using the 5-point scale below.

(Strongly disagree)	(Disagree)	(Neither agree nor disagree)	(Agree)	(Strongly agree)
1	**2**	**3**	**4**	**5**

<u>AFTER</u> MY EXPERIENCE OF THE DISPLAYED ENVIRONMENT…

1. I felt sad that my experience was over	1	2	3	4	5
2. I felt disorientated..	1	2	3	4	5
3. I had a sense that I had returned from a journey	1	2	3	4	5
4. I would have liked the experience to continue..	1	2	3	4	5
5. I vividly remember some parts of the experience	1	2	3	4	5
6. I'd recommend the experience to my friends..	1	2	3	4	5

PART B

Please indicate HOW MUCH YOU AGREE OR DISAGREE with each of the following statements by circling just ONE of the numbers using the 5-point scale below.

(Strongly disagree)	(Disagree)	(Neither agree nor disagree)	(Agree)	(Strongly agree)
1	**2**	**3**	**4**	**5**

<u>DURING</u> MY EXPERIENCE OF THE DISPLAYED ENVIRONMENT…

1. I felt myself being 'drawn in'.	1	2	3	4	5
2. I felt involved (in the displayed environment).	1	2	3	4	5
3. I lost track of time.	1	2	3	4	5
4. I felt I could interact with the displayed environment	1	2	3	4	5
5. The displayed environment seemed natural.	1	2	3	4	5
6. I felt I was visiting the places in the displayed environment.	1	2	3	4	5
7. The content seemed believable to me	1	2	3	4	5
8. I felt I wasn't *just* watching something	1	2	3	4	5
9. I had the sensation that I moved in response to parts of the displayed environment	1	2	3	4	5
10. I felt tired.	1	2	3	4	5

(Strongly disagree)	(Disagree)	(Neither agree nor disagree)	(Agree)	(Strongly agree)
1	**2**	**3**	**4**	**5**

<u>DURING</u> MY EXPERIENCE OF THE DISPLAYED ENVIRONMENT…

11. I felt dizzy.. 1 2 3 4 5

12. I felt that the displayed environment was part of the real world............. 1 2 3 4 5

13. My experience was intense.. 1 2 3 4 5

14. I paid more attention to the displayed environment than I did to my own thoughts (e.g., personal preoccupations, daydreams etc.). 1 2 3 4 5

15. I had a sense of being in the scenes displayed... 1 2 3 4 5

16. I felt that I could move objects (in the displayed environment)............... 1 2 3 4 5

17. I felt I had eyestrain... 1 2 3 4 5

18. I had a strong sense of sounds coming from different directions within the displayed environment 1 2 3 4 5

19. I felt surrounded by the displayed environment 1 2 3 4 5

20. I felt nauseous. 1 2 3 4 5

21. I could almost smell different features of the displayed environment...... 1 2 3 4 5

(Strongly disagree)	(Disagree)	(Neither agree nor disagree)	(Agree)	(Strongly agree)
1	**2**	**3**	**4**	**5**

<u>DURING</u> MY EXPERIENCE OF THE DISPLAYED ENVIRONMENT…

22. I had a strong sense that the objects were solid..	1	2	3	4	5
23. I felt I could have reached out and touched things (in the displayed environment)..	1	2	3	4	5
24. I sensed that the temperature changed to match the scenes in the displayed environment.	1	2	3	4	5
25. I responded emotionally	1	2	3	4	5
26. I felt that *all* my senses were stimulated at the same time.	1	2	3	4	5
27. I felt as though I was in the same space as the objects………….. ……...	1	2	3	4	5
28. I had the sensation that parts of the displayed environment were responding to me.	1	2	3	4	5
29. I felt I had a headache.	1	2	3	4	5
30. I felt as though I was participating in the displayed environment.	1	2	3	4	5
31. The content appealed to me.	1	2	3	4	5

<u>If there is anything else you would like to add, please use the space below:</u>

<u>PLEASE CHECK THAT YOU HAVE ANSWERED ALL THE QUESTIONS</u>

<u>THANK YOU VERY MUCH FOR YOUR TIME AND PARTICIPATION</u>

Appendix IV- ICT-SOPI questionnaire, Copyrights and Modifications

Modification Process of ICT-SOPI Questionnaire

This appendix outlines the process of modifying the ICT-SOPI questionnaire to fit the specific research design of my PhD project. The goal was to adapt the questionnaire for use in assessing the sense of presence within interactive VR storytelling environments. Below is the description of the modifications and the communication with the right holders.

Correspondence with ICT-SOPI Right Holders

Email from Mohammadreza Mazarei to Lewis Turner-Brown (i2 Media Research)

Sun 1/24/2021 10:21 AM

Dear Dr. Lessiter,

I am pursuing a practice-based PhD project at Staffordshire University to reach a structure for making Interactive VR movies by enabling audiences to experience a real-walk inside the virtual story world. Therefore, I need to conduct several practices to test the different aspects of such an experience for audiences, all relating to varying determinants of virtual presence.

I would be thankful if you could send me the ICT-SOPI questionnaire. Depending on the correlating factors, I would make some changes in the questionnaire for different practices. Please let me know the terms of use for the questionnaire or any Non-Disclosure Agreement required.

Best regards,

Mohammadreza Mazarei

Reply from Jonathan Freeman (i2 Media Research)

Sun 1/24/2021 10:24 AM

Hi Mohammadreza,

My colleague Lewis in CC will share the usage agreement for the ITC-SOPI with you.

Best wishes,

Jonny

Reply from Lewis Turner-Brown (i2 Media Research)

Mon 1/25/2021 10:37 AM

Hi Mohammadreza,

Thanks for your interest in the ITC-Sense of Presence Inventory. To approve your use of the ITC-SOPI, please agree to the following terms:

1. The questionnaire is for research purposes.
2. It will not be distributed outside your institution without prior written consent.
3. The copyright of i2 Media Research Ltd on the questionnaire will be respected.
4. Provide us with a copy of the SOPI data you collect with a brief description of the media experience and media system.
5. Cite the following reference in any reports or publications: Lessiter J., Freeman J., Keogh E., & Davidoff J.D. (2001). A Cross-Media Presence Questionnaire: The ITC Sense of Presence Inventory. Presence: Teleoperators and Virtual Environments, 10(3), pp. 282-297.

I will send an email which will constitute written authorization to use the questionnaire for six months from the date of sending. An extension is always granted if needed.

Best wishes,

Lewis

Email from Mohammadreza Mazarei to Lewis Turner-Brown

Tue 1/26/2021 11:16 AM

Hi Lewis,

Hope you are doing well! Thanks for replying to my request for the ICT-SOPI questionnaire. I confirm that I will use the questionnaire in several practices for my PhD course at Staffordshire University. I will make some changes in the questionnaire regarding the subject of each practice, which might include adding or removing questions or using only specific parts of the questionnaire while following the original method for gathering data. I will not distribute the questionnaire outside the research team without prior written consent from you.

Best regards,

Mohammadreza Mazarei

Reply from Lewis Turner-Brown

Mon 2/1/2021 11:11 AM

Hi Mohammadreza,

Thanks for your reply and agreement to the terms of use. It is fine for you to use the measure as you wish (e.g., using only a few of the scales).

Attached are:

1. "sopi-2004copyrightnotice.pdf" - the ITC Sense of Presence Inventory

2. "itc-sopi-admin-scoring" - administration and scoring instructions

This email constitutes written authorization to use the questionnaire from today's date to 01/08/2021. An extension can be requested if needed.

Best wishes,

Lewis

Modifications Made

I made the following changes to the ICT-SOPI questionnaire due to the lack of character and ability to manipulate objects and the environment in the video. These adjustments were necessary to tailor the questionnaire to the specific needs of my research project:

1. Removed Questions: B6, B7, B8, B20, B23, B33, B36.

2. Modified Questions: B27, B34, B37.

3. Added Questions: Nine questions were added as Part C, specifically asking about feelings and thoughts regarding different scenes of the movie.

These modifications were aimed at capturing more relevant data for my research on interactive VR storytelling, ensuring the questionnaire aligned with the objectives of my PhD project.

Conclusion

The modifications to the ICT-SOPI questionnaire were conducted with the approval of the original right holders and tailored to suit the specific requirements of my research on interactive VR storytelling. This appendix provides transparency regarding the changes made and the compliance with the copyright terms provided by i2 Media Research Ltd.

Appendix V- ICT-SOPI Questionnaire- Modified Version

Description

Instructions for using the questionnaire

We are interested in finding out what you feel about the experience you have just had in the 'DISPLAYED ENVIRONMENT'. We use the term 'displayed environment' here, and throughout this questionnaire, to refer to the virtual world that you have just encountered. Some of the questions refer to the 'CONTENT' of the displayed environment. By this we mean the scenes or events, or whatever you could see, hear, or sense happening within the displayed environment. The displayed environment and its content are different from the 'REAL WORLD': the world you live in from day-to-day. Please refer back to this page if you are unsure about the meaning of anyquestion. There are three parts to this questionnaire, PART A, PART B and PART C.

PART A asks about your thoughts and feelings once the displayed environment was over. PART B refers to your thoughts and feelings while you were experiencing the displayed environment and PART C contains both types, and we ask you to prepare a short description of your thoughtsand feelings during and after the experience.

Please do not spend too much time on any one question. Your first response is usually the best. For each question, choose the answer CLOSEST to your own. Please remember that there are no right or wrong answers – we are simply interested in YOUR thoughts and feelings about the displayed environment. Please do not discuss the questionnaire with anyone who may also complete it as this may affect your answers or theirs. We should be grateful if you would also complete the 'Background Information' in the first step.

To request a copy of your questionnaire responses, please email: mohammadreza.mazarei@research.staffs.ac.uk

- ○ Start the survey
- ○ I do not wish to fill in the survey

BACKGROUND INFORMATION

Age?

Gender?

- Male
- Female
- Non-binary / third gender
- Prefer not to say

What is your parent's nationality?

Rate your level of computer experience.

- None
- Basic
- Intermediate
- Expert

Rate how often you play computer games. (tick one)

- Never
- Occasionally (once or twice per month)
- 50% or more of days
- Every day

Which media did you use for watching the content?

- VR headset

- 2D screen with a controller

Have you watched any virtual reality content before?

- Yes
- No

What was the TV or Desktop size you used for watching content?

- Small/Portable (14" or less)
- Medium (15"-28")
- Large (more than 28")

Have you viewed 360 videos or images using 2D flat screens (e.g. Desktop or TV)before?

- Yes
- No

How would you rate your level of TV/film production knowledge?

- None
- Basic
- Intermediate
- Expert

How would you rate your knowledge of how 360 videos and images areproduced?

- None
- Basic
- Intermediate
- Expert

How would you rate your experience in using virtual reality systems?

- Non-experienced
- I have a little experience
- I have used VR often
- I'm an experienced VR user
- I'm a VR developer

Please write your email address. (optional)

Part A (After finishing the experience):

indicate how much you Agree orDisagree

I felt sad that my experience was over

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt disoriented

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I had a sense that I had returned from a journey

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I would have liked the experience to continue

- Strongly agree
- Somewhat agree
- Neither agree nor disagree

- Somewhat disagree
- Strongly disagree

I vividly remember some parts of the experience

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I'd recommend the experience to my friends

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

Part B (During your experience):

indicate how much you Agree or Disagree

I felt myself being "drawn in"

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt involved in the displayed environment

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I lost track of time

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt I could interact with the displayed environment

- Strongly agree Somewhat agree
- Neither agree nor disagree
- Somewhat disagree

- Strongly disagree

The displayed environment seemed natural

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt I was visiting the places in the displayed environment

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

The content seemed believable for me

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt I wasn't just visiting something

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree

- Strongly disagree

I had the sensation that I moved in response to parts of the displayedenvironment

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt tired

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt dizzy

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt that the displayed environment was part of the real world

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree

- Strongly disagree

My experience was intense

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I paid more attention to the displayed environment than I did to my own thoughts(e.g. personal preoccupations, daydreams etc.)

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I had a sense of being in the scene displayed

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt that I could move objects (in the displayed environment)

- Strongly agree
- Somewhat agree
- Neither agree nor disagree

- Somewhat disagree
- Strongly disagree

I felt I had eyestrain

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I had a strong sense of sounds coming from different directions within thedisplayed environment

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt surrounded by the displayed environment

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt nauseous

- Strongly agree
- Somewhat agree

- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I could almost smell the different features of the displayed environment

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I had a strong sense that the objects were solid

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt I could have reached out and touched things in the displayed environment

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I sensed that the temperature changed to match the scenes in the displayedenvironment

- Strongly agree
- Somewhat agree

- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I responded emotionally to the places I visited

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt that all my senses were simulated at the same time

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt as though I was in the same space as the objects

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I had the sensation that part of the displayed environment responded to me.

- Strongly agree
- Somewhat agree

- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt I had a headache

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I felt as though I was participating in the displayed environment

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

The contents appealed to me

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

Appendix VI- ICT-SOPI Questionnaire Result - First Experiment

ICT-SOPI Questionnaire Result for 2D screen Viewers

Age	Gender	What was the TV or Desktop size you used for watching contents?	Engagement	Spatial Presence	Ecological Validity/ Naturalness	Negative Effects	How long was the duration of the FIRST scene?
60	Female	Large (more than 28")	3	3.067	5	1.5	4
51	Male	Medium (15"-28")	3.75	3.467	4	1.5	3
34	Male	Medium (15"-28")	2.25	2.867	3.25	1.5	3
49	Male	Medium (15"-28")	3.167	2.6	3.25	1.167	4
45	Male	Medium (15"-28")	4	3.667	4	1.167	2
30	Male	Small/Portable (14" or less)	2.334	2.534	3.5	2	3
42	Male	Large (more than 28")	3.583	3.067	4	1.667	4
29	Male	Small/Portable (14" or less)	3.5	3.067	3.5	1.5	4
25	Female	Large (more than 28")	3.5	2.067	3.25	1.2	5
46	Female	Large (more than 28")	2.834	2.4	3.75	1.6	5
47	Male	Large (more than 28")	4	3.286	4.5	1.4	5
45	Female	Large (more than 28")	2.857	2.467	3.75	1.4	6
19	Female	Large (more than 28")	3.571	2.467	3.75	1.2	4
32	Male	Large (more than 28")	3.429	2.934	3.75	1.25	3
56	Female	Large (more than 28")	4.286	3.667	4.5	1.167	7
34	Male	Large (more than 28")	3.286	2.467	3.75	1.2	5
32	Female	Large (more than 28")	3.286	2.867	4	1.166666667	3
38	Male	Large (more than 28")	2.571	2.2	3.5	1.25	6
35	Female	Large (more than 28")	4	2.8	4	1.16667	4.5
27	Female	Large (more than 28")	3.286	2.4	3.25	1.2	5.5

Reliability Analysis

Component	4
Sum of Variance	339.1867628
Variance of Total Score	724.5749717
Cronbach Alpha	0.709175676

ICT-SOPI Questionnaire Result for VR Viewers

How long was the duration of the FIRST scene?	Age	Gender	VR Experience Level	Engagement	Spatial Presence	Ecological Validity/ Naturalness	Negative Effects
3	32	Male	Non-experienced	3.25	3.73	4.5	1.6
4	60	Female	Non-experienced	3	3.13	5	1.5
0.5	29	Male	I have a little experience	4.08	3.4	3.75	1.83
3	30	Male	Non-experienced	4.33	4.13	4.15	3
5	26	Female	I used VR often	4.83	4.86	5	2
3	37	Male	I have a little experience	4.33	2.86	3.25	2
4	61	Female	Non-experienced	3.75	4	4.75	1.5
4	63	Male	Non-experienced	3.41	3.86	4.25	3.5
3	28	Female	Non-experienced	3.83	4.13	5	2.16
10	36	Female	I used VR often	3.58	3.2	3.75	1.66
4	42	Male	Non-experienced	3.58	3.26	4	1.66
3	36	Female	Non-experienced	4.25	4.06	5	1.83
3.5	32	Male	Non-experienced	2.91	3.13	4	4.33
3	35	Male	I used VR often	3.08	3.33	3.25	3.16
2	27	Male	Non-experienced	4	4	4.75	1.5
3	30	Male	I'm an experienced VR user	4.16	3.33	3.75	3.16
2	35	Male	Non-experienced	3.58	3.6	5	1.5
5	32	Female	Non-experienced	4.16	4.2	4.75	1.16
4	51	Female	Non-experienced	3.75	4	4.75	1.5
2	45	Male	Non-experienced	4	3.73	4	3.83
3	51	Male	Non-experienced	3.91	3.46	4	3.5
3	30	Male	I used VR often	2.33	2.46	3.75	3
5	73	Female	Non-experienced	3.41	3.26	3.25	2.66
4	77	Male	Non-experienced	2.5	2.66	3.25	2.83

Reliability Analysis

Component	4
Sum of Variance	642.3139651
Variance of Total Score	1470.651536
Cronbach Alpha	0.750993738

Appendix VII- ICT-SOPI Questionnaire Result – Second Experiment

Age?	Gender?	How would you rate your experience in using virtual reality systems?	Engagement	Spatial presence	Naturalness	Adverse effects
54	Female	I have a little experience	3.53	3.33	4.75	1.165
24	Male	I have a little experience	4.5	4.25	4.5	2
39	Male	I have a little experience	4.81	3.93	4.25	2.5
22	Male	I have a little experience	4.81	3.73	4.75	2.87
27	Male	I have a little experience	4.33	3.73	3.25	1.33
36	Male	Non-experienced	4	3.44	4.5	1.165
35	Male	I have a little experience	3.05	2.125	2.25	1.33
25	Male	I have a little experience	4.58	4.53	5	3.65
45	Male	I have used VR often	4.5	3.33	3.75	3
20	Male	I have a little experience	3.58	2.33	3.25	3
36	Female	Non-experienced	4.75	4.13	5	1.165
37	Male	I have used VR often	3.91	4.25	3.75	1.825
23	Female	I have a little experience	4.33	3.93	4.25	1.165
36	Male	I have used VR often	3.58	2.93	3.5	2
2.5	Male	Non-experienced	5	4.93	5	3.61
18	Female	I have a little experience	3.25	2.8	3.75	1.165
18	Male	I have a little experience	4.33	3.93	4.25	3
26	Male	I have used VR often	3.91	3.53	4.5	2.66
25	Male	I have a little experience	3.25	2.615	3.25	2.33
21	Male	I have used VR often	4.25	3.825	4.5	1.4
19	Non-binary / third gender	I'm an experienced VR user	2.91	2.325	1.5	1.63
22	Male	I'm an experienced VR user	3.58	3.6	3.5	3.5
20	Male	I have a little experience	4	3.625	3.25	2.33
20	Male	I'm an experienced VR user	4.15	2.53	3.5	1.83
22	Male	I have a little experience	3.58	3.13	3.75	1.165
20	Female	I have a little experience	2.75	2.38	2.5	2
22	Male	Non-experienced	4.19	3	4.25	1.6
23	Male	Non-experienced	3.92	3.53	4.5	1.665
37	Male	Non-experienced	4.08	3.35	4.5	3.5
2	Female	I have a little experience	5	4.25	4.75	1.5

Reliability Analysis

Component	4
Sum of Variance	945.6140028
Variance of Total Score	2271.066125
Cronbach Alpha	0.778167345

Appendix VIII- Semi-Structured Survey- First experiment- How do You Feel It

Part C1(After experience): provide a description of your thoughts & feelings

Did you watch the movie to the end? If not, please explain when and why youstopped the experience?

Describe the image you remember from the FIRST scene.

What was the LAST scene? A sunset or a sunrise?

List the elements you remember from the LAST scene?

Would you like to experience the movie with a VR headset?

Part C2(During experience): provide a description of your thoughts & feelings

Did you see any movement in the SECOND scene? If yes, please describe it.

What feelings did you experience during the SECOND scene?

How long was the duration of the FIRST scene? Give a specific time

Is the LAST scene longer than the FIRST one?

Is there anything else you would like to add?

Appendix IX- Semi-Structured Survey - Second Experiment - The Man Who Disorientated in Time 2022

Part C1(After experience): provide a description of your thoughts & feelings

Did you watch the movie to the end? If not, please explain when and why youstopped the experience?

Describe an image you remember from the movie.

What was the most interesting thing about your experience?

What have annoyed you in this Virtual journey?

Please, list the elements you remember from the movie scenes?

Which seating places were repeated during the journey?

Part C2(During experience): provide a description of your thoughts & feelings

What feelings did you experience during your journey?

How long did you feel the duration of the movie was? Give a specific time

Is there anything else you would like to add?

Appendix X- Codebook for Narrative Engagement- Research - The man Who disorientated in Time 2022

Codes\\Narrative Engagement Analysis

All codes depict the engagement with narratives

Codes\\Narrative Engagement Analysis\\Disorientation

All code represents the appearance of viewer disorientation, such as having a state of mind or losing storylines due to camera movement.

Name	Description	Files	References
Conforming to the camera's motion	a set of themes that describes how audiences became accustomed to various camera movements and how their perception evolved over time.	0	0
A quick scan of the surroundings all over the experience		6	6
Bigger focus on cameraman over time		10	10
Discontinue experience at a spinning motion.		1	1
Explore a larger area of surroundings over time.		10	10
Explore Around while following camera movement.		2	2
Follow the camera's path and keep the cameraman in view at all times		2	2
Maintain camera attitude to avoid disorientation during spinning or level changes		5	5
The speed of environment scan slows over time		8	8

Name	Description	Files	References
Mirroring transitions	Themes that describe how viewers respond to mirrored cuts	0	0
Discontinue experience after a mirroring transition		1	1
Explore the surroundings		3	3
Focus on the mirror edge and keep both images in the frame		3	3
Glide over the two mirrored cameramen in the image.		6	6
Not Recognized (experience several Jump-cuts)		3	3
Rapidly switching between two pictures		5	5
Slowly toggle between two images		6	6
Point of interest	The most engaging objects or elements on which the audience concentrated throughout the experience.	0	0
Other people		11	11
River		9	9
Surrounding environment		8	8
The Cameraman		15	15
Their invisible Body (Monopod attaching point)		10	10
Transitions (entering new scene)	Audiences' actions when entering a new environment	0	0
Checking the Sky upon entering a new environment		1	1

Name	Description	Files	References
First, inspect their invisible body, then find the cameraman		1	1
Locate the cameraman and then explore the area		14	14
Maintain the point of interest and prevent head movement		6	6
Rapidly investigate the new place		4	4

Codes\\Narrative Engagement Analysis\\ Emotional contribution

All the emotions that provoked by the experience

Name	Description	Files	References
Amazed		9	9
Annoyance		1	1
Annoys	All the annoyances that audiences encountered	17	17
Level Changing		2	2
Looking Down		1	1
Nothing		6	6
Spinning movement of camera		6	6
Visual effects that caused Break in Presence		1	1
Walking Backward		1	1
Confusion		6	6
Dizziness		4	4
Enjoys	All of the enjoyments that audiences discovered during their experience	18	18

Name	Description	Files	References
a 360 degree viewpoint		1	1
believability		2	2
Camera's Motion blure		1	1
Camera's Spinning		1	1
Contrast between head movement and camera movement		1	1
Immersion		2	2
Philosophical Side		1	1
Provoking the senses		1	1
Reversing timeline		2	2
The Disorientation		1	1
Time representation		4	4
Transporting to different locations		1	1
Fear		1	1
Floating		1	1
Immersed		2	2
Melancholy		1	1
Relaxing		2	2
Sadness		1	1
Suspense		4	4
Tiredness		1	1

Codes\\Narrative Engagement Analysis\\Reading narratives

All audiences attempt to follow certain movement in the scene that generates story, such as following other characters, listening to the cameraman, etc.

Name	Description	Files	References
Narrative quiz	The participant's response to the question: Which seating places were repeated during the journey?	0	0
All three distinct scenes		2	2
Nonsense responses		6	6
Only Riverside		7	7
Riverside and west bank (Last scene)		3	3
The last scene (West Bank)		1	1
Reactions to reverse walking, and normal speaking in the last scene	Participants' reactions when the cameraman walks backwards but continues to speak normally in the last scene.	0	0
Concentrate solely on the cameraman		1	1
Flip between the cameraman and the old man perspectives		2	2
Focusing on the cameraman and quickly skimming others (last scene)		2	2
Maintain the gaze on the Oldman		12	12
Resist spinning to examine two girls		6	6
Reactions to the cameraman's speeches	the participants' reactions whenever they heard the cameraman's voices speaking, whether in reverse or chatting to them.	0	0
Investigate the surroundings		5	5

Name	Description	Files	References
keep glancing at cameraman, and listen Carefully		12	12
No reaction		2	2
Reactions to walking and talking backwards	Participant's reaction whenever the cameraman walks and talks backwards	0	0
Check the cameraman and forward motion (Foggy Scene)		9	9
Focus on the cameraman and check the road in the front and rear		13	13
Investigate the surroundings		5	5
Investigate the surroundings (Foggy scene)		1	1
Maintain the attention on the cameraman		1	1
Not realised (Foggy Scene)		7	7
Not realised		2	2
Reactions to walking normally, speaking backwards	Participants' reactions when the cameraman walks normally but speaks backwards in the riverside scene.	0	0
Check the cameraman and forward movement direction		13	13
Investigate the surroundings		5	5
Maintain the attention on the cameraman		1	1
Not Realized		1	1

Name	Description	Files	References
Remembering elements and picture	All elements of the virtual journey that participants recalled.		
Benches		6	7
Bins		1	1
Birds Chirping		1	1
Blue sky		1	1
Bridge		1	1
Brown Buildings		1	1
Bush		1	1
Cameraman		1	1
Cameraman Cloth		1	1
Cameraman eyeglasses		2	2
Cameraman Hand		1	1
cameraman moustache		1	1
Cameraman questions the reality		3	3
Clouds		1	1
The contradiction of video and sound		1	1
Dirt		1	1
Foggy scene		10	12
The glitch in the picture		2	3
Grass		1	1
Last scene landscape		1	1
monopod shadow		1	1

Name	Description	Files	References
Oldman		4	4
Oldman Blue Jacket		1	1
Other people		2	2
people's interaction		4	4
Reverse language		1	1
Reverse walking normal speaking		7	7
River (water)		6	6
Sound of Water		1	1
Student Campus		1	1
Sunlight		2	2
The Cameraman		2	2
Trees		2	2
Valley (Westbank Landscape)		2	2
varity of natural environments		5	5
Walkways		4	4
wooden guards		1	1
Wooden Hut		1	1
Woodland		1	1
Responses to cameraman questions	The audience's response to the cameraman's questions: 1. are you really sitting beside me? 2. Beautiful, isn't it?	0	0
Check the front landscape in response to questions regarding its beauty.		8	8
Check their invisible body (seating		7	8

Name	Description	Files	References
location) when asked, are you sitting beside me			
Concentrate on Cameraman		5	5
Not responded and looked around		4	4
Sudden Attractions	The narrative elements that drew the audience's attention caused them to shift their gaze and focus on something specific.	0	0
Cameraman's voice		9	9
First reverse walking in the foggy scene		4	4
Invisible body (monopod)		5	5
Mirrored Cameraman		4	4
Oldman Reverse walking		4	4

Appendix XI - Codebook for Guiding Methods - Research The man Who disorientated in Time

Codes\\Guiding methods analysis

reactions of audiences to different types of camera movements

Codes\\Guiding methods analysis\\Level changing

Name	Description	Files	References
Explore a wide area of surroundings		4	4
Explore surroundings while on a higher level		5	5
Explore surroundings while in the lower level		1	1
They Felt disorientated and changed their actual body posture		1	1
Keep looking at Cameraman.		10	10
Keep Looking at Monopod		2	2
Keep track of the camera motion.		8	8
Look downside		1	1
Look down while in Lower Level		1	1

Codes\\Guiding methods analysis\\Spinning

Name	Description	Files	References
A bit of resistance at first, then following the track of camera motion.		6	6
Following		16	36
Keep the cameraman in the viewpoint.		10	11

Name	Description	Files	References
Turn the head faster the camera spinning speed		3	3
Resistant		19	53
Checking other people (Oldman and two Girls in the last scene)		16	21
Explore the Surrounding while the camera is spinning.		3	3
Looking down		9	15
Looking up at the sky		1	1
Resisting to look at the front landscape in the last scene		2	2
Spinning faster than the camera motion speed		1	1
Try to keep the cameraman in the viewpoint		6	6
Turning head in the opposite direction		3	4
Stop the experience		2	3

Codes\\Guiding methods analysis\\still camera

Name	Description	Files	References
Checking the seating place		3	3
Exploring all 360 degrees of surroundings		5	5
Keep Looking at the cameraman		12	12

Name	Description	Files	References
Look at the front landscape		4	4

Codes\\Guiding methods analysis\\Straight movement

Name	Description	Files	References
Check surroundings		19	39
Following a particular moving object	including river, other people, or any other moving object	14	14
Looking at the cameraman and checking the forward direction of movement		15	15
Scanning all 360 degrees of the surroundings		9	9
Skimming a small area of surroundings		1	1
Keep looking at the cameraman.		3	3

Codes\\Narrative Engagement Analysis\\Disorientation

All the code that shows the appearance of a disorientation state in audiences, including mind state and losing narratives because of camera movement

Name	Description	Files	References
Matching the camera's motion	a set of themes describing how audiences became accustomed to various camera movements and how their perception evolved.	0	0
A quick scan of the surroundings all over the experience		6	6
Bigger focus on cameraman over time		10	10
Discontinue experience at a spinning motion		1	1

Name	Description	Files	References
Explore a larger area of surroundings over time		10	10
Explore Around while follow camera movement		2	2
Follow the camera's path and keep the cameraman in view at all times		2	2
Maintain camera attitude to avoid disorientation during spinning or level changes		5	5
The speed of environment scan slows over time		8	8
Mirroring transitions	Themes that describe how viewers respond to mirrored cuts	0	0
Discontinue experience after a mirroring transition		1	1
Explore the surroundings		3	3
Focus on the mirror edge and keep both images in the frame		3	3
Glide over the two mirrored cameramen in the image.		6	6
Not Recognized (experience several Jump-cuts)		3	3
Rapidly switching between two pictures		5	5
Slowly toggle between two images		6	6

Name	Description	Files	References
Point of interest	The most engaging objects or elements on which the audience concentrated throughout the experience.	0	0
Other people		11	11
River		9	9
Surrounding environment		8	8
The Cameraman		15	15
Their invisible Body (Monopod attaching point)		10	10
Transitions (entering new scene)	Audiences' actions when entering a new environment	0	0
Checking the Sky upon entering a new environment		1	1
First, inspect their invisible body, then find the cameraman		1	1
Locate the cameraman and then explore the area		14	14
Maintain the point of interest and prevent head movement		6	6
Rapidly investigate the new place		4	4

Appendix XII- Viewpoint Description form – Sample

Viewpoint characteristic

I. Main interesting Areas

The main character:

Their invisible body:

Moving objects in the scene (people, river):

II. Sudden attraction to any elements; colour, moving objects, characters interaction, sound

---

III. Matching or resisting camera movement in spinning time.

First

Second

Third

Forth

Fifth

IV. Reaction to the camera's level changing

V. The observation of the transition periods; Mirroring, glitch

---

VI. Observation in the moment of seating on the bench

VII. Observation in the moments that the cameraman's speaking

---

VIII. Observation in the moment of the cameraman is;

1. acting backwards and speaking normally

2. acting normal, speaking backwards

3. acting backwards, speaking backwards

IX. Environment's skimming trends

Appendix XIII- Déjà vu, Introduction script

Introduction Sequence

The audience finds themselves sitting on a chair in the corner of Scene One as they launch the application. Suddenly, the Architect appears in the centre of the scene with a glitch. He starts describing three options for the audience to enter the movie. The controllers' trace-light activates, and by pointing at the floor of each scene, the corresponding scene gets highlighted. Pressing the trigger button places the audience in one of three different starting positions.

Architect:

It is a film that depicts an incident between me and my beloved Liz when I was younger, in three different parallel timelines.

Tom and Liz appear in Scenes Two and Three.

Architect:

We are traveling between these three universes.

The Architect walks to Door One and passes through it, appearing in Scene Two and staying in the middle of the scene. Tom and Liz do the same, with Tom heading to Scene Three and Liz heading to Scene One. The Architect continues to converse with the audience from Scene Two, while Tom and Liz have vanished.

Architect:

You can do the same thing and visit all three universes... To do this,..

The Architect walks over to the chair in Scene Two and sits.

Architect:

After choosing your starting place, …

The Architect gets up and walks around.

Architect:

Get up and walk around the set, follow the characters' stories.

He walks up to Door Two, passes through it, and appears in Scene One, standing in front of the doors.

Architect:

To travel clockwise, simply hit this door.

He touches Door One, jumps to Scene Two, does it again, transports to Scene Three, and then returns to Scene One.

Architect:

And for anticlockwise travel, touch this door.

He touches Door Two and is transported to Scene Three, then to Scene Two, and back to Scene One. Then he moves to the middle of the stage and faces the audience.

Architect:

Finally, it is an infinite film with no beginning and no end. So, if you want to leave this virtual world, return to the beginning, find the chair you chose to begin the journey, and sit over... You're now ready to dive into déjà vu!

The Architect vanishes. Users can begin their experience by pointing their controller to a scene. They can stand up and walk inside the scene, as well as touch the doors and travel to other scenes. The controller point light is deactivated as soon as they point to each of the scene floors and press the trigger button.

List of motion capturing recordings:

Architect:

1. standing in the middle, first dialogues walk toward door one
2. Enter from door one, goes toward the centre, say dialogues, sits on the chair, gets up and walks say dialogues, goes to door two and exit the scene
3. Enter the scene from door 2, stay in front of the doors and hit door one three times, then door 2 three times and then goes to middle of the scene say the las dialogues.

Other character:

1. appear in the middle of scene stay for a while goes toward door one and exit
2. enter from door one and stays in middle of stage.

Appendix XIV- Deja Vu, Screen script

Déjà vu

Script for an interactive VR movie

By

Mohammadreza Mazarei

Abstract

The project concentrates on the nuances and audience experience of an interactive VR movie. The premise of the movie takes place in an art gallery presented in three parallel universes, each with a different timeline.

The movie consists of three characters and focuses on their interaction and relationships. All of the characters occupy all of the universes, but the events and characters' relationships are different in each of these areas.

Reading instructions for understanding the whole story

The whole of the story is represented through three different timelines. The young Tom and Liz who appear in each storyline are not aware of events taking place in the two other storylines. Only the architect knows about other timelines and travels between them to impact on each story's progression as he wishes.

To gain a better interpretation from the "whole" of the story, it is suggested that after reading the script in linear order (each storyline from beginning to end), re-read the journey of each character and follow each of them separately through different storylines till a loop is completed. It is better to begin with the architect and then the girl, Liz and finally the young Tom.

You can find the path of every character and concurrency of timelines in the map provided.

Storyline01 (the sort of events happens in scene01)

Scene01, P1

Architect enters from scene03, P1

A man wears in Black, the Architect, enters from door01 into the place and walks toward a black hole in the corner of the scene, he stands there for a while. As soon as the audience enters the space, the Architect turns his face toward him/her, looks for a while, then returns his face to the hole and starts narrating the story of this virtual space.

ARCHITECT

I Built this place to seize a
moment,a moment that changed my
life...

He smiles and walks toward the video display on the left wall, which displays his close-up remembering something sad.

ARCHITECT

And as I created my own reality,
infact, I changed everything...
even the past reality

He shows the other space in front of him (place02). A youngman, Tom and a woman, Liz, are speaking together. Then, Architect points the video display on the wall andcontinues…

ARCHITECT

a failed proposal… But the curiosity of knowing why, was the reason for failure.

He turns his face toward the other place and looks at Tom and Liz for a while. Liz leaves Tom and goes to the other side of the scene, then she leaves the scene and goes to the other place on the right side (place03). The architect follows her with his eyes and then walking toward to his first place in front of the black hole.

ARCHITECT

making a virtual reality which impacted the past events in reality...

He stays for a while there, then looks at Tom on the place02. Tom starts walking toward door02 and changes his place to the current place(Place01), concurrently the architect starts walking toward door01, and while Tom enters this place, the Architect goes to place02, which Tom was before.

Architect goes to Scene02, P1

Scene01, P2

Tom enters Place01 from Scene02, P3

Tom walks around the scene and looks at the photos on the wall. The pictures show some location including an empty room, a deteriorated building, a gloomy sunset with a red sky,and the last one is a blurry picture of a girl. he recognizes the picture and the girl inside it. he turns confused and anxious. he takes a deep breath look at the blurry picture again and walks toward door02 and left the scene to Place03.

Tom goes to Scene03, P3

Tom returns from Scene03, P3

Tom backs to the scene after a while. he still looks confused and frightened from what happens around him. he exits from the other door, door01, in the scene and goes to the Place02.

Tom goes to Scene02, P2

Scene01, P3

Tom enters from scene02, P2

Tom enters the scene seeking the blurry picture of Liz. he stands there for a while and thinks. go toward the video display and look at the close up of the architect repeated in a loop, then he walks toward door01 and back to the Place02.

Tom goes to Scene02, P2

Storyline 02 (the sort of events happens in scene02)

Scene02, P1

Architect enters from Scene01, P1

The Architect enters the space from door01 and stands in front of the black hole in the middle of the scene. As soon as the audience enters the space, the Architecture turns his face toward him/her look for a while.

Liz enters from Scene03, P3

Liz enters the scene from door02. She is anxious, and she starts to look at the photos on the wall. The pictures belong to Tom, who captured Liz in different situations. Architect gets close to her,

ARCHITECT

Hey, you're right? I’m looking for you everywhere.

Liz looks at him curiously.

LIZ

Looking for me?

ARCHITECT

Yes, for you. the pretty girl in these pictures

The architect points to another space in front of them (Place01) which is a young man is standing alone in front of the pictures.

ARCHITECT

that's me. A long time ago, I
proposed to you to be my lover,
and you rejected me.

Liz can't see what he pointed out. She is scared, rapidly checks all over the scene. then ask the architect

LIZ

there is no one here except us.

ARCHITECT

yes, we are alone.

both look at each other for a while, Liz continues looking at pictures on the wall

ARCHITECT

Anyway. I'm here to admire your
beauty, nothing more.

Liz turns his face to Architect

LIZ

what?

She gets confused, Architect smiles, Liz gets act together

LIZ

Sorry... I mean thanks

The Architect points out one of the pictures. It is the same picture that was blurry in the Place01.

ARCHITECT

I like this one

both get close to that picture on the wall.

ARCHITECT

You’re sad but we don’t know why, it is something out of the field... something that only you know, and I've never realized it.

Liz looks at the architect curiously and asks

LIZ

Did we meet each other before? Cause you look familiar.

ARCHITECT

Yes, fifteen years ago.

LIZ

Fifteen years ago, I was a little kid, that's why I can’t remember you...

ARCHITECT

But this is our first meeting.

LIZ

yeah. weird

Liz seems confused, trying to remember something. Suddenly she realises what architect said

LIZ

First meeting? But you said fift…

ARCHITECT

yes, I know. You are experiencing a weird situation, can't remember the first time we saw each other while you are sure it is the first time.

LIZ

Stop doing that.

ARCHITECT

doing what?

LIZ

Scaring me.

ARCHITECT

Sorry, can I offer coffee and sit somewhere. I promise no more non-sense talking. Just this last one... remember, you will reject any offers you receive today!

LIZ

How do you know that?

Architect smiles

ARCHITECT

No more non-sense. Let's drink a coffee and talk about the ART.

the architect goes toward door01 waits there and asks Liz with his hand to join him

ARCHITECT

After you, my lady

Liz walks towards the door, and they cross the door01 go to Place03.

Architect and Liz go to Scene03, P1

Scene02, P2

Tome enters from Scene02, P2

Tom enters the scene. He is extremely frightened and confused. he looks at the photos on the wall rapidly. The pictures belong to his memories with Liz captured her in different positions alone.

Tom stands in front of one picture and stares at it. the picture is the same picture which is blurry in Place01. he goes toward door02 and back to Place01.

Tom goes to scene01, P3

Scene is empty for 1 minute

Tom return from Scene01, P3

Tom back to the scene and looks at the picture more carefully this time, then he walks toward the bench and sits there for a while. he stares at door01 seems expecting someone, but Liz enters the scene from the other door, door02.

Scene02, P3

Liz enters from Scene03, P1

Liz enters the scene and looks at Tom for a while. then she goes toward the photos. Tom gets close to her

TOM

I searched for you everywhere.

Liz looks at him curiously, then turn his face toward the pictures on the wall

LIZ

You always seeking for me!

TOM

Yes… I was expecting you to visit the gallery today to see my pictures. in fact, your pictures.

Liz starts walking, checking other pictures

LIZ

yes, My pictures.

Then she looks at the display on the other wall and walks toward it. Tom follows her.

LIZ

do you remember something happy when looking at my sad pictures?

TOM

I'm happy cause remember you.

Liz stares at Tom. Tom gets anxious. he wants to say something but hesitates. turn his face toward the display and speaks

TOM

Do you want me to replace it with a sad moment? ... Actually, I'm going to offer...

Liz stops him with her hand and tries to remember something

LIZ

wait?

TOM

what happened?

LIZ

Deja Vu.

Liz walks toward the bench while Tom stays there follows her with his eyes.

LIZ

I will reject every offer received from you today.

She sits on the bench. and look at Tom

LIZ

So please say nothing more. I like your works and I like you. but I need some space to be alone.

She stands up and looks at Tom

LIZ

I should be somewhere else.

Liz walks toward the door01 and enter the Place03.

Liz goes to Scene03, P3

Tom just looks at Liz leaving the place, then looks at his video on the wall. He walks beside the wall of photos and looks at the photo of Liz one by one. Then he goes toward door02 and enters Place01.

Tom goes to scene01, P2

Storyline03 (the sort of events looping in scene03)

Scene03, P1

Architect and Liz enter from Scene02, P1

The Architect and Liz enter the scene. The Architect goes toward the black hole in the intersection of two walls and stands there. while Liz walks around the scene and looks at the pictures. As soon as the audience enters the space, the Architect turns his face toward him/her look for a while. Liz gets close to the architect and talks to him

LIZ

Honey, how lovely is the place you created for us. I like that. the best present I received.

ARCHITECT

My Pleasure darling. It is something belongs to the future, and we are pioneers among the other artists. With your talent and my creativity, we can do many more. that's just a start for me.

Liz looks at him and her mood changes. she becomes angry and speaks

LIZ

But you said this virtual gallery is my birthday gift... just for me... but in fact you used my artworks to develop your ideas.

ARCHITECT

Wait there. It is yours. but I'm the architect. I’m the designer of the space. So, the copy-right of space still belong to me even I give you this virtual place as a gift or even sell it to you. can you understand that

Liz angrily turns her face toward the pictures to her photos on the wall and then the video display.

LIZ

if it is mine now, I ask you to change this video with a moment that I will remember this day sadly.

ARCHITECT

Do you want me to change it with a sad face? technically I can reject your offer, but I will do it for you, my love.

the architect opens his arms to hug Liz, but she pushed him back and while clenching her teeth says

LIZ

you're disgusting.

Liz goes to another side of the scene and sits on the bench.

ARCHITECT

I know. But there are no other options.

He starts walking towards Liz

ARCHITECT

I really wished that everything between you and me led to other ways, but it is the reality of our relationship... you and I turns to disgusting people who discuss in a virtual reality.

The Architect and Liz look at each other for a while.

ARCHITECT

I know you can't understand that and may never realize the truth,

LIZ

Do not start non-sense talking again.

ARCHITECT

yeah, the truth is not understandable.

The architect cogitates for a while.

ARCHITECT

It's a Deja Vu. But when exactly does it happen or where?

He turns his face toward two other places, place01 and place02.

LIZ

what is it now?

ARCHITECT

Deja-Vu should not happen for me inside the world that I created. I should find the glitch in my matrix.

The Architect walks toward door01 and enters Place01.

Architect goes to scene01, P1

Liz still sitting on the bench and following him with her eyes. she wants to say something but hesitates. She stands up and goes toward her video of remembering on the wall and watching it for a while, then, she leaves the scene from the other door, door02, and goes to the Place02.

Liz goes to Scene02, P3

Scene03, P2

This space remains clear during this period

Scene03, P3

Liz enters from Scene02, P3

Liz enters the scene. she felt sad. she stands for a moment in the middle of the scene. then she looks around and walks to the wall with the video display showing her remembering something happy. she takes a quick look at the pictures on the wall and then walks toward the doors, stands in the middle of them and then chooses to pass Door02, to enter place02 the place that Architect expecting her.

Liz goes to Scene02, P1

Tom enters from Scen01, P2

while Liz leaves the scene, Tom enters the scene from the other door, door01. He is searching for someone. he takes a quick look at the picture and then stands in front of the wall with video displays which show Liz smiling repeatedly. He leaves the scene from the door01 and backs to Place01.

Tom goes to Scene01, P2

The End

Script in the second Order (each Character's journey between places repeated in a loop)

The journey of the Architect

Place01 (3 min)

Architect enters from scene03, P1

A man wears in Black, the Architect, enters from door01 into the place and walks toward a black hole in the corner of the scene, he stands there for a while. As soon as the audience enters the space, the Architect turns his face toward him/her, looks for a while, then returns his face to the hole and starts narrating the story of this virtual space.

ARCHITECT

I Built this place to seize a moment,a moment that changed my life...

He smiles and walks toward the video display on the left wall, which displays his close-up remembering something sad.

ARCHITECT

And as I created my own reality, infact, I changed everything... even the past reality

He shows the other space in front of him (place02). A youngman, Tom and a woman, Liz, are speaking together. Then, Architect points the video display on the wall andcontinues… **(1min)**

ARCHITECT

a failed proposal… But the curiosity of knowing when and where this Déjà vu happened, was the reason for failure.

He turns his face toward the other place and looks at Tom and Liz for a while. Liz leaves Tom and goes to the other side of the scene, then she leaves the scene and goes to the other place on the right side (place03). The architect follows her with his eyes and then walking toward to his first place in front of the black hole. **(2 min)**

ARCHITECT

I made this impact.

He stays for a while there, then looks at Tom on the place02. Tom starts walking toward door02 and changes his place to the current place(Place01), concurrently the architect starts walking toward door01, and while Tom enters this place, the Architect goes to place02, which Tom was before.

Architect goes to Scene02, P1

Place02 (3 min)

Architect enters from Scene01, P1

The Architect enters the space from door01 and stands in front of the black hole in the middle of the scene. As soon as the audience enters the space, the Architecture turns his face toward him/her look for a while. **(20 s)**

Liz enters the scene from door02. She is anxious, and she starts to look at the photos on the wall. The pictures belong to Tom, who captured Liz in different situations. Architect gets close to her,

ARCHITECT

Hey, you're right? I'm looking for you everywhere.

Liz looks at him curiously.

LIZ

Looking for me?

ARCHITECT

Yes, for you. the pretty girl in these pictures

The architect points to another space in front of them (Place01) which is a young man is standing alone in front of the pictures.

ARCHITECT

that's me. A long time ago, I proposed to you to be my lover, and you rejected me.

Liz can't see what he pointed out. She is scared, rapidly checks all over the scene. then ask the architect

LIZ

there is no one here except us.

ARCHITECT

yes, we are alone.

both look at each other for a while, Liz continues looking at pictures on the wall

ARCHITECT

Anyway. I'm here to admire your beauty, nothing more.

Liz turns his face to Architect

LIZ

what?

She gets confused, Architect smiles, Liz gets act together

LIZ

Sorry... I mean thanks

The Architect points out one of the pictures. It is the same picture that was blurry in the Place01.

ARCHITECT

I like this one

both get close to that picture on the wall.

ARCHITECT

You’re sad but we don’t know why, it is something out of the field... something that only you know, and I've never realized it.

Liz looks at the architect curiously and asks

LIZ

Did we meet each other before? Cause you look familiar.

ARCHITECT

Yes, fifteen years ago.

LIZ

Fifteen years ago, I was a little kid, that's why I can’t remember you...

ARCHITECT

But this is our first meeting.

LIZ

yeah. weird

Liz seems confused, trying to remember something. Suddenly she realises what architect said

LIZ

First meeting? But you said fift…

ARCHITECT

yes, I know. You are experiencing a weird situation, can't remember the first time we saw each other while you are sure it is the first time.

LIZ

Stop doing that.

ARCHITECT

doing what?

LIZ

Scaring me.

ARCHITECT

Sorry, can I offer coffee and sit somewhere. I promise no more non-sense talking. Just this last one... remember, you will reject any offers you receive today!

LIZ

How do you know that?

Architect smiles

ARCHITECT

No more non-sense. Let's drink a coffee and talk about the ART.

the architect goes toward door01 waits there and asks Liz with his hand to join him

ARCHITECT

After you, my lady

Liz walks towards the door, and they cross the door01 go to Place03.

Architect and Liz go to Scene03, P1

Place03 (3 min)

Architect and Liz enter from Scene02, P1

The Architect and Liz enter the scene. The Architect goes toward the black hole in the intersection of two walls and stands there. while Liz walks around the scene and looks at the pictures. As soon as the audience enters the space, the Architect turns his face toward him/her look for a while. Liz gets close to the architect and talks to him

LIZ

Honey, how lovely is the place you created for us. I like that. the best present I received.

ARCHITECT

My Pleasure darling. It is something belongs to the future, and we are pioneers among the other artists. With your talent and my creativity, we can do many more. that's just a start for me.

Liz looks at him and her mood changes. she becomes angry and speaks

LIZ

But you said this virtual gallery is my birthday gift... just for me... but in fact you used my artworks to develop your ideas.

ARCHITECT

Wait there. It is yours. but I'm the architect. I’m the designer of the space. So, the copy-right of space still belong to me even I give you this virtual place as a gift or even sell it to you. can you understand that

Liz angrily turns her face toward the pictures to her photos on the wall and then the video display.

LIZ

if it is mine now, I ask you to change this video with a moment that I will remember this day sadly.

ARCHITECT

Do you want me to change it with a sad face? technically I can reject your offer, but I will do it for you, my love.

the architect opens his arms to hug Liz, but she pushed him back and while clenching her teeth says

LIZ

you're disgusting.

Liz goes to another side of the scene and sits on the bench.

ARCHITECT

I know. But there are no other options.

He starts walking towards Liz

ARCHITECT

I really wished that everything between you and me led to other ways, but it is the reality of our relationship... you and I turns to disgusting people who discuss in a virtual reality.

The Architect and Liz look at each other for a while.

ARCHITECT

I know you can't understand that and may never realize the truth,

LIZ

Do not start non-sense talking again.

ARCHITECT

yeah, the truth is not understandable.

The architect cogitates for a while.

ARCHITECT

It's a Deja Vu. But when exactly does it happen or where?

He turns his face toward two other places, place01 and place02.

LIZ

what is it now?

ARCHITECT

Deja-Vu should not happen for me
inside the world that I created.
I should find the glitch in my
matrix.

The Architect walks toward door01 and enters Place01.

The Journey of Liz

Place02 (2:30)

Liz enters from Scene03, P3

Liz enters the scene from door02. She is anxious, and she starts to look at the photos on the wall. The pictures belong to Tom, who captured Liz in different situations. Architect gets close to her,

ARCHITECT

Hey, you're right? I’m looking for you everywhere.

Liz looks at him curiously.

LIZ

Looking for me?

ARCHITECT

Yes, for you. the pretty girl in these pictures

The architect points to another space in front of them (Place01) which is a young man is standing alone in front of the pictures.

ARCHITECT

that's me. A long time ago, I
proposed to you to be my lover,
and you rejected me.

Liz can't see what he pointed out. She is scared, rapidly checks all over the scene. then ask the architect

LIZ

there is no one here except us.

ARCHITECT

yes, we are alone.

both look at each other for a while, Liz continues looking at pictures on the wall

ARCHITECT

Anyway. I'm here to admire your
beauty, nothing more.

Liz turns his face to Architect

LIZ

what?

She gets confused, Architect smiles, Liz gets act together

LIZ

Sorry... I mean thanks

The Architect points out one of the pictures. It is the same picture that was blurry in the Place01.

ARCHITECT

I like this one

both get close to that picture on the wall.

ARCHITECT

You’re sad but we don’t know why, it is something out of the field... something that only you know, and I've never realized it.

Liz looks at the architect curiously and asks

LIZ

Did we meet each other before? Cause you look familiar.

ARCHITECT

Yes, fifteen years ago.

LIZ

Fifteen years ago, I was a little kid, that's why I can’t remember you...

ARCHITECT

But this is our first meeting.

LIZ

yeah. weird

Liz seems confused, trying to remember something. Suddenly she realises what architect said

LIZ

First meeting? But you said fift…

ARCHITECT

yes, I know. You are experiencing a weird situation, can't remember the first time we saw each other while you are sure it is the first time.

LIZ

Stop doing that.

ARCHITECT

doing what?

LIZ

Scaring me.

ARCHITECT

Sorry, can I offer coffee and sit somewhere. I promise no more non-sense talking. Just this last one... remember, you will reject any offers you receive today!

LIZ

How do you know that?

Architect smiles

ARCHITECT

No more non-sense talking. Let's drink a coffee and talk about the ART.

the architect goes toward door01 waits there and asks Liz with his hand to join him

ARCHITECT

After you, my lady

Liz walks towards the door, and they cross the door01 go to Place03.

Architect and Liz go to Scene03, P1

Place03 (3:45)

Architect and Liz enter from Scene02, P1

The Architect and Liz enter the scene. The Architect goes toward the black hole in the intersection of two walls and stands there. while Liz walks around the scene and looks at the pictures. As soon as the audience enters the space, the Architect turns his face toward him/her look for a while. Liz gets close to the architect and talks to him

LIZ

Honey, how lovely is the place you created for us. I like that. the best present I received.

ARCHITECT

My Pleasure darling. It is something belongs to the future, and we are pioneers among the other artists. With your talent and my creativity, we can do many more. that's just a start for me.

Liz looks at him and her mood changes. she becomes angry and speaks

LIZ

But you said this virtual gallery is my birthday gift... just for me... but in fact you used my artworks to develop your ideas.

ARCHITECT

Wait there. It is yours. but I'm the architect. I’m the designer of the space. So, the copy-right of space still belong to me even

I give you this virtual place as
a gift or even sell it to you.
can you understand that

Liz angrily turns her face toward the pictures to her photos on the wall and then the video display.

LIZ

if it is mine now, I ask you to
change this video with a moment
that I will remember this day
sadly.

ARCHITECT

Do you want me to change it with
a sad face? technically I can
reject your offer, but I will do
it for you, my love.

the architect opens his arms to hug Liz, but she pushed him back and while clenching her teeth says

LIZ

you're disgusting.

Liz goes to another side of the scene and sits on the bench.

ARCHITECT

I know. But there are no other
options.

He starts walking towards Liz

ARCHITECT

I really wished that everything between you and me led to other ways, but it is the reality of our relationship... you and I turns to disgusting people who discuss in a virtual reality.

The Architect and Liz look at each other for a while.

ARCHITECT

I know you can't understand that and may never realize the truth,

LIZ

Do not start non-sense talking again.

ARCHITECT

yeah, the truth is not understandable.

The architect cogitate for a while.

ARCHITECT

It's a Deja Vu. But when exactly does it happen or where?

He turns his face toward two other places, place01 and place02.

LIZ

what is it now?

ARCHITECT

Deja-Vu should not happen for me
inside the world that I created.
I should find the glitch in my
matrix.

The Architect walks toward door01 and enters Place01. **(3 min)**

Liz still sitting on the bench and following him with her eyes. she wants to say something but hesitates. She stands up and goes toward her video of remembering on the wall and watching it for a while, then, she leaves the scene from the other door, door02, and goes to the Place02. **(3:45)**

Liz goes to Scene02, P3

Place02 (2 min)

Liz enters from Scene03, P1

Liz enters the scene and looks at Tom for a while. then she goes toward the photos. Tom gets close to her

TOM

I searched for you everywhere.

Liz looks at him curiously, then turn his face toward the pictures on the wall

LIZ

You always seeking for me!

TOM

Yes… I was expecting you to visit the gallery today to see my pictures. in fact, your pictures.

Liz starts walking, checking other pictures

LIZ

yes, My pictures.

Then she looks at the display on the other wall and walks toward it. Tom follows her.

LIZ

do you remember something happy when looking at my sad pictures?

TOM

I'm happy cause remember you.

Liz stares at Tom. Tom gets anxious. he wants to say something but hesitates. turn his face toward the display and speaks

TOM

Do you want me to replace it with a sad moment? ... Actually, I'm going to offer...

Liz stops him with her hand and tries to remember something

LIZ

wait?

TOM

what happened?

LIZ

Deja Vu.

Liz walks toward the bench while Tom stays there follows her with his eyes.

LIZ

I will reject every offer received from you today.

She sits on the bench. and look at Tom

LIZ

So please say nothing more. I like your works and I like you.

but I need some space to be alone.

She stands up and looks at Tom

LIZ

I should be somewhere else.

Liz walks toward the door01 and enter the Place03.

Liz goes to Scene03, P3

Place03 (1:20)

Liz enters from Scene02, P3

Liz enters the scene. she felt sad. she stands for a moment in the middle of the scene. then she looks around and walks to the wall with the video display showing her remembering something happy. she takes a quick look at the pictures on the wall and then walks toward the doors, stands in the middle of them and then chooses to pass Door02, to enter place02 the place that Architect expecting her.

The Journey of Tom

Place01 (1:20)

Tom enters from Scene02, P3

Tom enters the scene from door02, walks towards the display screen and then walks and looks at the photos on the wall. The pictures show some location including an empty room, a deteriorated building, a gloomy sunset with a red sky,and the last one is a blurry picture of a girl. he recognizes the picture and the girl inside it. he turns confused and anxious, looks at the blurry picture again and walks toward door02 and left the scene to Place03.

Tom goes to Scene03, P3

Place03 (1 min)

Tom enters from Scen01, P2

Tom enters the scene from the door02.. he takes a quick look at the pictures in the corner then check the video display to realize to whom it belongs and then walk and take a look at the other pictures and stands in front of the wall with video displays which show Liz smiling repeatedly. He leaves the scene from the door01 and backs to Place01.

Tom goes to Scene01, P2

Place01 (40s)

Tom returns from Scene03, P3

Tom backs to the scene from door01. he still looks confused and frightened from what happens around him. he exits from the door01, in the scene and goes to the Place02.

Tom goes to Scene02, P2

Place02 (1:15)

Tom enters from Scene02, P2

Tom enters the scene from door01. He is confused. He checks his video on the display and looks at the photos on the wall rapidly. The pictures belong to his memories with Liz captured her in different positions alone.

Tom walks around scene and sit on the bench but suddenly he notices the picture in the corner. the picture is the same picture which is blurry in Place01. he goes toward the wall and then rapidly exit the booth from door02 and back to Place01.

Tom goes to scene01, P3

Place01 (1 min)

Tom enters from scene02, P2

Tom enters the scene seeking the blurry picture of Liz. he stands there for a while and thinks. go toward the video display and look at the close-up of the architect repeated in a loop, then he walks toward door01 and back to the Place02.

Tom goes to Scene02, P2

Place02 (3 :45)

Tom return from Scene01, P3

Tom backs to the scene and looks at the picture more carefully this time, then he walks toward the bench and sits there for a while. he stares at door01 seems expecting someone. **(45 S)**

But Liz enters the scene from the other door, door02. She looks at Tom for a while. then she goes toward the photos. Tom gets close to her

TOM

I searched for you everywhere.

Liz looks at him curiously, then turn his face toward the pictures on the wall

LIZ

You always looking for me!

TOM

Yes… I was expecting you to visit the gallery today to see my pictures. in fact, your pictures.

Liz starts walking, checking other pictures

LIZ

yes, My pictures.

Then she looks at the display on the other wall and walks toward it. Tom follows her.

LIZ

do you remember something happy when looking at my sad pictures?

TOM

I'm happy cause remember you.

Liz stares at Tom. Tom gets anxious. he wants to say something but hesitates. turn his face toward the display and speaks

TOM

Do you want me to replace it with a sad moment? ... Actually, I'm going to offer...

Liz stops him with her hand and tries to remember something

LIZ

wait?

TOM

what happened?

LIZ

Deja Vu.

Liz walks toward the bench while Tom stays there follows her with his eyes.

LIZ

I will reject every offer received from you today.

She sits on the bench. and look at Tom

LIZ

So please say nothing more. I like your works and I like you. but I need some space to be alone.

She stands up and looks at Tom

LIZ

I should be somewhere else.

Liz walks toward the door01 and enter the Place03. **(2:45)**

Tom just looks at Liz leaving the place, then looks at his video on the wall. He walks beside the wall of photos and looks at the photo of Liz one by one. Then he goes toward door02 and enters Place01. **(3:45)**

The End

Appendix XV- Shooting Schedule

Morning Session:

Title: Archi, A

Character(s): Architect

Virtual Space: 01

Story point: S1, P1

Duration: 3 min

A man wears in Black, the Architect, enters from door01 into the place and walks toward a black hole in the corner of the scene, he stands there for a while. As soon as the audience enters the space, the Architect turns his face toward him/her, looks for a while, then returns his face to the hole and starts narrating the story of this virtual space.

ARCHITECT

I Built this place to seize a moment,a moment that changed my life...

He smiles and walks toward the video display on the left wall, which displays his close-up remembering something sad.

ARCHITECT

And as I created my own reality, infact, I changed everything... even the past reality

He shows the other space in front of him (place02). A youngman, Tom and a woman, Liz, are speaking together. Then, Architect points the video display on the wall andcontinues… **(1min)**

ARCHITECT

a failed proposal… But the curiosity of knowing when and where this Déjà vu happened, was the reason for failure.

He turns his face toward the other place and looks at Tom and Liz for a while. Liz leaves Tom and goes to the other side of the scene, then she leaves the scene and goes to the other place on the right side (place03). The architect follows her with his eyes and then walking toward to his first place in front of the black hole. **(2 min)**

ARCHITECT

I made this impact.

He stays for a while there, then looks at Tom on the place02. Tom starts walking toward door02 and changes his place to the current place(Place01), concurrently the architect starts walking toward door01, and while Tom enters this place, the Architect goes to place02, which Tom was before.

Title: Tom, B2

Character(s): Tom

Virtual place: 01

Story point: S1, P2-1

Duration- 01:15

Tom enters the scene from door02, walks towards the display screen and then walks and looks at the photos on the wall. The pictures show some location including an empty room, a deteriorated building, a gloomy sunset with a red sky,and the last one is a blurry picture of a girl. he recognizes the picture and the girl inside it. he turns confused and anxious, looks at the blurry picture again and walks toward door02 and left the scene to Place03.

Title: Tom, B3

Character(s): Tom

Virtual Place: 03

Story point: S3, P3

Duration: 1 min

Tom enters the scene from the door02.. he takes a quick look at the pictures in the corner then check the video display to realize to whom it belongs and then walk and take a look at the other pictures and stands in front of the wall with video displays which show Liz smiling repeatedly. He leaves the scene from the door01.

Title: Tom, C1

Character(s): Tom

Virtual Space: 01

Story point: S1, P2-3

Duration (45 sec)

Tom backs to the scene from door01. he still looks confused and frightened from what happens around him. he exits from the door01.

Title: Tom, C2

Character(s): Tom

Virtual Space: 02

Story point: S2, P2-1

Duration (01:15)

Tom enters the scene from door01. He is confused. He checks his video on the display and looks at the photos on the wall rapidly. The pictures belong to his memories with Liz captured her in different positions alone.

Tom walks around scene and sit on the bench but suddenly he notices the picture in the corner. the picture is the same picture which is blurry in Place01. he goes toward the wall and then rapidly exit the booth from door02 and back to Place01.

Title: Tom C3

Character(s): Tom

Virtual Space: 01

Story point: S1, P3

Duration: (1min)

Tom enters the scene seeking the blurry picture of Liz. he stands there for a while and thinks. go toward the video display and look at the close-up of the architect repeated in a loop, then he walks toward door01.

08:15 recording for morning session

Afternoon Session

Title: Liz, B1

Character(s): Liz

Virtual Space: 03

Story-point: S3, P3-1

Duration: 20 Sec

Liz enters the scene. she felt sad. she stands for a moment in the middle of the scene. then she looks around and walks to the wall with the video display showing her remembering something happy. she takes a quick look at the pictures on the wall and then walks toward the doors, stands in the middle of them and then chooses to pass Door02, to enter place02 the place that Architect expecting her.

Title: Tom A, B1 - Liz A2

Character(s): Tom, Liz

Virtual space: 02

Story point: S2, P2-3 to S2, P3

Duration: 03:45 – (45 sec P2, 3 min P3)

Tom backs to the scene and looks at the picture more carefully this time, then he walks toward the bench and sits there for a while. he stares at door01 seems expecting someone. **(45 S)**

But Liz enters the scene from the other door, door02. She looks at Tom for a while. then she goes toward the photos. Tom gets close to her

TOM

I searched for you everywhere.

Liz looks at him curiously, then turn his face toward the pictures on the wall

LIZ

You always looking for me!

TOM

Yes… I was expecting you to visit the gallery today to see my pictures. in fact, your pictures.

Liz starts walking, checking other pictures

LIZ

yes, My pictures.

Then she looks at the display on the other wall and walks toward it. Tom follows her.

LIZ

do you remember something happy when looking at my sad pictures?

TOM

I'm happy cause remember you.

Liz stares at Tom. Tom gets anxious. he wants to say something but hesitates. turn his face toward the display and speaks

TOM

Do you want me to replace it with a sad moment? ... Actually, I'm going to offer...

Liz stops him with her hand and tries to remember something

LIZ

wait?

TOM

what happened?

LIZ

Deja Vu.

Liz walks toward the bench while Tom stays there follows her with his eyes.

LIZ

I will reject every offer received from you today.

She sits on the bench. and look at Tom

LIZ

So please say nothing more. I like your works and I like you.

but I need some space to be
alone.

She stands up and looks at Tom

LIZ

I should be somewhere else.

Liz walks toward the door01 and enter the Place03. **(3:00)**

Tom just looks at Liz leaving the place, then looks at his video on the wall. He walks beside the wall of photos and looks at the photo of Liz one by one. Then he goes toward door02 and enters Place01. **(3:45)**

Title: Archi, B

Character(s): Architect, Liz

Virtual Space: 02

Story-point: S2, P2

Duration: 3 min

The Architect enters the space from door01 and stands in front of the black hole in the middle of the scene. As soon as the audience enters the space, the Architecture turns his face toward him/her look for a while. **(20 s)**

Liz enters the scene from door02. She is anxious, and she starts to look at the photos on the wall. The pictures belong to Tom, who captured Liz in different situations. Architect gets close to her,

ARCHITECT

Hey, you're right? I’m looking
for you everywhere.

Liz looks at him curiously.

LIZ

Looking for me?

ARCHITECT

Yes, for you. the pretty girl in
these pictures

The architect points to another space in front of them (Place01) which is a young man is standing alone in front of the pictures.

ARCHITECT

that's me. A long time ago, I
proposed to you to be my lover,
and you rejected me.

Liz can't see what he pointed out. She is scared, rapidly checks all over the scene. then ask the architect

LIZ

there is no one here except us.

ARCHITECT

yes, we are alone.

both look at each other for a while, Liz continues looking at pictures on the wall

ARCHITECT

Anyway. I'm here to admire your beauty, nothing more.

Liz turns his face to Architect

LIZ

what?

She gets confused, Architect smiles, Liz gets act together

LIZ

Sorry... I mean thanks

The Architect points out one of the pictures. It is the same picture that was blurry in the Place01.

ARCHITECT

I like this one

both get close to that picture on the wall.

ARCHITECT

You're sad but we don't know why, it is something out of the field... something that only you know, and I've never realized it.

Liz looks at the architect curiously and asks

LIZ

Did we meet each other before? Cause you look familiar.

ARCHITECT

Yes, fifteen years ago.

LIZ

Fifteen years ago, I was a little kid, that's why I can't remember you...

ARCHITECT

But this is our first meeting.

LIZ

yeah. weird

Liz seems confused, trying to remember something. Suddenly she realises what architect said

LIZ

First meeting? But you said fift…

ARCHITECT

yes, I know. You are experiencing a weird situation, can't remember the first time we saw each other while you are sure it is the first time.

LIZ

Stop doing that.

ARCHITECT

doing what?

LIZ

Scaring me.

ARCHITECT

Sorry, can I offer coffee and sit somewhere. I promise no more non-sense talking. Just this last one... remember, you will reject any offers you receive today!

LIZ

How do you know that?

Architect smiles

ARCHITECT

No more non-sense. Let's drink a coffee and talk about the ART.

the architect goes toward door01 waits there and asks Liz with his hand to join him

ARCHITECT

After you, my lady

Liz walks towards the door, and they cross the door01.

Title: Archi, C – Liz C, A1

Character(s): Architect, Liz

Virtual Space: 03

Story Point: S1, P1 to S1, P2-1

Duration: 03:45

The Architect and Liz enter the scene. The Architect goes toward the black hole in the intersection of two walls and stands there. while Liz walks around the scene and looks at the pictures. As soon as the audience enters the space, the Architect turns his face toward him/her look for a while. Liz gets close to the architect and talks to him

LIZ

Honey, how lovely is the place you created for us. I like that. the best present I received.

ARCHITECT

My Pleasure darling. It is something belongs to the future, and we are pioneers among the other artists. With your talent and my creativity, we can do many more. that's just a start for me.

Liz looks at him and her mood changes. she becomes angry and speaks

LIZ

But you said this virtual gallery is my birthday gift... just for me... but in fact you used my artworks to develop your ideas.

ARCHITECT

Wait there. It is yours. but I'm the architect. I’m the designer of the space. So, the copy-right of space still belong to me even I give you this virtual place as a gift or even sell it to you. can you understand that

Liz angrily turns her face toward the pictures to her photos on the wall and then the video display.

LIZ

if it is mine now, I ask you to change this video with a moment that I will remember this day sadly.

ARCHITECT

Do you want me to change it with a sad face? technically I can reject your offer, but I will do it for you, my love.

the architect opens his arms to hug Liz, but she pushed him back and while clenching her teeth says

LIZ

you're disgusting.

Liz goes to another side of the scene and sits on the bench.

ARCHITECT

I know. But there are no other options.

He starts walking towards Liz

ARCHITECT

I really wished that everything between you and me led to other ways, but it is the reality of our relationship... you and I turns to disgusting people who discuss in a virtual reality.

The Architect and Liz look at each other for a while.

ARCHITECT

I know you can't understand that and may never realize the truth,

LIZ

Do not start non-sense talking again.

ARCHITECT

yeah, the truth is not understandable.

The architect cogitate for a while.

ARCHITECT

It's a Deja Vu. But when exactly does it happen or where?

He turns his face toward two other places, place01 and place02.

LIZ

what is it now?

ARCHITECT

Deja-Vu should not happen for me inside the world that I created. I should find the glitch in my matrix.

The Architect walks toward door01 and enters Place01. **(3 min)**

Liz still sitting on the bench and following him with her eyes. she wants to say something but hesitates. She stands up and goes toward her video of remembering on the wall and watching it for a while, then, she leaves the scene from the other door, door02, and goes to the Place02. **(3:45)**

10:50 recording for afternoon session