Universidade de Aveiro
2021

Pedro André de Almeida Martins

Quais as potencialidades da criação de um videoclip em Realidade Virtual?
What are the potentialities of the creation of a Music Video in Virtual Reality?

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What are the potentialities of the creation of a Music Video in Virtual Reality?

Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Comunicação Multimédia, realizada sob a orientação científica do Professor Doutor Mário Vairinhos, Professor auxiliar do Departamento de Comunicação e Arte da Universidade de Aveiro.

o júri

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agradecimentos

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palavras-chave Virtual Reality, Music Video, Cinematic Virtual Reality

resumo

O foco desta dissertação é na potencialidade de criação de videoclips em Realidade Virtual. Como tal, foi analisado no enquadramento teórico o que são videoclips, o que é a Realidade Virtual e, mais especificamente, o que são videoclips em Realidade Virtual, tópico sobre o qual não existe muita investigação no meio académico, de maneira a que esta dissertação serve como base para investigações futuras.
Um videoclip foi feito para Realidade Virtual para a investigação da qual esta dissertação faz parte, a fim de perceber as potencialidades do meio. O videoclip foi criado com base nas fases convencionais de produção audiovisual. Feito isto foram feitos testes de utilizador para avaliar as características do videoclip. Estes testes foram feitos em 3 amostras independentes cada uma para um formato diferente de visualização de videoclips em Realidade Virtual, desktop-360-2D, mobile-360-2D e em Realidade Virtual com um *Head Mounted Display.* Isto foi feito de modo a perceber melhor as potencialidades da Realidade Virtual comparativamente com os outros meios. Cada participante teve de responder a um questionário pré-teste e a um questionário pós-teste. A análise dos resultados mostrou que apesar da Realidade Virtual oferecer o benefício da imersão, ela tem os seus desafios, e requere uma abordagem completamente nova para a realização de videoclips.

keywords Virtual Reality, Music Video, Cinematic Virtual Reality

abstract

The focus of this dissertation is in the potentiality of the creation of a music video in Virtual Reality (VR). As such, it was analyzed in the theoretical framework what are music videos, what is VR and, more specifically, what are music videos in VR, which is a unresearched topic in the academic field, to which this dissertation provides some basis for feature research in this area. A music video for VR was made for this dissertation as to better understand the potentialities of the medium. The music video was made under the conventional phases of audiovisual production. Then user tests were made for this music video in order to evaluate its characteristics. The tests were made with 3 independent samples because the music video was shown in desktop-360-2D, mobile-360-2D, and VR on a Head Mounted Display (HMD). This was done as to better understand the potentialities of VR by comparing it to other mediums. Each participant had to answer to a pre-test questionnaire, and to a post-test questionnaire. The analysis of the results showed that although VR offers the added benefit of immersion it also poses its own challenges and a completely new approach to music video making.

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List of Abbreviations

HMD – Head Mounted Display

VR – Virtual Reality

CG – Computer Graphics

1. Introduction

Music videos have a long history starting with its predecessors in the beginning of the 20th century, to the new paradigms of content creation and dissemination on the internet, where it is now possible for users to easily create, publish and share their own content. Arguably, a single user could create an entire music track and then create the respective music video (even a Virtual Reality one) using only a computer. Likewise, VR (Virtual Reality) technology has also come a long way: from its inception in the middle of the 20th century to the current Head Mounted Displays (HMDs).

The internet alongside the development of affordable and quality devices for recording both immersive audio and video and affordable and wildly available reproduction systems such has HMDs, has paved the way to the appearance of VR music videos as well as to the easiness of user content creation.

It has not been discussed, at the least to the knowledge of the creator of this paper, the characteristics of the creation and fruition of music videos for VR in the academic field. Despite its similarities with other VR content, music videos in VR have an inherent musical nature and visual codes associated with its standard counterpart and other VR content.

1.1 The goals of the investigation

Given its uprise in recent years, VR is a new technology despite its long history. Because of this, VR holds a lot of latent potentialities, being one of them the music video, which, in this context, is a very underdeveloped format. As such, it is the aim of this dissertation to better understand the potentialities of creation of music videos in Virtual Reality (VR). Therefore, the main goal of this investigation project was the creation of one for such format. Once this music video was made, the next step was to evaluate it with user tests, in which the participants watched the music video in 3 different formats, desktop-360º-2D- mobile-360º-2D, and VR with a HMD, as to then be able to analyze and to form conclusions via comparison.

The goal of this investigation is to understand the potentialities of creation of a music video for VR through the process of creating one.

1.2 Structure of the dissertation

The present dissertation is divided into 5 chapters: introduction; theoretical framework; the development of a music video for Virtual Reality, evaluation of the music video created for Virtual Reality and the conclusion.

The introduction presents the thematic of the investigation, describes the problematic that was the basis for this project, and the goal aimed to be answered through the implementation of this dissertation project. The theoretical framework presents all the theoretical basis for the execution of this project. In the following chapter, the development of a music video for Virtual Reality, there is described all the process of creation of a music video for VR. Thereafter, the data gathered through the tests was discussed and analyzed. Finally, we did a reflection of the investigation done for this dissertation, and issued some conclusion based on the findings.

2. Theoretical framework

2.1 Music videos and the popular culture

In the first part of this theoretical framework it will be presented what is a music video and its place on popular culture, as well as an overview of its development, showcasing how image has enhanced the experience of music listening across time, in this case the music video, as well as milestones that allowed such growth. There will also be an exploration of how the music video was changed when it entered the internet.

As to better understand the place of the music video on popular culture, it is necessary an understanding of what popular culture is. We accept popular culture as that created for mass consumption, and that reflects the "traditions and material culture of a particular society. In the modern West, pop culture refers to cultural products such as music, art, literature, fashion, dance, film, cyberculture, television, and radio that are consumed by the majority of a society's population" (Crossman, 2019). We also accept the second definition of popular culture proposed by Crossman which is that culture which is created by the people¸ and which is seen as a lesser form compared to the "official" culture.

The music video is clearly a product of popular culture as it was created as a mean to promote popular songs, and at a certain point to promote the artist himself, including its own image. This format is also a cultural product as it is composed of various artistic forms such as cinema, music and fashion.

João Costa (2016), in his book "From MTV to YouTube"[1], which is the result of an investigation made in the ambit of a doctoral thesis, does a theoretical framing of what he considers the most important academic studies about music videos. Costa (2016) proposes a division of this framework in two time frames: the first ranging from 1983 to 1993, a time within which researchers focused on the rise of the music video due to the MTV; and the second, ranging from 1996 to 2015, in which the focus was in the decentralization of the format on television and its complete abandonment by the MTV, as well as its shift to the internet.

In his theoretical framework, Costa (2016), highlights authors such as John Fiske, Andrew Goodwin, Kevin Williams, Carol Vernallis, Henry Keazor, Thorsten Wubbena, Diane Railton and Paul Watson as being the main influences on his investigation. Later, the author focuses on the convergence of the music video on the internet.

[1] Author translation of the original Portuguese title: "Da MTV para o YouTube".

This work will constitute most of the base for the conceptual analysis of what is a music video and its place on culture, as well as its convergence to the digital platforms such as YouTube.

Most will agree that the term “music video” was coined by Jiles Perry Richardson, in a 1959 interview for the “Disk Magazine” (Starej, 2017). This term is used to reference what is commonly considered a promotional video for a piece of popular music such as rock, pop, hip-hop, rap, etc. (Alfieri, 2019; Costa, 2016; Tom Carson, 2010). This format was massively popularized by the advent of MTV, in 1981, which, at the time, was a television channel that dedicated all its runtime purely to music videos (Costa, 2016; The Editors of Encyclopaedia Britannica, 2019a; Tom Carson, 2010). Due to its impact on culture and music videos, Costa (2016) points out that in the first theoretical time frame the authors made music videos synonymous with the MTV.

Being a commercial product itself, the music video is part of popular culture which is why music videos have always been made for mainstream music. However, that changed, as it will be explain later, with the appearance of the internet. Albeit capitalist in nature, the music video doesn’t promote its roots, but rather motivates people to counter the political and economic agenda. Furthermore, the music video serves as a bridge between underground art and mainstream content consumption, incorporating a sophisticated vanguardist language, which is why that for John Fiske, the music video is the only genuine art form produced for television (Costa, 2016). Also, despite being promotional pieces, music videos started to develop a language of their own, which is further proven by the fact that not always music videos helped to promote the artist and raise sales. Still, music videos were only reserved to mainstream hits, which made bands release less singles (Costa, 2016).

The music video is often considered the “quintessential postmodern art form: hybrid, parasitic, appropriative, often compromised by commerce or undermined by aesthetic pretension, ideally compact, and assimilable.” (Tom Carson, 2010). Costa (2016) enumerates how Peter Wollen in his 1986 article “Ways of thinking about music videos (and post-modernism)” sees the music video as post-modernist: firstly, the music video joins fine arts with vanguardism, social communication, popular culture, and new technology. Secondly, the music video is born out of a combination of different media, including, but not limited to cinema, fashion, and television. Lastly, the format is both referential to other forms of art such as cinema and painting, as well as to itself.

Andrew Goodwin, however, questions the post-modernist framing of the music video, because the scholars to that point had approached music videos as post-modernist, neglecting the musical aspect of the music videos, the impact of the VJs on audiences, the historical development of MTV as well as the fact that the channel had other content besides music videos. Furthermore, they also viewed the MTV as an individual entity rather than the network that it is a part of (Costa, 2016).

Music videos have influenced several fields such as fashion and politics (Costa, 2016). It is also important to refer that given their impact on society, they are commonly targeted for the way they represent people; be it in matters of sex, gender, ethnicity and so on. Such is the case with how music videos, as well as their predecessors, were always criticized for the way they sexualize women. On the flip side, music videos were also responsible for helping empowering women through Madonna's music videos for example (VH1, 2001).

Further on it will be explored all these cases in more detail throughout my exploration of the development of the music video.

2.2 Defining music videos

In his book, Costa (2016) elaborated a table comparing chronologically various attempts at categorizing music videos into genres which will be duplicated here. In this table there are present taxonomies by Marsha Kinder (1984), Ann Kaplan (1987), Joe Gow (1992), Carol Vernallis (2004) and Railton & Watson (2011).

KINDER (1984)	KAPLAN (1987)	GOW (1992)	VERNALLIS (2004)	RAILTON & WATSON (2011)
Narrative	Romantic	Non-performative	Narrative	Narrative
	Classic			
	Socially Conscious			
Performative	Nihilistic	Performative documentary		Pseudo-documentary
		Choreographic		Performative
		Pseudo-reflective performance		
		Mixed performative		
Dreamlike Visuals	Post-modern	Extravagant	Non-narrative	Artistic

Table 1 - Table for categorizing music videos (Costa, 2016)

As the author points out, all these categories have only the visual aspect of the video in consideration and were created based upon the narrative and performative aspect of the music video (Costa, 2016).

Perhaps the most interesting categorization in that it does not frame the music video in very specific categories such as nihilistic, classic, choreographic, or artistic, and which in turn allows for greater flexibility is that of Carol Vernallis (2004), which proposes a spectrum ranging from narrative to non-narrative. Furthermore, Costa (2016) suggests a continuum that ranges from the simplicity of the video musical diaporamas to the more complex interactive music videos later in his book.

The table provided by Costa (2016) offers an important basis for the categorization of music videos, however, the categorizations themselves could be further enhanced. As such, it is suggested, in this paper, a set of categorizations for various aspects of the music video. These categorizations include Vernallis' continuum of non-narrative to narrative, and it was based on this idea, that the other characteristics were created.

In the following table there are present all the categories:

Short ◄——————————————————————► Long
Non-interactive ◄——————————————————————► Totally interactive
Non-performative ◄——————————————————————► Performative
Non-narrative ◄——————————————————————► Narrative

Non-fiction ◄——————————————————————► Fiction
Non-immersive ◄——————————————————————► Totally immersive
Figurative ◄——————————————————————► Abstract
Non-diegetic ◄——————————————————————► Diegetic

Table 2 - Proposed table for categorizing Music Videos

The aspects being categorized are the following:

Firstly, the length of the music video is important because it help differentiate between standard music videos of 3-5 minutes (short) to lengthy music videos such as those of Michael Jackson, like "Thriller" (1984), and even visual albums (long).

Secondly, nowadays it is relevant to differentiate between the Non-interactive and the Totally interactive. Being the former the standard music videos with only video and audio, and the latter being a music that is completely interactive, from its visual to its sonic aspect. It is at this later point that the boundaries between what is a music video and what is a videogame completely become blurred.

Thirdly, it was added the non-performative to performative axis, which, has the name implies, is a continuum from the music video that does not have any performative aspects to the one that has. There was a preference to create this has a continuum rather than two categories of non-performative and performative because not all performative music videos are completely performative.

Fourthly, the non-narrative to narrative axis proposed by Carol Vernallis.

Next, it is suggested the non-fiction to fiction axis, which is also very self-explanatory: the first end is completely real, in like a documentary, and the other end is completely fiction, like fantasy.

Given the music video entrance in the virtual reality market it is also important to differentiate between the standard non-immersive music videos to those that are totally immersive, being made to be watched, at least, in a Head Mounted Display (HMD for short) with headphones for total simulation of the space being represented.

The proceeding axis differentiates the figurative from the completely abstract music video.

And lastly, there was marked a difference between the non-diegetic and the diegetic music video, which should not be mistaken by the performative music video, since they can overlap in terms of their qualities. For example, if a music video has people dancing to the song, such has in Sia's "Chandelier" and "Elastic Heart" but there's no one performing the song, the video is performative but non-diegetic. However, the diegetic music video is performative by nature.

2.3 The development of the music video

It is interesting to think that music always has been paired with a visual element of some kind, from the performer, to more sophisticated media such as music videos. LPs, EPs, singles, all have covers portraying the musicians or a visual representation of the music, there's concert posters and even dancing.

In another way, we can also think of silent films, that in turn have never been silent. In the early days of cinema, films were accompanied with live performers, some even creating sound effects for specific actions in the film (Cook & Sklar, 2019).

Given this, we have a broad picture of how sound has this complementary link with image.

> *(...)Music in the videoclip is heard as the source of images and their movement, never as their accompaniment. Videoclips produce a constantly fluctuating set of relationships between music and image, but the resulting form is not one in which either of these expressive forms somehow "represents" the other* (Straw, 2018).

2.3.1 The predecessors of the Music Video

In order to analyse the development of the music video it is relevant to start with an overview of its predecessors. It is worth pointing out that some of the predecessors of the music video share some, or even all, of its characteristics, however, they cannot be fully considered music videos since, in the first place they were not made or prepared to be mass produced unlike music videos after the birth of the MTV. They were rather a novelty, and were used to fill programming gaps, either in television or in other contexts, and, as such, they did not occupy the same space in culture as modern music videos do. Secondly, these did not have some of the complex codes of language predominant in the modern music video, such as its use of cinematic visual elements.

2.3.1.1 The Illustrated Song

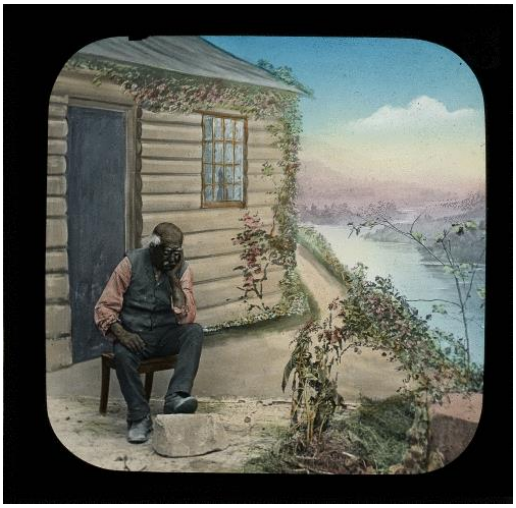

Figure 1 - Illustration of a slide to accompany the song "The Little Old Log Cabin in the Lane"[2].

The first predecessor of the music video was the Illustrated song (Figure 1). This format was born and popularized at the Vaudevilles[3] in the beginning of the 20th century in the south of the United States of America. The Illustrated Song was part of the program of these events were a musical piece would be performed and accompanied by a projection of illustrations of the song's lyrics (Starej, 2017).

Given their popularity, Illustrated Songs would later be performed on Nickelodeons[4], as a form to fill the gap between film re-wounds, as these theatres only had one projector. Because of this feature, Illustrated Songs grew in popularity over time surpassing their initial purpose as a program fillers (Starej, 2017).

2.3.1.2 Song-Car-Tunes

[2] Retrieved January, 24, 2020 from: https://en.wikipedia.org/wiki/Illustrated_song#/media/File:Little_Old_Log_Cabin_Illustrated_Song.gif

[3] Vaudevilles were entertainment houses from the United States of America that were popular from the mid-1980s to the early 1930s. These featured such acts like dancing, comedy, singing, illusionism, and illustrated songs (Starej, 2017; The Editors of Encyclopaedia Britannica, 2017).

[4] Nickelodeons were the first form of indoor motion-picture theaters from the 1905-1915. They were such named because the admission costed a nickel (5 cents) (Starej, 2017; The Editors of Encyclopaedia Britannica, 2019b)

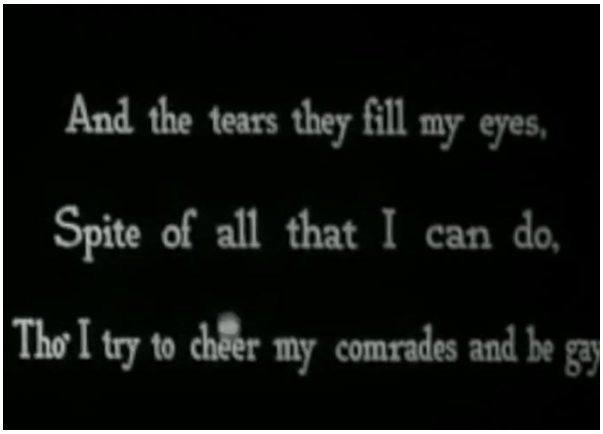

Figure 2 - Frame of the Song-Car-Tune "Tramp, Tramp, Tramp" (1924)[5].

In 1924, brothers Max and Dave Fleischer created the "Song-Car-Tunes" (see Figure 2), which were short animated musical films, and which were the first to apply sound to animation. They also pioneered the "bouncing ball", which was, as the name suggests, a ball that bounced over each syllable at the right time of singing. The importance of these feature lies in the fact that the ball was animated to the rhythm of the song, hence a visual representation of the rhythm of the music (Starej, 2017).

2.3.1.3 The Musical shorts

Figure 3 - Roy Smeck - "His Pastimes" (1926)[6].

Warner Brothers wanted the technology to provide synchronized musical accompaniment to their films (Filmmaker IQ, 2014). As such, in 1927 all Warner Brothers films would include sound (Starej, 2017).

With the advent of the Vitaphone came the musical shorts (see Figure 3). An example of this format were the "Screen Songs", a continuation of the "Song-Car-Tunes" by the Fleischer brothers, which

[5] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=_wX1_acp53U
[6] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=4i7--NRiK-I

were distributed by Paramount Pictures between 1929 and 1938 (Starej, 2017). In this time period, Warner Bros also produced thousands of musical shorts (Starej, 2017).

"(…) movie studios used musical shorts as a showcase for the new and upcoming actors" (Starej, 2017), which was an important stepping stone for actors as musical shorts were usually displayed before feature length films (Starej, 2017).

Meanwhile, musical shorts stopped being popular in the 1940s due to technological developments. However, they resurged in the 1950s to fill programming gaps in television (Starej, 2017).

2.3.1.4 Musical jukeboxes

Figure 4 - The Panoram. Look magazine, 19 nov. 1940[7].

The first musical jukebox was the Panoram (see Figure 4). It contained a screen approximately the size of a television, where was projected a 16mm film accompaniment for the music being played. (Friedwald, 2007; Starej, 2017). These films were called Soundies, which were "three-minute films made by the Mills Novelty Company between 1940 and 1947-about 1,865 in all" (Friedwald, 2007). These were films of bands, orchestras, or solo performers. The sound was recorded prior to the filming, for which the musicians would play or lip synch to the recording (Friedwald, 2007). From romantic music, to jazz, and even comedy musicians, Soundies covered all sorts of music (Friedwald, 2007; Starej, 2017). Despite their expense, Panorams were installed in various public spaces such as

[7] Retrieved January, 24, 2020 from: https://www.researchgate.net/publication/236754461_In_the_Flesh_Space_and_Embodiment_in_the_Pornographic_Peep_Show_Arcade/figures?lo=1

restaurants, bars, clubs, cafes, dance halls and even factories (Costa, 2016; Friedwald, 2007; Starej, 2017).

Friedwald (2007), suggests that instead of thinking of the Soundies phenomenon as the MTV of that time, we should think of it as the YouTube of that time.

As Starej (2017) points out, Louis Jordan, a vocalist, a bandleader, and saxophone player, was of extreme importance for music and music videos due to him being "(…) the first to use dance moves and matching suites, recognizing the importance of making a brand-name out of an artist(…)" (Starej, 2017, p. 9) . A paradigm that would be of extreme importance in the years following the launch of the MTV as it will be explained later.

2.3.1.5 Scopitones and the Cineboxes

Figure 5 - Scopitone ST36. 1963[8].

In France, in the beginning of the 1960s, a company called CAMCA (*Compagnie d'Applications Mecaniques a L'Electronique au Cinema et a l'Atomistique*), created a version of the Panoram, the

[8] Retrieved January 24, 2020 from: https://moma.tumblr.com/post/114766783296/tonight-a-rare-chance-to-see-a-scopitone-film

Scopitone. The Scopitone (see Figure 5), similarly to the Panoram, was a jukebox with a screen on top of it, on which there were projected 16 mm films. However, the Scopitone allowed each person to choose their preferred film, and supported colour film (Chicago Reader, 2016; Owens, 2016; Starej, 2017). The Cineboxes on the other hand, were the Italian competitors of the Scopitones. However, neither technology got attention outside of Europe (Starej, 2017).

2.3.1.6 The modern music video

Figure 6 - Frame from "Dame si do bytu" by Iren Kacirkova and Josef Bek (1958)[9].

What can be considered the first "fairly modern music video" (Starej, 2017, p. 10) was made in 1958 for the song "Dame si do bytu" by Iren Kacirkova and Josef Bek (see Figure 6) (Starej, 2017). This video was made in Czechoslovakia and was directed by Ladislav Rychman. It was "essential for music video history for the reason that it is the first music video that had a narrative incorporated within the song, not being part of a broader story" (Starej, 2017, p. 10)Furthermore, the video approximated the feature film with its art direction, which was uncommon for the music videos of that time, as well as for its use of special effects.

In 1964 The Moody Blues released both the song "Go Now" and its music video at the same time which leads "us to the conclusion that the song marketing strategy was built around the video" (Starej, 2017, p. 12).

The immense British group, arguably the most important band in music history, was the first to recognize the vastness of possibilities a connection of sound and picture could bring. An important factor in The Beatles making a global brand out of themselves were their movies (Starej, 2017, p. 12).

[9] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=lpmAUVchBeg

"A Hard Day's Night" was the first Beatles feature film, released in 1964 and directed by Richard Lester who, a year later, also directed their second film, "Help!". The former is a comedy-musical film which showcases the group sense of humour, and presents them in a natural, almost spontaneous way, as in the story they are travelling to London to perform a live set. It features dialogue scenes paired with musical ones, each standing on its own, with its particular narrative. Therefore each a music video (Pfeiffer, 2019; Starej, 2017; The Editors of Encyclopaedia Britannica, 2019c).

Not only are these two films predecessors of the mockumentary genre, but they also had a big impact in both the feature film world as well as in music videos, since these films helped to demonstrate that music videos could have narratives of their own, rather than a filmed performance of the song (Costa, 2016; Starej, 2017; The Editors of Encyclopaedia Britannica, 2019c).

Another staple of the 1960s music videos was Bob Dylan's "Subterranean Homesick Blues"[10], which is the introduction for a documentary about is English tour in 1965, named "Don't Look Back". In this video, Dylan is holding cards with some phrases of the lyrics written on them, which he changes accordingly. This video became "highly influential and often imitated" (Starej, 2017, p. 13).

Still In the 60s, artists started to understand the importance of the music videos and how to use them to their own advantage. However, despite all the advances being made in this industry, music videos were still being used to fill programming gaps on television (Starej, 2017).

2.3.2 Music in television

The First TV shows

Figure 7 - The Moody Blues on Top of the Pops in 1964[11].

[10] Bob Dylan – Subterranean Homesick Blues - https://www.youtube.com/watch?v=MGxjlBEZvx0
[11] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=sUFFRd27YDw

It's interesting to notice that some of the innovations happening on television for the propagation of music were inspired by radio. Such was the case with the British television show "Top of the Pops", which started on the 1st of January in 1964 and lasted for more than 40 years. This program, as the name suggests, was a showcase for the week's hit songs with respective music videos and live performances. Its main influence was Radio Luxembourg's "Teen and Twenty Disc Club", which was similar in concept.

The impact of the "Top of the Pops" was huge, not only on television as there were dozens of millions of people watching the program every week, as well on the music industry as it made the music video a necessity for anyone wanting to promote their music. This charged a lot of pressure on bands and music labels to produce high quality music videos who had to compete as to being featured on the show.

In 1969 there was premiered a television show named "Hee Haw" which presented country music videos, where were portrayed "animals and farmers in rural areas" (Starej, 2017, p. 13). Funnily enough

the guests of the show had the opinion that the videos took away the attention from their live performances, which they disliked since they thought that live performances would help promoting record sales more than music videos, an opinion proven to be wrong in the next decades of music video and mass media history (Starej, 2017, p. 13).

Queen's notorious video for "Bohemian Rhapsody" was made because the band couldn't perform live for "Top of the Pops", so they decided to do a music video to be shown there instead (Starej, 2017).

MTV

Figure 8 - MTV's premiere in 1st of August, 1981[12].

It is well known that the MTV started airing on the 1st of August 1981, as well that the first music video displayed was Buggle's "Video Killed the Radio Star"[13]. On those early times, the channel played exclusively rock music videos all the time, similarly to how a radio station would play the Top 40 hits, being the first channel to do so (Alfieri, 2019; Costa, 2016; Starej, 2017; The Editors of Encyclopaedia Britannica, 2019a; VH1, 2001).

Since the medium was so new, musicians were sceptical about doing music videos for their songs. This led to many bands that were not played on the radio to have a new medium of exposure, which in turn led to increasing record sales (VH1, 2001). From this point on, people started to realize that the music video was a powerful way of marketing music (Costa, 2016; VH1, 2001). At this rate musicians were becoming TV stars. Before music videos, people knew the artists appearance through, posters, album covers and live concerts, now people can get a closer look at the artists through the music video, which became one of the primary introductory elements for the artists and their music (VH1, 2001). This was the biggest step yet for music videos as it became plainly obvious how crucial was for an artist to have good music video in order to reach success (Costa, 2016; Starej, 2017; VH1, 2001).

This visual aspect of the band and their members started to gain new heights as androgynous personas like Boy George from Culture Club and Annie Lennox from Eurythmics tested the limits of gender (VH1, 2001). Before Michael Jackson's Billie Jean[14], MTV had already played some video clips by some African-americans, however they were very few. And in 1983, Rick James accused the channel of being racist when, at the time, they did not play his video for "Super Freak"[15] (Mitchell & Newman, 2009; VH1, 2001).

Some of the greatest milestones for music videos were videos made for Michael Jackson songs, mainly Billie Jean and, most importantly, Thriller[16]. Billie Jean was the first Michael Jackson music video on MTV, and its impact lies, among other factors, on the fact that his video helped to open the doors to black artists on the channel such as Prince, Billy Ocean and Eddy Grant. The video also displayed some other novelties like the choreographed sequences which were used in the context of the video. Which is why this video catapulted Jackson's record sales (Mitchell & Newman, 2009; VH1, 2001). "By

[12] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=i1QDSmflFtM
[13] The Buggles – Video Killed The Radio Star - https://www.youtube.com/watch?v=W8r-tXRLazs
[14] Michael Jackson – Billie Jean - https://www.youtube.com/watch?v=Zi_XLOBDo_Y
[15] Rick James – Super Freak - https://www.youtube.com/watch?v=QYHxGBH6o4M
[16] Michael Jackson – Thriller - https://www.youtube.com/watch?v=sOnqjkJTMaA

then the demand for "Thriller" was so intense that (…) manufacturing plants had slowed the pressing of other albums to make more copies of it." (Mitchell & Newman, 2009).

Michael Jackson's 1984 video for "Thriller" however, came unlike anything people had ever seen at the time. It had a runtime of almost 14 minutes, and it was the first music video directed by a film director, John Landis, it also cost 1 million dollars at the time, which was incredibly expensive for music videos at the time as their budgets only rounded to about $30,000 – $40,000, being it the most expensive of its time which is justified by the complex production and special effects. This did pay up however, and Jackson rose to stardom, being named King of Pop (Starej, 2017). The impact of Thriller was greatly felt on the music industry as people started buying records again after a 3-year decline in record sales prior to that (Mitchell & Newman, 2009; VH1, 2001).

Before Thriller, "the most that viewers could hope for from the three-minute interludes were either lip synced mini-concerts on makeshift stages or melodic tableaux of enraptured couples strolling" (Rouse, 2000).

> *It was a pivotal transition in that it marked the shift of emphasis from musical performance to visual presentation. In stark contrast to the other, live, performances of Motown 25, Jackson performed a pre-recorded soundtrack, lip-synching to his multi-layered pre-recorded voice, thus indicating that the visual reenactment of music video imagery had become an integral, and perhaps dominant part of live performance* (Matthew Delmont, 2010, p. 77).

Many bands only did music videos for their songs as a marketing strategy because otherwise they would be left behind the competition, which also meant that many musicians were very awkward about doing them and did it almost as an obligation. Such was the case with Journey's music video for the song "Separate Ways"[17] which the musicians despised doing (VH1, 2001).

For John Fiske, the MTV echoes the fragmentary nature of the music video, as the former is an uninterrupted flow of music videos, while the latter is an uninterrupted flow of moving images (Costa, 2016).

[17] Journey – Separate Ways - https://www.youtube.com/watch?v=LatorN4P9aA

Video Albums

Figure 9 - Blondie - "The Hardest Part" (1979)[18].

Video albums are essentially music videos playlists, which, at the time, were distributed physically on VHS and DVD with the advent of those formats in the decades of the 80s and 90s, respectively. The videos on those playlists corresponded with the musical alignment of a given LP (Costa, 2016). The predecessors of this format are the video albums which date back to the decade of the 70s, starting when every song of Blondie's album, "Eat to The Beat" (1979) was paired with a music video[19] (see Figure 9) (Costa, 2016).

2.3.3 The internet

The biggest turning point to the music, and music video industry was the internet, which allowed anyone to listen to whatever music they wanted, at the time they wanted, and how many times they wanted. This was made possible because, from this point on, users could upload and share their own content on the internet, which led to the rise of new musical genres, and to the rise in popularity of non-mainstream artists, as well as from artists from around the world. This was the decentralization of the music industry (Costa, 2016; Starej, 2017).

As television was losing its monopoly over the music video industry, music videos became free of the ephemeral programming nature of television, which was exemplified by the resurgence of old music videos which were uploaded mostly on YouTube (Costa, 2016). YouTube, is a platform for sharing user created videos which started in 2005 (Hosch, 2019). YouTube "(...) did not simply replace

[18] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=vEjCDriXwnI

[19] Eat to the Beat (1979) video album available at this playlist: https://www.youtube.com/playlist?list=PLj2djiWVJQExnnNZ6fy1XUz_78tEqNE0Y

older broadcasting models, but significantly transformed the way users and creators engage with and conceptualise the music video" (Johnson & Wilson, 2016, p. 167). In other words, YouTube was the greatest element of change for music videos on the web.

"the music industry is (...) under structural pressure to provide online content, notably video. The intensification of the information flow creates a need for stronger means to generate attention." (Holt, 2011). On the internet the music video became the main vehicle for the musical entertainment of many people (Costa, 2016).

With time, the internet has gathered a large range of music platforms and distributors, while, parallelly, there's been an increase in the amount of devices through which users can experience the content they want (McIntosh, 2016). Before the digital age of the internet, it was difficult, and less common to copy and pirate since there was a degradation in the quality of the copy (McIntosh, 2016).

Straw *(2018)* defends that, although in the age of the internet, the music video is the main source of music, it lost its cultural status given the fact that, firstly, videos are lost in the chaos of the millions and millions of unrelated videos being uploaded every day. Secondly, the video is usually just a conduit for the listening experience alone, which places the video in the background of the experience. Thirdly, music videos have failed to gain presence on social platforms such as Instagram, Facebook, and Twitter.

Meanwhile the music industry has its focus on the streaming services available to us today like Spotify, Deezer, Tidal and Apple Music (Straw, 2018). Nowadays, there's the necessity of naming a music video as "official" since there exist many others created by fans (Holt, 2011). And independent productions are creating simple and inexpensive productions as means of distribution (Holt, 2011).

It should not be overlooked the importance of MySpace in the development of the music industry. MySpace is a social network that allowed musicians and bands to share their work, to connect among each other and among fans. This in turn led to artists to collaborate, and to connect with the fans. Independent bands, and other, more obscure musical acts, founds their presence in circles of people who had similar tastes, which allowed those musicians to gain a wider audience.

The most prominent video-based platform, YouTube, serves as both an aggregator and a distributor (Burgess and Green) by gathering and promoting content as well as making it available to users (McIntosh, 2016). Music videos, now, however, are created for a large range of platforms and devices (Holt, 2011). Music distribution has become democratized, for example both fan-made videos as well as parodies inhabit the same space as regular music videos, and as such they can be considered legitimate video musical creations. (Johnson & Wilson, 2016).

Currently, music videos are the most viewed content on YouTube, being the top 10 all music videos, which are topped by Luis Fonsi and Daddy Yankee's "Despacito"[20] with 6 billion views, and with Kate Perry's "Roar"[21] on the bottom of the list with 2 billion views.

> *With figures like these, it comes as little surprise that the majority of the most popular videos on YouTube are music videos. Since 2010, all the most-viewed videos on YouTube have been music videos, signifying the platform's shift in focus from funny, viral videos to professionally produced content. As of 2019, about half of the U.S. population accessed YouTube for music consumption on a weekly basis* (Clement, 2019).

These facts represent the ever importance of music videos for music industry and their ongoing impact on culture.

User created content

It's interesting to note that although there were all these forms of media through the ages, baring similar resemblances but being separate through their context and their delivery medium, now they flow together on the internet, were any of these pieces of content are all but files being shared from computer to computer. This is an example of media convergence, and how all these meanings and definitions start to become blurred.

Media convergence is a "phenomenon involving the interconnection of information and communications technologies, computer networks, and media content" (Terry Flew, 2017), such as a smartphone which as numerous functions like standard phone calling and text messaging, to internet browsing, a feature that previously was exclusive of a computer (Terry Flew, 2017). Media convergence also "erodes long-established media industry and content "silos" and increasingly uncouples content from particular devices" (Terry Flew, 2017). One of the fundamental characteristics of media convergence is the participatory culture from which was born remediation, the remix, and collage (Costa, 2016).

With the birth of Web 2.0 the user has become an active user, in the sense that he is not just an spectator as that of television or radio, but more importantly a creator, called "prosumer" or "produser" (Güven, 2017). The type of content that a user can post on a social media platform can

[20] Luis Fonsi ft. Daddy Yankee – Despacito - https://www.youtube.com/watch?v=kJQP7kiw5Fk
[21] Kate Perry - Roar- https://www.youtube.com/watch?v=CevxZvSJLk8

either be “User Generated Content” or “Company Generated Content” (Park, Park, & Park, 2018). The availability of content online combined with the easiness of how a user can produce and share content online has led to users to use appropriated content in their work, which has proved a threat to intellectual property (Güven, 2017). “(…)consumer generated intellectual property, which arises when consumers rather than firms contribute content, innovate, modify, hack or in other ways change or add value to the offerings of organizations” (Berthon, Pitt, Kietzmann, & Mccarthy, 2015, p. 27).

Audio-visual gear and software are becoming more affordable by the day which allows users and consumers to more easily create quality content rivalling that of professional one, which is why the frontier between production and consumption as well as that of the amateur and the professional has become blurred (Güven, 2017), and which is why artists no longer need a record label (Holt, 2011).

From the 90s onward there’s been an ever-increasing body of work born of the manipulation of existing material. This has been a consequence of an extensive offer of content, the distribution of software such as video editors, and the advent of a participatory culture. All characteristics of the culture of information (Costa, 2016).

With the rise and proliferation of these new paradigms of creation and distribution, came the legitimization of media formats, previously ignored or neglected (Costa, 2016). The idea of the consumer and producer is being diluted (Costa, 2016).

Using existing material in order to manipulate and create something is not new and has been used in a wide range of artistic areas. For writing, Brion Gysin, discovered the cut-up technique (Collins English Dictionary, n.d.), which was later used and popularized by William S. Burroughs in his books “The Nova Trilogy” (Costa, 2016). In music, from the 70s there’s been a rise in popularity of techniques of remixing, sampling and mashups, which were responsible for the creation of new musical genres such as dub, hip-hop and house (Costa, 2016).

2.3.4 New forms of music video on the internet

In this section it will be explored some of the new types of music video which were born in the internet from the media convergence. It is also worthy to mention that many music videos will fall into more than one category of this list.

Medium to long duration music videos

Figure 10 - Kanye West - "Runway" (2010)[22].

Music videos are commonly the length of the music it is made for. Because of that, they generally fall between 3-5 minutes in duration. However, there have been some cases of music videos with an extended duration, some having 10 minutes, and some even 40, which is the case with some Michael Jackson's music videos, such has "Thriller" (1984), which runs for 13 minutes (Costa, 2016).

These videos normally have an extended duration, past its audio-source given the fact that they might feature a narrative or some other audio-visual component. Some examples of lengthy music videos are Kanye West's "Runway" (see Figure 10) and Arcade Fire's "Afterlife"[23].

This type of music video was the result of the convergence of video art, cinema, rock operas, and of course, music videos.

It should be noted that the medium to long duration music video, should not be confused with the visual album, since the former refers to the duration of a single music video, made for a single musical piece and not a video made for various musical pieces.

There are, however, some music videos that do use more than one song of the artist, which is the case for FKA twigs' "Video Girl"[24], which besides the main track, also features the track "Preface"[25] as an intro for the video. Other music videos use as well other tracks of the same artist as intros or outros as well, which is the case of Childish Gambino's "3005"[26] that features a clip of his song "II. Zealots of Stockholm [Free Information]"[27].

[22] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=Jg5wkZ-dJXA
[23] Arcade Fire – Afterlife - https://www.youtube.com/watch?v=EcKinnMXuKg
[24] FKA twigs – Video Girl - https://www.youtube.com/watch?v=2jhTiLuGezI
[25] FKA twigs – Preface - https://open.spotify.com/track/4A3cxxQ70VvwzyteN6sIbo?si=EW9mZ8KnQ0a03H801H4DLg
[26] Childish Gambino – 3005 - https://www.youtube.com/watch?v=tG35R8F2j8k
[27] Childish Gambino - II. Zealots of Stockholm [Free Information] - https://open.spotify.com/track/4J5vBoKj2w2mBXbGqNDFYV?si=QJzTQR5oRs-csnhAOymtFg

Music Video Series

There has been a rise of music video series, which was made possible by technological developments, such as more accessible audio-visual gear and software, this is true because those series of music videos are very expensive to make, since they implied more than one video. Costa *(2016)* identifies their predecessors as the video albums which were referenced back in this work. However, music video series differ from those, and the visual albums is that each video of the series is distributed online separately, which makes the experience of watching the whole difficult *(Costa, 2016)* and not the main focal point.

Online, these videos are either brought together through playlists, which can also include visual albums, or made as a single video containing all the videos. The latter differs from the lengthy type of music video in that it is composed of various music videos rather than a single video for a song. And the former also differs from the lengthy music video in that each video can be watched separately, and that it does not need a consistent story overarching every music video.

Finally, Costa *(2016)*, mentions that the music video series, aside from the video albums, were also influenced by television shows (namely soap operas) in that there are elements of story and production that clearly evidence the similarities.

Visual Album or the Musical film

Figure 11 - Daft Punk - Interstellar 5555[28]*.*

"The visual album is a hybrid medium between music video and film; like music video, it promotes an audio album, and like film, it is conceived as a whole work of art" (Harrison, 2014, p. ii).

Cara Harrison (2014) defines two formal qualities of the visual album: firstly, there's the *direct relationship,* which is defined by the visual album having a direct relationship with the audio album.

[28] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=3Qxe-QOp_-s

In other words, the visual album and the audio album must have songs and the artist in common with the audio album. This does not mean that the songs need to be in the same order, or that the visual album needs to have all the songs of the audio album. The second formal characteristic is the *album length,* which must be superior to the average music video (3-5 minutes) and has no superior limit.

A middle term between the standard music video and the visual album is that of, what Fabian Holt calls the *cinematic song-video* which he claims that it is pushing the boundaries of the music video. They create a cinematic experience with introductions and narrative moments without the music. Some examples of this feature are Lady Gaga's "Telephone"[29], Michael Jackson's "Thriller", Bush's "Greedy Fly"[30], among many others.

The term visual album came to the fore with Beyoncé's self-titled album that was released on iTunes in 2013. In this release there was the normal LP edition and another with all the audio-visual versions of the songs of the LP except for the song "Grown Woman" (Harrison, 2014). In this case, each video can be experienced as a standalone experience, however it was made to be watched has a whole, which is why it is both a visual album and a music video series. Previously the band Animal Collective released a self-proclaimed visual album called "ODDSAC"[31] in 2010. Some modern examples of this format are Daft Punk's "Interstellar 5555" (2003) (see Figure 11), Noah and the Whale's "The First Days of Spring"[32] (2009), Girl Talk's "Girl Walk, All Day"[33] (2011) and iamamiwhoami who has a music video for each song for all her three albums: Kin[34], Bounty[35] and BLUE[36].

Some of the predecessors of this genre are The Beatles' "A Hard Day's Night" (1964), Serge Gainsbourg's "Histoire de Melody Nelson" (1971), Pink Floyd's "The Wall" (1982) and Prince's "Purple Rain" (1984) (Vogler, 2016).

Like Beyoncé, Kanye West and Frank Ocean are other contemporary artists pushing the envelope of artistry through music videos, and particularly visual albums. For instance Frank Ocean's Endless" is a 45 minutes experimental film, in black and white, featuring "no discernible narrative, depicting a digitally multiplied Frank Ocean slowly (…) assembling, from scratch, a stairway to nowhere in the middle of a warehouse, all set to new, often equally inscrutable music by Ocean and an array of

[29] Lady Gaga ft. Beyoncé – Telephone - https://www.youtube.com/watch?v=EVBsypHzF3U

[30] Bush – Greedy Fly - https://www.youtube.com/watch?v=6FExyoAh6Ng

[31] Animal Collective – Oddsac - https://www.youtube.com/watch?v=tC-0yVR6uSI&t=1150s

[32] Noah and the Whale – The First Days of Spring (short trailer) - https://www.youtube.com/watch?v=leYud3uv5pY

[33] Girl Talk – Girl Walk, All Day (playlist) - https://www.youtube.com/playlist?list=PLAA43C8477E3D03AF

[34] iamamiwhoami – Kin: https://www.youtube.com/playlist?list=OLAK5uy_lA6d2kYzNWlP9PYN_2-nDoXyLuEL99ySw

[35] iamamiwhoami – Bounty: https://www.youtube.com/playlist?list=OLAK5uy_lH-y6WK0eLdlQ-XCQTTtqg98FWMjlS87M

[36] iamamiwhoami – BLUE: https://www.youtube.com/playlist?list=OLAK5uy_kh0vDEQghX8I7nPKby3yc-JfisCo9sD7I

collaborators" (Atad, 2016). It is through this pieces, derived by the appeal of this mainstream artists, that audiences experience avant-garde cinema (Atad, 2016).

On a side note, although not a visual album or a music video, the film "Baby Driver" (2017) is interesting to mention in this context since the whole film was created around the soundtrack: actors movements and sound effects, for example, all were made to be synchronized with the music (Marshall, 2017).

Video-musical performative sessions

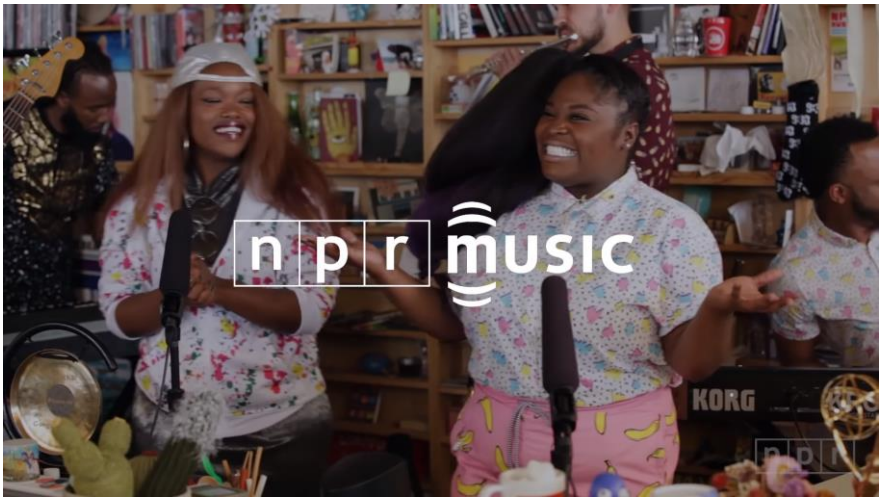

Figure 12 - Tank And The Bangas: NPR Music Tiny Desk Concert[37].

Thirdly, one of the most popular genres of music videos on the internet are the video-musical performative sessions in which, as the name suggests, the artists do a live performance of their music, which is recorded and distributed mainly on the web. These recordings are produced by discographic editors, tv and radio stations, specialized magazines, independent producers, portals, brands and even common internet users. These performances are usually uploaded on to YouTube or Vimeo and are generally made in a studio, a room hall, or an office, without an audience *(Costa, 2016).*

The predecessors of video-musical performative sessions are the recordings of live concerts on CD, DVD, VHS, vynil and cassette tapes; by live programs such as BBC's Top of the Pops, ABC's American Bandstand, PBS's Soundstage, MTV's unplugged, BBC's Later...with Jules Holland, and PBS's City Limit; and finally, standard live concerts.

All these formats: the live concert, the concert recordings, and the live music programs were "converged" later into the internet as the video-musical performative sessions *(Costa, 2016).*

[37] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=QKzobTCIRDw

Interactive music videos

The fourth type is the interactive music video. These are music videos which can be directly manipulated by the user and can be differentiated from the standard music video by three key aspects: firstly, they are distributed on different platforms such as app stores and streaming platforms such as Within[38] for example. Secondly, they have short lifespans since they require extensive maintenance. And lastly, is the fact that the interaction happens mostly for the visual aspect of the music video (Costa, 2016)

Costa (2016), points out that the advent of this format is the result of the convergence of the casual videogames with music videos on the internet. The similarities between both are that they have a wide target audience, have simple rules of gameplay, don't require a strong investment on the part of the user, are usually free, and don't require large costs of production. The author also comments that this type of music videos have vastly unexplored potential (Costa, 2016).

Some examples of these are Bjork's "Biophilia" app for the album of the same name, Arcade Fire's "The Wilderness Downtown" (see Figure 13).

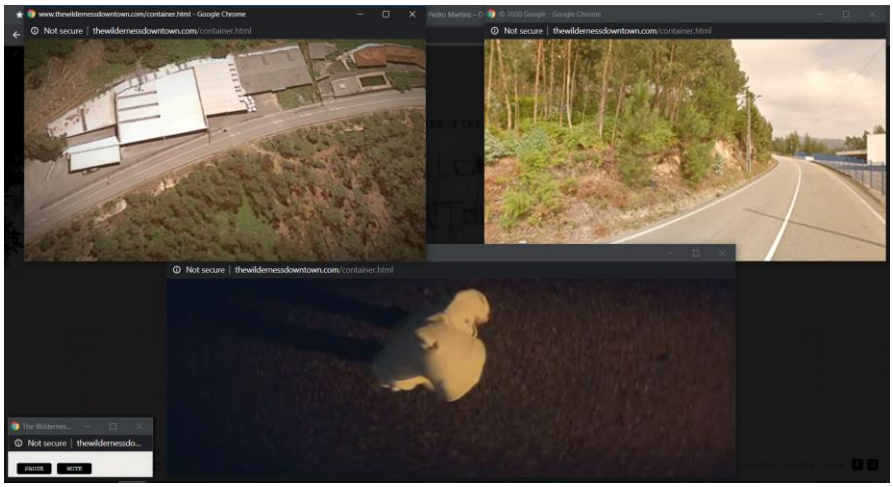

Figure 13 - Screenshot of Arcade Fire - "The Wilderness Downton"[39].

[38] A platform for distributing 360 and Virtual Reality content. Available at: https://www.with.in/

[39] Retrieved January 24, 2020 from: http://www.thewildernessdowntown.com/

Videomusical Diporamas

Figure 14 - Daft Punk ft. Pharrell Williams, Nile Rodgers - Get Lucky (2013)[40].

Diaporamas are video slideshows with synchronized sound. In this context they are music accompanied with an image or more, but typically just the cover of the album from which the music is from. This type of videos is widely common and shared throughout YouTube (see Figure 14) (Costa, 2016).

The author points out some characteristics inherited from the media convergence, namely the fact that musical fruition is not exclusively musical. Secondly, the fact that this type of music videos help to provide the visual component of music on the internet, previously destined to physical components such as album covers and inlays, as well as merchandising materials such as posters, flyers, T-shirts, and so on.

One of the predecessors of this type of music videos are the vids or fanvids which were fan-made videos composed of static images of feature films or TV shows paired with a soundtrack constructed in a way to provide a narrative (Costa, 2016)

On the web, this format is on the tip of the convergence of the fanvids, artwork such as album art and the diaporamas. One of many examples is a fanmade lyric video with a photo in the background of Chase Atlantic's "Friends"[41].

Costa (2016) mentions that some fan videos being the predecessors of the videomusical diaporamas.

However, not all these types of videos are just static images. In Daft Punk's "Get Lucky" (see Figure 14) the band at a certain point starts to move and perform according to the music. Another example, but this time with constant animation, is the audio only version of Kate Perry's "Bon Appétit" ft. Migos

[40] Retrieved January 24, 2020: https://www.youtube.com/watch?v=5NV6Rdv1a3I
[41] Chase Atlantic - Friend - https://www.youtube.com/watch?v=xKtkpHsK7jI

[42], which is composed of a picture of Perry's head rotating while blinking on of her eyes and with other animated components in the background.

Typographic music videos

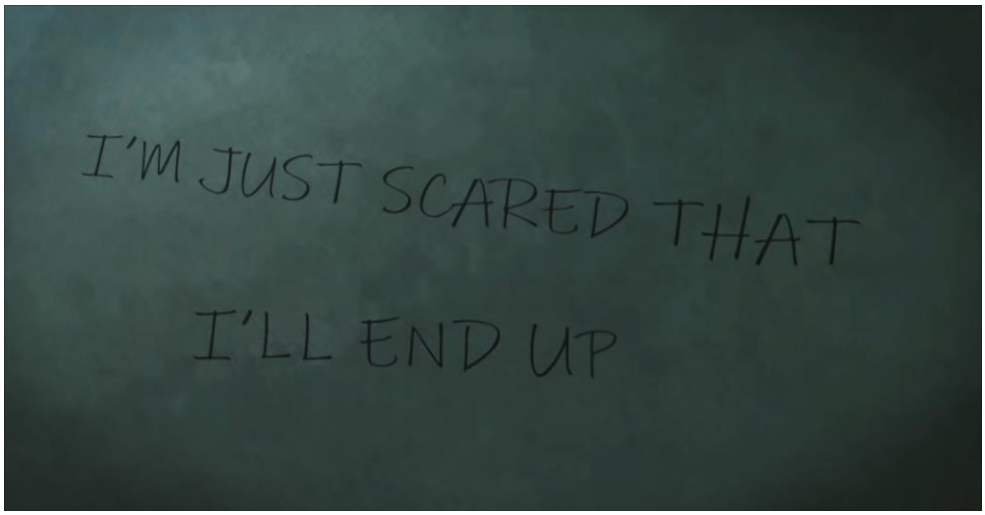

Figure 15 - Au/Ra, Alan Walker - Ghost (2019)[43].

Typographic music videos, which are often called lyric music videos, are text animations of the lyrics of a song with the music being the soundtrack (Costa, 2016). This format dates back to 1987 with Prince's "Sign "O" Times"[44], which was made because the singer didn't want to make a music video for the song. However, the predecessor of this format was the title sequence for Alfred Hitchcock's "North by Northwest"[45] created by Saul Bass (Costa, 2016)

Similarly to the diaporama music video, the typographic music videos share the common importance of providing a visual component, in this case that of the inlays of the physical material, which held the lyrics of the songs. One of the advantages of the typographic music videos are the fact that they are very cheap to create (Costa, 2016).

The typographic music videos on the web result of the convergence of the music videos, the inlays of the physical materials and the kinetic typographies (Costa, 2016).

Data visualization or graphical score music videos

[42] Kate Perry ft. Migos – Bon Appétit - https://www.youtube.com/watch?v=MH9ilfAZHOs
[43] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=0siAhk2DlgA
[44] Prince – Sign O' The Times - https://www.youtube.com/watch?v=8EdxM72EZ94
[45] North by Northwest (1959) – Title Sequence - https://www.youtube.com/watch?v=1ON67uYwGaw

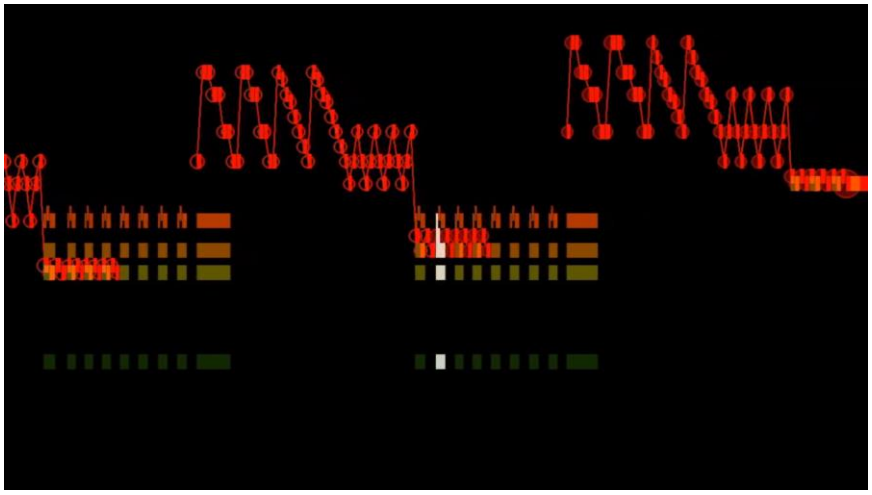

Figure 16 - Vivaldi, Winter, Four Seasons (Allegro)[46].

A video musical genre and that is also at the heart of the new paradigm of music videos on the internet, is music videos made with data visualization. They are visual representations of sound through time, resembling an animated partiture.

Firstly, these videos are important because they are used more frequently for classical music, which is an example of how the internet favoured genres of music which are not in the mainstream. Furthermore, it lies in the convergence of musical notation, which is the musical representation of rhythm and pitch in a partiture, hence a "set of visual instructions for performance of music" (Bent, 2019) and motion graphics, which were preceded by the title sequences of Saul Bass.

Here it will be presented some examples of this type of music videos. The first is an animation made for Vivaldi's first movement (Allegro) of "Winter" from *The Four Seasons*[47] by YouTuber smalin (see Figure 16). Another example, this time for jazz, was made for John Coltrane's "Giant Steps"[48]. However, this last example is not a musical score but rather a visual abstract representation of sound. On a completely different genre of music there is the official video for Autechre's "Gantz Graf"[49] which features abstract 3D elements distorting and moving according to Auterchre's glitched music. On another note, the official video for Ólafur Arnalds's "Ljósið"[50] instrumental music is a simple but effective representation of sound through bouncing and expressive particles of different colours, each representing a different instrument. A figurative attempt was made in Chemical Brothers' "Star Guitar"[51] , in which we see the perspective from inside a moving train seat looking outside, from which

[46] Retrieved January 24, 2020: https://www.youtube.com/watch?v=Qqe0GdUpJHs

[47] Vivaldi, Winter, Four Seasons (Allegro), with animated score - https://www.youtube.com/watch?v=Qqe0GdUpJHs

[48] John Coltrane - Giant Steps - https://www.youtube.com/watch?v=rh6WTAHKYTc

[49] Autechre - Gantz Graf (Official Music Video) - https://www.youtube.com/watch?v=ev3vENli7wQ

[50] Ólafur Arnalds - Ljósið - https://www.youtube.com/watch?v=mYIfiQlfaas

[51] The Chemical Brothers - Star Guitar - https://www.youtube.com/watch?v=0S43IwBF0uM

we can notice that each element, be it a house or a bridge for instance, that the train passes by is synchronized with a respective element of the music track.

Music video collage

Figure 17 - Jake Chudnow - "Shona" (2013)[52].

This format of music video can be characterized by, as the name implies, the use of content of different sources at the same time. In this case it can be either content (lyrics, music or image) from different music videos together or the juxtaposition of music (lyrics and audio) from a music video with images from other sources that are not music videos (Costa, 2016). There are several examples of this type of music video such has the fan made video for Aphex Twin's "Stone in Focus"[53], in which there was used a loop of a clip from the film "Baraka" (1992) of an ape in water. Another example is the use of public domain footage found in the website archive.org for Jake Chudnow's music videos, made by the musician himself (see Figure 17). Another example of these are the music video mashups such as the one that was made with Slipknot's "Psychosocial" with Justin Timberlake's "Sexy Back"[54]. The animated music video (AMV for shot) could be considered a subgenre of music video collage, where a song is played on top of edited anime footage, a good example of that is one called Numinus[55] made by user MrNosec which uses footage from various anime and two songs: Modestep & Koven's "Take it All" and Access Denied Remix of Audiomachine's "Guardians at the Gate".

[52] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=WBAIyY9y3HM

[53] Aphex Twin – Stone in Focus - https://www.youtube.com/watch?v=q86g1aop6a8

[54] Slipknot - Psychosocial But It's Sexyback by Justin Timberlake - https://www.youtube.com/watch?v=o-vHiR-GCzs

[55] Numinous – https://www.youtube.com/watch?v=aht9ZSwpMCk

Fan-made music videos

The fan-made music video could be described as an independent, non-official, video created for an existing piece of music. Some of the fan-made production rival that of the professional music video. For example, on April, 08 of 2016, artist Grimes commented on her official Tumblr page that a fan made music video directed by Anastasia Shulepova[56] for her song "Dream Fortress" (see Figure 18) would count as an official music video (actuallygrimes, 2016).

It is important to mention that the music video collage influenced the music and video production of amateurs and enthusiasts that produce content to be published on social networks, but primarily YouTube. When it comes to music covers of various types of music, be it of a soundtrack of videogame or a popular song, people that live in different geographic places can record their part of the music (e.g. in their room) and later combine the different recordings in an edited, mixed and cohesive piece.

Figure 18 - Grimes - Dream Fortress (2013)[57].

These videos also serve as a perfect example of the paradigm of the amateur /enthusiast user which rivals that of the professional in all aspects of production, a concept which is further enhanced through the development of platforms of crowdfunding such as Patreon and Kickstart, and with how easy it is to distribute videos online, on platforms like YouTube, Vimeo, Facebook or Instagram for instance, as well as on music platforms such as Spotify, iTunes, Deezer and Bandcamp. An example of a how, through these tools and platforms, content creators on the internet can achieve a high production value is, among many others, the Grissini Project cover of a song from the videogame The

[56] Grimes - Dream Fortress - https://www.youtube.com/watch?v=hy3FPRaeW3Y
[57] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=hy3FPRaeW3Y

Witcher 3 – "Lullaby of Woe"[58] (see Figure 19) which features musicians, actors, set design, outfits, lighting, and even visual effects.

Figure 19 - The Witcher 3 - Lullaby of woe cover by Grissini Project (2019)[59].

Even more simple videos might feature a thoughtful editing and cinematography, like YouTuber Patti Rudisill violin cover of the theme "Gazing at Sirius" from the video game *Fire Emblem: Three Houses*[60]. These Performance Music Video covers also inherit the collage technique of employing many videos and their respective audio sources. Some of many good examples are YouTuber insaneintherainmusic jazz covers of video game music, like his medley of the video game "Shovel Knight"[61] , which also features another characteristic of this type of music videos, which is the collaboration between content creators.

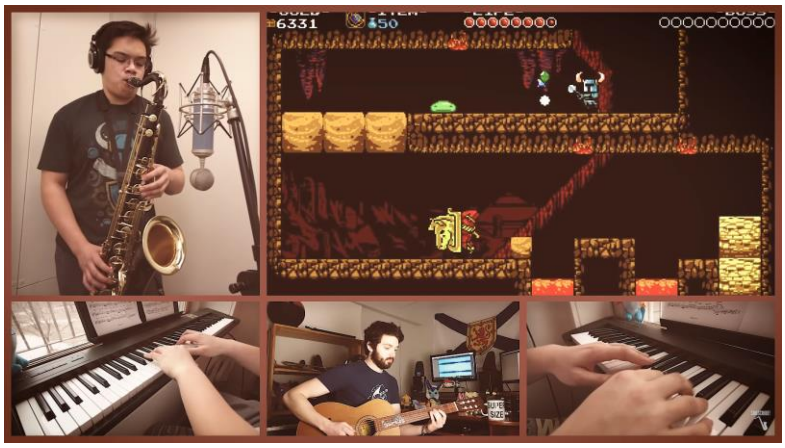

Figure 20 - Shovel Knight Jazz Medley || insaneintherainmusic (feat. Ryan Lafford) (2017)[62].

[58] The Witcher 3 - Lullaby of woe cover by Grissini Project https://www.youtube.com/watch?v=BGHbdq_DgMc

[59] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=BGHbdq_DgMc

[60] Fire Emblem: Three Houses - Gazing at Sirius (Violin Cover) https://www.youtube.com/watch?v=sRLKICP7wmg

[61] Shovel Knight Jazz Medley || insaneintherainmusic (feat. Ryan Lafford) https://www.youtube.com/watch?v=RkD_ynqh2VM

[62] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=RkD_ynqh2VM

These are all excellent examples of the decentralization of the music video industry.

Music video parody and pastiche

Figure 21 - "Weird Al" Yankovic -Eat It (1984)[63].

Parodies and pastiches differ in that the parody is an imitation of something made for comedic effect, while the pastiche is an imitation of a certain style (Costa, 2016; The Merriam-Webster.com Dictionary, n.d.-a, n.d.-b).

The proliferation of these types of video on the web is a consequence of the gradual publication of music videos that had previously only been seen on television in its short time frame (Costa, 2016).

A specific type of parody are the literal music videos, which consist of the original video and music with an alternative version of the lyrics which have been changed to tell what is happening in the video with subtitles which emphasizes them (Costa, 2016). The author explains that far from just exposing the randomness of the images being presented on the screen, these parodies employ a complex subversion of the music video since that instead of the video being made for the music, the lyrics, in other words, the music is representing the image. Furthermore, the video loses its narrative cohesion when juxtaposed with those lyrics, because when the music videos loses its original lyrics it loses one of the fundamental elements that compose its narrative core (Costa, 2016). The author also highlights these productions are one of the aspects that keep the music video alive on the web (Costa, 2016). A good example of parodies is "Weird Al" Yankovic parodies, like his music video for "Eat It" (see Figure 21), which is a parody of Michael Jackson's "Beat it". And an example of pastiche is in Lucy Rose's

[63] Retrieved January 24, 2020 from: https://www.youtube.com/watch?v=ZcJjMnHoIBI

music video for “Shiver”[64], in which at certain points there is the use of vintage video style to indicate the idea of the past.

Another type of music video was identified by the researcher after the writing of the theoretical framework, is that of the Visualizer, who Chaudhry (2017) mentions being

> *a simplistic visual intended to accompany a song, much like a music video or lyric video, and it’s a new trend. They tend to be less developed and fully–fledged than music videos, which often have more complicated visuals or a plot and characters. This term could come from music visualizers, software which produce graphics in response to audio, like Windows Media Player. This means that by calling their video clips “visualizers,” artists are arguing that this is the visual representation of their audio pieces* (Chaudhry, 2017).

This is also interesting considering that there are applications for visualizing music in VR such as

In the next chapter it will be addressed what is Virtual reality as well as its development over time, which are important concepts to understand before explaining what music videos in VR are, as well as the analysis which will be made for that format of music videos.

[64] Lucy Rose – Shiver - https://www.youtube.com/watch?v=1o84y-5-cO0

2.4 Virtual Reality

This section is devoted to Virtual Reality, and it covers its fundamental concepts, its genesis, an overview of its development, its qualities, and, lastly, on what is Cinematic Virtual Reality since it is the basis for VR music videos.

2.4.1 Concept

Virtual Reality is also known as Virtual Environments, Synthetic Experience, Virtual Worlds, Artificial Worlds or Artificial Reality (Gervautz & Mazuryk, 1999).

In 1935 Stanley G. Weinbaum published a fictional short story called "Pygmalion's Spectacles", in which a character created a pair of goggles which allowed a person to experience a movie with all their senses (Maravilla et al., 2019). In the academic field the concept of Virtual Reality (VR) was first explored by Ivan Sutherland in his seminal paper, "The Ultimate Display" in which he refers to the concept of immersion inside a virtual world (Cipresso, Giglioli, Raya, & Riva, 2018; Gobbetti & Scateni, 1998). However, it was only in 1989 that Jaron Lanier coined the term "Virtual Reality" who defined it has "a computer generated, interactive, three-dimensional environment in which a person is immersed" (Gobbetti & Scateni, 1998, p. 6; Lowood, 2019).

Gervautz & Mazuryk (1999) point out some definitions of Virtual Reality come from scholar literature in their article, all of which feature most prominentely these three components which they highlighted: *immersiveness,* of all senses in order to create an accurate feeling of presence and *interactiveness* with a given virtual and *autonomous* world. Cipresso et al. (2018) similarly pointed out definitions of VR reality all coming from the literature of this technology, and all of which share three common characteristics as well that the authors highlighted: *immersiveness, interactiveness*, and the sensation of being *present* in an environment.

Maravilla et al (2019), on the other hand, composed a research to understand how Virtual Reality has been conceptualized by scholars and technologists across 80 years of theory. From this, the authors analyzed all the definitions of VR and used "affinity diagramming [3] to create a work-in-progress framework for defining VR" (Maravilla et al., 2019, p. 2). From this process the authors arrived at the following three definitions: Firstly, "VR as environment", which is a view of VR as a technology that allows the creation of any kind of virtual environment, with the requirement that each environment must be 3D and interactive (Maravilla et al., 2019). Secondly, "VR as form of interaction", which defines VR on a more intuitive manipulation of the virtual world (Maravilla et al., 2019). And lastly, "VR as immersion", which is how the user feels that he or she is in another world, or in another words, how much that person is disconnected from reality (Maravilla et al., 2019).

Lowood (2019), in turn defines VR has “the use of computer modelling and simulation that enables a person to interact with an artificial three-dimensional (3-D) visual or other sensory environment”.

With all these definitions considered we can understand that some of the most singular aspects of Virtual Reality are immersiveness and interactiveness, and secondly, the sensation of being present in a virtual and autonomous world separated from physical reality.

2.4.2 Mixed Realities

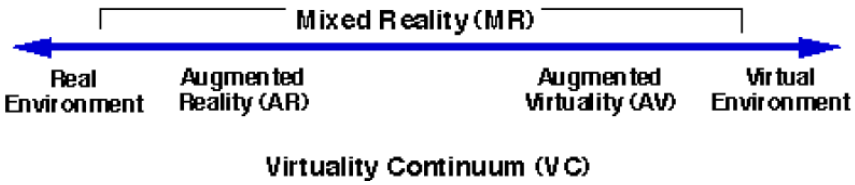

Figure 22 - Milgram & Kishino's Virtuality Continuum (1994)

Given the extent of modalities of interaction and visualization system with virtual worlds Milgram & Kishino (1994), suggest a Virtuality Continuum (see Figure 22), in which, at one end there are the real environments and at the opposite the virtual ones. Along this continuum we find near the real environment end Augmented Reality which is the augmentation of a real environment through virtual elements (Milgram & Kishino, 1994). Which is often the case when people use their smartphones to interact with real objects (Gandolfi, 2018). The opposite idea of virtual environments being augmented by the introduction of real objects is Augmented Virtuality (Milgram & Kishino, 1994). To these subcategories of real and virtual worlds being merged together we call Mixed Realities (Milgram & Kishino, 1994).

Some examples of Mixed Reality interfaces include the use of overlaid images like through chroma keying, for instance, either on a typical video monitor or a Head Mounted Display (Milgram & Kishino, 1994). Another type of Mixed Reality interface is See-Through Head Mounted Display, which is a transparent display, allowing the user to see the world, while also seeing the superimposed graphics (Milgram & Kishino, 1994). A well-known example of this type is the Google Glass.

Similarly, the Video See-Through Head Mounted Display, has an opaque screen on which is displayed an image of the immediate outside world. That image is filmed through a front camera. The computer graphics are then overlaid on top of image being displayed to the user (Milgram & Kishino, 1994).

Next is the case of the totally immersive virtual environments on which are superimposed video of real-world footage (Milgram & Kishino, 1994). And similarly, the partially immersive virtual environments, like that of large screen displays, in which the user interacts with real world objects, which in turn influence the virtual environment (Milgram & Kishino, 1994).

Virtual Reality is a way of a person to be present in a Virtual Environment or World (Gandolfi, 2018) And it is these worlds that have been proliferating since the dawn of the internet, with settings such has those of Massive Multiplayer Online Games (MMOGs), like World of Warcraft, Second Life (Gandolfi, 2018).

It is evident that Virtual Reality is not just for overcoming technological limitations but also exploring new possibilities of interaction, opening up a new range of uses (Gobbetti & Scateni, 1998).

2.4.3 VR as user interface

With the development of user-friendly interfaces for computers, users from various fields have been able to take advantage of the computer. The most important of these interfaces is that of the Desktop metaphor, which, has the name suggests, mimics the functionality of a desktop (Gobbetti & Scateni, 1998). However, this interface has its limitation when working with three-dimensional objects and environments given its restrictions on 2D outputs like a standard monitor and 2D inputs like a mouse (Gobbetti & Scateni, 1998). To counteract the low feedback given to the user, it is common to use multiple views of the same object (see Figure 23) (Gobbetti & Scateni, 1998).

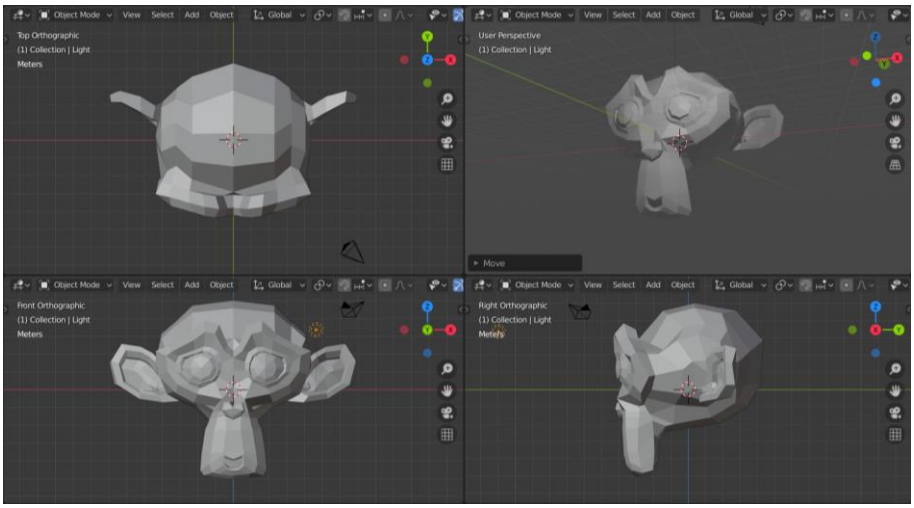

Figure 23 - Multiple views of an object in 3D space. Screenshot of the Blender software.

VR, in turn, allows the user to interact with the virtual object or environment using the same faculties he or she uses in the real world, thus eliminating needless complexity for the task being performed, and allowing for a more complete, intuitive and natural involvement of the person, exploiting the "(…) existing cognitive and motor skills for interacting with the world in a range of sensory modalities."(Gobbetti & Scateni, 1998, p. 3) (Gervautz & Mazuryk, 1999). VR even allows for people with disabilities to use computers (Gervautz & Mazuryk, 1999).

Virtual reality is more than just interacting with 3D worlds. By offering presence simulation to users as an interface metaphor, it allows operators to perform tasks on remote real worlds, computer generated worlds or any combination of both. The simulated world does not necessarily have to obey natural laws of behavior. Such a statement makes nearly every area of human activity a candidate for a virtual reality application (Gobbetti & Scateni, 1998).

2.4.4 Inputs and output devices

In VR the user interacts with the virtual world through input devices which should aim to create as a natural experience of interaction for the user as possible. These devices vary from simpler interfaces such as a mouse and a keyboard to more sophisticated 3D mouses, Head Mounted Display rotation tracking systems which interpret where the user is looking to, or standing within a room, and even "pinch gloves that detect the fingers movements, and trackers able to follow the user's movements in the physical world and translate them in the virtual environment" (Cipresso et al., 2018, p. 3; Gervautz & Mazuryk, 1999).

The output devices, on the other hand, are the ones that give feedback of the virtual world to the user senses. These devices can range from simpler, or lesser immersive displays such as desktop monitors to HMD or CAVEs when it comes to sight. In terms of sound, devices can vary from simpler speaker arrangements like that of a television or a computer, to surround sound environments setups and ultimately headphones (Gervautz & Mazuryk, 1999).

Levels of immersion

The level of immersion that a virtual reality system gives can be measured by how much of the human senses that system can stimulate and its level of fidelity (Gervautz & Mazuryk, 1999). The Desktop VR is a low immersive system because it features only a standard monitor which displays a monoscopic image (Cipresso et al., 2018; Gervautz & Mazuryk, 1999). The Fish Tank VR, similarly to the Desktop VR can also feature a simple monitor, however the level of immersion is elevated comparatively due to the fact that the head position of the user is tracked in order to display the image according to its perspective which gives the illusion that the person is watching through a window[65] (Cipresso et al., 2018; Gervautz & Mazuryk, 1999). Immersive systems such as that of HMD allow for

[65] https://www.youtube.com/watch?v=Jd3-eiid-Uw&t=23s – In this video Johnny Lee, created a system that uses the Wii remote to provide a head tracking interface in order to create a Fish Tank effect on his television.

a more deeper experience, which can be “enhanced by audio, haptic and sensory interfaces” (Gervautz & Mazuryk, 1999, p. 5)(Cipresso et al., 2018).

2.4.5 Uses of VR

Virtual Reality has been used in a variety of fields like force training, medicine (surgical training and psychological treatments and motor rehabilitation), entertainment (mainly gaming), employee training, data visualization, real estate, social skill learning, elderly assistance, architecture, education, and marketing (Bis, 2019; Cipresso et al., 2018; Gervautz & Mazuryk, 1999; Gobbetti & Scateni, 1998; Jenkins, 2019). One of many examples is Virtual Prototyping in fields such as engineering in “domains ranging from aerospace and automotive manufacturing to architecture” (Gobbetti & Scateni, 1998, p. 3). This technology allows for faster manipulation of the virtual object or environment and lower costs as a consequence of the increase in fidelity (Gobbetti & Scateni, 1998).

Virtual Reality is extremely helpful when it comes to simulators and training, because the greater fidelity allows the user to behave how it would in a real environment, exercising then, motor skills which can later be extrapolated to a real situation, this without the expense of traditional training and with greater safety (Gobbetti & Scateni, 1998; Lowood, 2019). An example of these are flight simulators which are used for training pilots and can be considered the precursors of modern VR as it will be explored later in this article (Gervautz & Mazuryk, 1999; Gobbetti & Scateni, 1998).

With high quality sensory feedback and technological prowess, it is possible, through virtual reality, to manipulate robots remotely in order to simulate the actual presence of a person (Gervautz & Mazuryk, 1999; Gobbetti & Scateni, 1998). This technology is used for exploring places that a human couldn’t access otherwise such as damaged nuclear plants or planets. Another remarkable use of this technology is remote surgery (Gobbetti & Scateni, 1998). Similarly, cooperative work can help remote users to work together remotely (Gervautz & Mazuryk, 1999).

VR is being

> *used in research on new ways of applying psychological treatment or training, for example, to problems arising from phobias (agoraphobia, phobia to fly, etc.) (Botella et al., 2017). Or, simply, it is used like improvement of the traditional systems of motor rehabilitation (Llorens et al., 2014; Borrego et al., 2016), developing games that ameliorate the tasks. More in detail, in psychological treatment, Virtual Reality Exposure Therapy (VRET) has showed its efficacy, allowing to patients to gradually face fear stimuli or stressed situations in a safe environment where the psychological and*

physiological reactions can be controlled by the therapist (Botella et al., 2017). (Cipresso et al., 2018)

2.4.6 The development of Virtual Reality

In this section it will be pointed out major landmarks on the development of Virtual Reality.

> *Artists, performers, and entertainers have always been interested in techniques for creating imaginative worlds, setting narratives in fictional spaces, and deceiving the senses. Numerous precedents for the suspension of disbelief in an artificial world in artistic and entertainment media preceded virtual reality (Lowood, 2019).*

Some of the early attempts at creating simulated worlds were the panoramic paintings of the 18th and 19th century (Figure 24) (Lowood, 2019). These paintings were placed in a way that made the work blend with the actual physical space in which they were displayed. The panoramas, the early ones measuring about 18 meters in diameter and later iterations 40, were wrapped around cylindrical walls, which made the need for a person to be in the middle of the room, on a platform, in order to correctly be immersed in that world of the painting. The immersion effect was further emphasized by the use of indirect lighting, which created the sensation that the light was coming from the painting (Lowood, 2019; The Editors of Encyclopaedia Britannica, 2018).

Figure 24 - Raevsky Battery during the Battle of Borodino by Franz Roubaud (1812)[66].

The panorama influenced the coming panoramic formats of the 20th century, namely the Cinerama (see Figure 25) (formerly known as the Vitarama), which was a cinema widescreen projection and filming technique for which were utilized three cameras next to each other in order to capture a wide

[66] Retrieved January 24, 2020 from: https://en.wikipedia.org/wiki/Panoramic_painting#/media/File:Battery_of_Raevsky.jpg

field of view. These images were then projected through three projectors on a wide curved screen (Lowood, 2019; The Editors of Encyclopaedia Britannica, 2014). This technology was abandoned, however, due to its large production costs (The Editors of Encyclopaedia Britannica, 2014).

The idea for this concept was born from one of the creators of this technology, Fred Waller, who was conducting studies on perception of visual depth, and his focus on the importance of the peripheral vision for conveying a sense of immersion (Lowood, 2019).

Figure 25 - A shot of the film "This is Cinerama" (1952)[67].

Later, the Cinerama technology was used by the Army Air Corps during the Second World War in order to train soldiers "under the name Waller Flexible Gunnery Trainer—an example of the link between entertainment technology and military simulation that would later advance the development of virtual reality." (Lowood, 2019).

Training has always been an important area for VR given the qualities expressed before in this text. The first prototype of a flight simulator was developed by Edwin Link in the late 1920s, with the name "Link Trainers" (Lowood, 2019). "The first systems used motion feedback to increase familiarity with flight controls. Pilots trained by sitting in a simulated cockpit, which could be moved hydraulically in response to their actions" (Lowood, 2019). Gradually the technology used in these simulators would advance and become more faithful in its simulation of reality. In the first iterations film strips were used to provide visual feedback for the user. Later, in 1968¸ Ivan Sutherland, alongside David Evans, founded the Evans & Sutherland Computer Corporation, in which they developed scene generators to use in flight simulators systems. The first flight simulators with real-time generated images were created by the General Electric Company, firstly for the Apollo program in 1960 and later for the U.S.

[67] Retrived January 24, 2020 from: https://pt.wikipedia.org/wiki/This_Is_Cinerama#/media/Ficheiro:This_Is_Cinerama_03.jpg

Navy in 1972. By this time they were starting to use 3D graphics (rudimentary by today's standards) for visual information, and later to use HMDs (since they require less space than full sized displays), which would, at a certain point, feature eye tracking (Lowood, 2019). These advances made for flight simulators paved the way for modern Virtual Reality given their necessity for fidelity and, through extension, immersiveness.

Modern Virtual Reality

Since the 1950s there have been attempts at building "devices that would allow users to experience different environments" (Maravilla et al., 2019, p. 2). One of the first attempts at integrating the user in a completely virtual environment was Morton Heilig's "Sensorama" of 1962 (see Figure 26), which was a mechanical device that allowed only one spectator at the time to experience short films which incorporated sensorial illusions of sigh through a coloured stereoscopic film, earing with binaural audio, touch with wind and vibrations and smell through channelled scents. However, the machine was not interactive unlike many of its successors (Cipresso et al., 2018; Gandolfi, 2018; Gervautz & Mazuryk, 1999; Lowood, 2019).

Figure 26 – Sensorama (1962)[68]

In 1963, Ivan Sutherland developed the Sketchpad, a computer system for drawing on a CRT monitor through a pen and a control board (Lowood, 2019). Later, based on Sutherland's ideas, were developed "the Sketchpad III (…) by Timothy Johnson, which presented 3-D views of objects; Larry Roberts's Lincoln Wand, a system for drawing in three dimensions; and Douglas Engelbart's invention of a new input device, the computer mouse (Lowood, 2019). In 1968, Sutherland developed, with Bob

[68] Retrieved January, 29, 2020 from: http://web.ist.utl.pt/ist170613/

Sproull, the first Head Mounted Displays, being “The Sword of Damocles” (see Figure 27) considered the first modern Virtual Reality system, and the first HMD with headtracking (Cipresso et al., 2018; Gandolfi, 2018; Gervautz & Mazuryk, 1999).

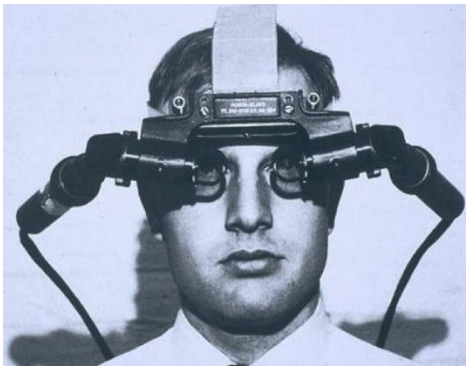

Figure 27 - Sword of Damocles (1968)[69]

In 1971, at the University of North Carolina, there it was developed the “GROPE” which was the first prototype of a force-feedback system (Cipresso et al., 2018; Gervautz & Mazuryk, 1999). Later, in 1975, Myron Krueger invented a system in which a person was filmed by a camera. That video was projected onto a screen as a silhouette and then the person could interact with the elements on screen through its movement (Cipresso et al., 2018; Gervautz & Mazuryk, 1999).

In the 1980s it was developed at MIT a system which allowed the user to manipulate a virtual 3D object through hand movement, being that the object had a correspondent position to that of the hand (Gobbetti & Scateni, 1998). Later, in 1984, NASA started the VIVED (Virtual Visual Environment Workstation) project and in posteriority the VIEW (Virtual Interactive Environment Workstation) project (Gobbetti & Scateni, 1998).

[69] Retrieved January, 29, 2020 from: http://web.ist.utl.pt/ist170613/

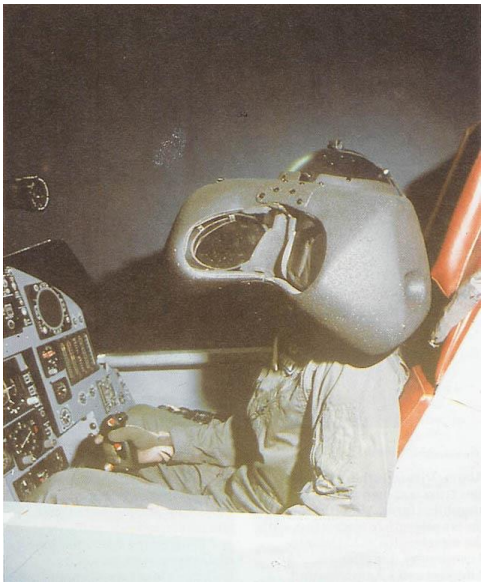

Figure 28 – VCASS (1982)[70]

In 1982, the first flight simulator was created by the United States Air Force, the VCASS (Visually Coupled Airborne System Simulator), which featured a HMD displaying targets and optimal flight paths (Cipresso et al., 2018; Gervautz & Mazuryk, 1999).

It was only in June 6, 1989, however, that Virtual Reality was introduced to the general public by VPL Research and Autodesk, who presented commercially available Virtual Reality devices (Cipresso et al., 2018; Gobbetti & Scateni, 1998). In the case of VPL, the company introduced the DataGlove in 1985, a glove that could register any hand gesture and rotation made by the user, and later the Eyephone in 1988, an HMD (Cipresso et al., 2018; Gervautz & Mazuryk, 1999).

In 1989 Fake Space Labs developed the BOOM (Binocular Omni-Orientational Monitor), an HMD composed of two CRT monitors, one for each eye, attached to a mechanical arm, which responded to the user's movements very quickly. This allowed for a more stable image compared to other HMD of that time (Cipresso et al., 2018; Gervautz & Mazuryk, 1999). This technology paired with the DataGlove were used by NASA Ames[71] in the early 1990s to develop the Virtual Wind Tunnel, which allowed one to visualize and manipulate flow fields, such as airflow for airplanes and space ships (Cipresso et al., 2018; Gervautz & Mazuryk, 1999).

Being that the technology would get progressively cheaper and more powerful, it came a time when VR would start to be sold to the masses. It was in this context that in 1990s that Nintendo and Sega released the *Virtual Boy* and the *SegaVR* respectively (Jenkins, 2019; Maravilla et al., 2019). These

[70] Retrieved January, 29, 2020 from: http://web.ist.utl.pt/ist170613/

[71]NASA Ames Research Center, is one of NASA's ten field centers "located in the heart of California's Silicon Valley. Since 1939, Ames has led NASA in conducting world-class research and development in aeronautics, exploration technology and science aligned with the center's core capabilities.", retrieved December 21, 2020: https://www.nasa.gov/centers/ames/about/index.html

devices, however, did not sold well due to technical problems and the lack of fidelity. This, in turn, led people to be less optimistic about the future of VR (Maravilla et al., 2019).

Some other examples of consumer grade VR are the Insidetrack, i-glasses! and Mattrel PowerGlove (Gervautz & Mazuryk, 1999).

In 1992, in the Electronic Visualization Laboratory of the University of Illinois, it was developed the CAVE (CAVE Automatic Virtual Environment) which is a room with stereoscopic images projected on the walls in order to simulate a virtual environment without the need for a HMD. This assures a wider field of view than its portable counterpart (Cipresso et al., 2018; Gervautz & Mazuryk, 1999).

Figure 29 - CAVE VR[72]

Facial Waldo^{tm} and VActor were two systems developed by SimGraphics which sampled an actors face and expression onto a cartoon in order to be animated (Gervautz & Mazuryk, 1999).

Past the turn of the millennium, in 2012, a company called “Oculus raised almost $2.5 million from a Kickstarter campaign for the Rift, their first head mounted VR display” (Maravilla et al., 2019). Later, in 2014, Facebook paid 3 billion dollars to Oculus. This marked the beginning of a race to bring consumers immersive headsets with companies like Google, HTC, Samsung and Sony rivalling Facebook, and the sparked the interest of investors and the public on VR (Cipresso et al., 2018; Jenkins, 2019). In that same year Google launched the Cardboard, which is a design reference to make a headset made of card board and that can be assembled by the user in order to be used with his or her phone (Maravilla et al., 2019). This technology takes advantage of the smartphone technology such as a built in gyroscope and its power in order to deliver a cheap VR solution (Maravilla et al., 2019). In 2015, Samsung, in partnership with Oculus released the Gear VR, which also uses the smartphone (Maravilla et al., 2019). HTC and Steam collaborated to create the HTC Vive (now known only as Vive)

[72] Retrieved January 29, 2020 from: http://piotrkolodynskiitx1000.blogspot.com/2018/01/cave-automatic-virtual-environment.html

which was the first HMD to provide three-dimensional tracking capabilities (Maravilla et al., 2019), and Sony with its PlayStation VR (Cipresso et al., 2018). These later devices such as Oculus and Vive, provide better device quality, as well as wider field of view and lower latency than their predecessors (Cipresso et al., 2018). Furthermore, these "(…) devices can be now combined with other tracker system as eye-tracking systems (FOVE), and motion and orientation sensors (e.g., Razer Hydra, Oculus Touch, or HTC Vive)" (Cipresso et al., 2018, p. 3).

Despite all the initial hype VR headsets didn't really sell that well. And some of the causes for that, is that this technology is still "too expensive, too clunky, or too uncomfortable, and lacking in content that is worth trying more than once or twice" (Jenkins, 2019, p. 44), but perhaps, most importantly, because it imply an almost complete abandonment of reality (Jenkins, 2019), which is, perhaps, why Augmented Reality has seen an increase in popularity with applications such as "Pokémon Go". This application, for instance, allows one to collect Pokémon in his or her hometown, or anyplace that person visits. "The thought for some is that perhaps it's more compelling to enhance our world than to replace it or create a new one" (Jenkins, 2019). Despite all this speculation, it is clear that Augmented Reality is taking the spotlight from Virtual Reality, from investors (Jenkins, 2019).

One of the first VR videos (and by extension one of the first VR music videos) was a Paul McCartney's stadium concert at San Francisco's historic Candlestick Park in 2014 created by Scott Brook (see Figure 30) (Jenkins, 2019). Prior to this event, Beck has been filmed in 360 in a concert doing a cover of David Bowie's "Sound and Vision" (Gibbs, 2014).

Figure 30 - Paul McCartney's concert at Candlestick Park (2014)[73]

A recent approach to explore Virtual Reality potentialities for entertainment is the LBE (Location Based Entertainment), which are arcade like environments where people can experience VR content. Some of which is playable, and made for being played with, or against, other people on the spot (Jenkins, 2019). In gaming, one of the most successful VR games is Beat Saber. It was the first VR game to sell more than 1 million copies (Jenkins, 2019).

Cinematic Virtual Reality

With all the developments being made, VR technology became much more affordable and powerful for viable commercial use. This development has led to the, so called, Cinematic Virtual Reality (CVR for short).

> *While a formal definition of CVR is still being developed, the emerging consensus is that the term refers to a type of immersive Virtual Reality experience where individual users can look around synthetic worlds in 360° often with stereoscopic views, and hear spatialised audio specifically designed to reinforce the veracity of the virtual environment (as a note, there are presently no initiating studies or foundational articles that can be seen as seminal at this point). Unlike traditional Virtual Reality in which the virtual world is typically generated through graphics processing and audio triggers in real-time, CVR uses pre-rendered picture and sound elements exclusively. This means that the quality of these assets can approach that found in high-end television or feature film* (Mateer, 2017).

Contrarily to videogames, simulations and other type of content, in the case of Cinematic VR the content is pre-rendered, as such, the main, or only mode of interaction in this format, is that of the viewing perspective (Mateer, 2017). However, there are cases of productions that take advantage of this limitation in interaction such as in *Imago,* a proof-of-concept VR film, made for the Project Hypnos at the University of Carnegie Mellon University, in which the whole story is viewed through the perspective of a former dancer, who is now confined to a wheelchair.

[73] Retrieved January 29, 2020 from: https://www.theguardian.com/technology/2014/nov/21/sir-paul-mccartney-virtual-reality-concert-app

Given the characteristics, and the fact that some of the techniques used in traditional filmmaking can be applied to Cinematic VR, Mateer (2017) suggests that it might be considered a new type of filmmaking. Furthermore, some well-known filmmakers have attempted to create CVR content like Doug Liman, Justin Lin, Eric Darnell, and Alejandro González Iñárritu (Jenkins, 2019; Mateer, 2017).

However, despite the similarities, VR is an entirely new medium which demands a very different approach to filmmaking.

Firstly, since the content is filmed in 360° (except for 180°) the production team needs to hide all the equipment and the staff itself from view (Dooley, 2017; Mateer, 2017).

Secondly, it should be considered that the user is going to look around the space, which is the opposite from the traditional viewing of the carefully framed image, forcing the filmmakers to think of ways to capture the user attention in the 360° space (Mateer, 2017).

Thirdly the user for the first time is inherently part of the narrative. And being part of the narrative. Cho et al. (2016), in their development of the VR short-film "Imago", created VR video demos which would be viewed by users, who would then answer questions about their experience. Of those experiments, the researchers understood that "viewers were unable to detach themselves from being part of the experience, as one might when watching a traditional film" (Cho et al., 2016, p. 1), and that they felt the need to be acknowledged while in the VR space. Viewers often described themselves as being a character in the film, whether or not they were given indication that this was the case. When acknowledged as being a character in the film and given eye contact from actors in the scene, viewers described feeling more immersed in the story and used more emotional words to describe those experiences (Cho et al., 2016, p. 1).

Creators, also need to take into account the different devices and platforms through which content will be consumed such as smartphones, tablets, computers, HMDs and TVs for instance (Dooley, 2017).

In the face of the developments being made for the future of Cinematic Virtual Reality and in the search for how to direct the user attention in the same way traditional cinema does, it is perhaps important to consider that given the user's freedom of exploration in virtual space, it should be questioned if the user should have its attention controlled in the first place.

Lastly, it is important that creators take into consideration the health risks associated with the use of HMDs such has nausea, vertigo, eye strain, headache, physical injury, or transmittable disease (Dooley, 2017). This is one of the reasons why in distribution platforms there are usually warning signs if a content is more prone to evoke side effects, and others were there is a ranking according to how

intense the experience is. For example, in Within's platform Squarepusher's "Stor Eiglass" music video has the following warning: "Explicit imagery, intense audio and visuals"[74].

All these aspects lead to the necessity of a grammar for CVR (Dooley, 2017; Mateer, 2017). CVR videos are short in length, typically no more than 10 minutes in length (Dooley, 2017).

With the development of Cardboard, Google was one of the three leading entities to propel this format to the fore, alongside Jaunt VR and The New York Times. In 2013, Jaunt VR launched its CVR online distribution platform, and in late 2016, The New York Times, premiered "The Daily 360", another CVR distribution platform, focused on journalistic material, where is published a new video every day (Mateer, 2017; The New York Times, 2016). This makes The New York Times one of the largest producers and distributors of CVR content (Mateer, 2017).

There is already a variety of CVR content published online, which include music videos, sports, fashion, travel, and documentaries. However, the majority of the programs are either non-fiction or action-based narrative (Mateer, 2017).

Hearing is our second most important sense for perceiving reality, which is why it is very important to taking it into consideration when talking about Virtual Reality since it is one of the main elements that allow for a more immersive experience (Gervautz & Mazuryk, 1999; Hines, Jahromi, Ragano, & Siddig, 2019). Furthermore, VR implies a degree of freedom from the user to which not only image, but sound as well, as to respond to. To that end, it is common to use ambisonics for greater immersion of the user.

"Ambisonics is a method that reproduces a real soundfield previously recorded with microphones or synthesised. It virtually creates a 3D sound sphere around the listener (…) giving the impression of a real acoustic scene." (Hines et al., 2019, p. 30). For VR it creates the illusion that sound is being generated from its specific sound source. For instance, if, using a HMD, we see a piano being played on our left in the virtual space, we expect the sound of the instrument to come from that direction.

[74]Squarepusher - Stor Eiglass - https://www.with.in/watch/stor-eiglass

2.5 Music Video in Virtual Reality

Music videos in Virtual Reality remain, to this moment, an unexplored research topic in the academic field. As such, it is pretended of this text to provide a basis for this subject.

Similarly to how other forms of music videos have emerged in the internet with the convergence of media, the music video in Virtual Reality had an identical path. Firstly, the VR music video was born from the convergence of the VR cinematic video and the music video. This first layer of convergence implies all the variants of the music video born on the internet discussed earlier in this paper, as well as the various types of VR content. Secondly, the VR interactive music videos were born from the convergence of the music video, and VR videogames.

Some examples of interactive VR music videos are The Chemical Brother's "Under Neon Lights" (2017)[75] (see figures 33 and 34), and Matthew Dear's "What You Don't Know" (2019)[76] (see figure 35). The first one features only visual interaction. When viewed on a desktop, if the mouse is pressed, an animated pattern appears over all the objects and colours change slightly. In the later video, both music and video are interactive. As it is presented on the video's page:

> *Dive into the creative process of avant-pop artist Matthew Dear from his new single of the same name. Floating above you is a magic eight-ball reciting lyrics. In the distance planetary objects orbit around you to the beat. And directly ahead is an elastic donut which bounces, bulges, and twists to the complex melodies. This multi-layered visualization allows you to pivot along eight unique instruments, manipulate the speed of each one, and scratch as if you were standing on a giant turntable. The result is a music video that asks what you know about music creation. Whether through VR, mobile, or desktop, this WebVR experience offers a new way to appreciate the craft of music* (Within, 2019).

[75] The Chemical Brothers' "Under Neon Lights" - https://www.with.in/watch/under-neon-lights
[76] Matthew Dear's "What You Don't Know" - https://www.with.in/watch/what-you-dont-know

Figure 31 - Frame of the VR music video Under Neon Lights by The Chemical Brothers, without the overlay

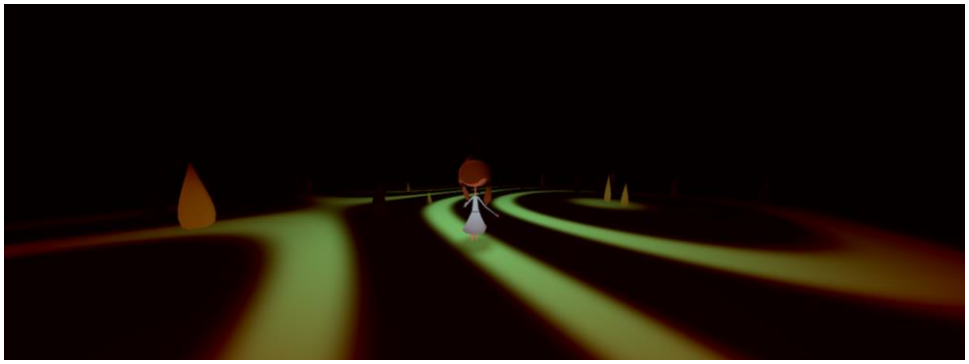

Figure 32 - Frame of the VR music video Under Neon Lights by The Chemical Brothers, with the overlay

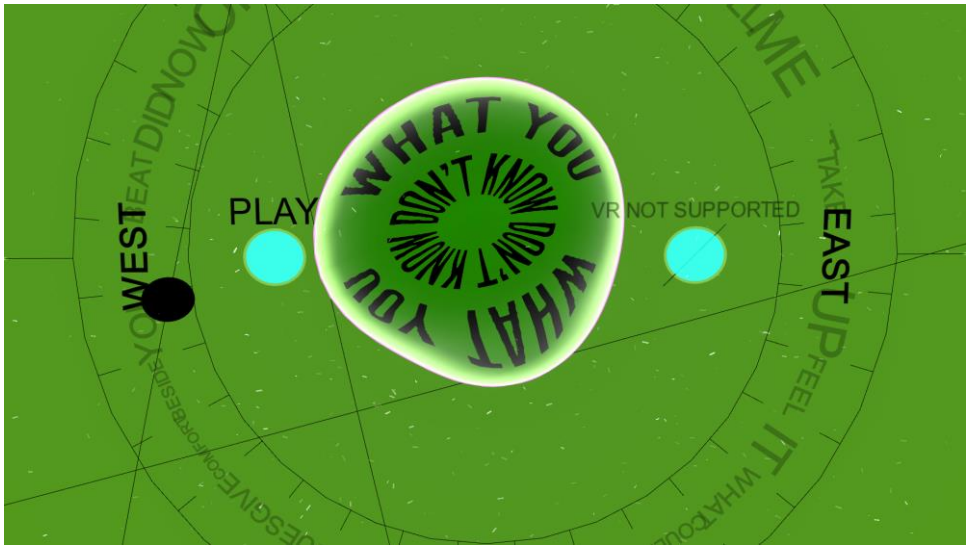

Figure 33 - Frame of the interactive VR music video: Matthew Dear - What You Don't Know

Given the lack of research on this topic it was conducted a search on music videos made for VR. The requisite for each video to be considered into the study is that it needed to be, at least, a 180° video, which is a format that can take advantage of a HMD and that is a CVR video. However, most of the music videos in VR are made to be viewed in 360°.

It was made an analysis for each video exploring the following characteristics:

- Artist and Song Title

- Release Date (by year)
- Marketed as VR
- Marketed as a 360° video
- 180° video (since most of the videos are 360° it was decided to isolate those which weren't)
- Stereoscopic
- 3D audio (ambisonics)
- Interactive
- Concert (it is, or as parts of a concert)
- Dance (it as elements of dance)
- Lyric Video (if it's a lyric video)
- 3D elements (if it features any)
- Point of View (there was an analysis of the various points of view explored in the video)
- Analysis/observations (There was made an in-depth analysis or observations were given about the video in all its aspects)
- Similar videos (if it features elements of other videos, like, for example, the original 2D video)
- Independent videos (The song has other videos besides the VR one, which are independent)
- Fan-made (is the video fan-made?)

The table with video analysis is in Appendix A of this paper.

One of the first things that stood out when reviewing each video is that there are few videos which are stereoscopic and even fewer which have spatialised audio.

It is very common the use 3D elements, or the video being made entirely in 3D. This has its benefits, since some of the constrains of filming in 360° typically do not exist in 3D like stitching[77] and the fact that there is no need to hide and be concerned about aspects like seeing the camera tripod, or its shadow of the camera, or having to hide the crew. For example, in Redfoo's "Booty Man"[78] (Figure 34) the ceiling and the lights of the studio are visible which takes a person out of the immersion, and in many videos the tripod legs, shadow or reflection are visible. On the other side, the production of 3D content for VR can be hardware demanding.

[77] Stitching is the process of combining and aligning the different images provided by the different cameras of into a seamless 360 image.

[78] Redfoo – Booty Man - https://www.youtube.com/watch?v=Md-8YIE-KhA

Figure 34 - Screenshot of Redfoo's "Booty Man".

Some examples of 3D VR music video are Shigeto's "Hovering" ft. Josef Deas[79], Night Club's "Show It 2 Me"[80] and Savlonic's "Action Causes Reaction"[81].

Of the reviews, came across some aspects which could be considered bad in their use of the VR technology, and which should be considered in the production of content for this medium.

Firstly, is the case of music videos which feature performers playing and singing around the listener in 360°, but which do not have spatialised audio, hence not providing a more immersive experience for the listener, and possibly disorientating the user, since we expect the sound to come from its source. And if that requisite is not met, it might cause confusion since the user is turning his/her head around, looking at each performer, but the sound is not aligned spatially with its source.

This happened in several videos, which include: Ethiocolor's "Mali Malonayie"[82], Yurp's "Dirty Secrets"[83], Roomie's cover of Maroon 5's "This Summer"[84], Muse's "Revolt"[85], The Main Squeeze's cover of Bob Marley's "Sun is Shining"[86], Trevor Wesley's "Chivalry is Dead"[87], and Megadeth's "Poisonous Shadows"[88].

[79] Shigeto – Hovering ft. Josef Deas - https://www.with.in/watch/hovering
[80] Night Club – Show It 2 Me - https://www.youtube.com/watch?v=JtYa0rb_jGQ
[81] Savlonic – Action Causes Reaction - https://www.youtube.com/watch?v=Imz77tPsVrA
[82] Ethiocolor – Mali Malonayie - https://www.youtube.com/watch?v=_Y3SHsxKbhk
[83] Yurp – Dirty Secrets - https://www.youtube.com/watch?v=W_AXg3eW-bE
[84] Roomie - This Summer (Maroon 5 cover) - https://www.youtube.com/watch?v=Hpq66FJh8zA
[85] Muse – Revolt - https://www.youtube.com/watch?v=91fQTXrSRZE
[86] The Main Squeeze - Sun is Shining (Bob Marley cover) - https://www.youtube.com/watch?v=W-qZmVk_VS8
[87] Trevor Wesley – Chivalry is Dead - https://www.youtube.com/watch?v=jb0a9kGoZu0
[88] Megadeth – Poisonous Shadows - https://www.youtube.com/watch?v=unQZvhQ9Giw

Other performance videos which include spatialised audio, include U2's "Song for Someone"[89], "Waterloo" from the film "Mamma Mia! Here We Go Again"[90], and the video for Mozart's "Gloria"[91].

When seeing music videos in VR that featured acting, it was, in some cases, very easy to see right through it. Which might be due to the fact that there are no cuts that would hide it, plus the fact that the camera is showing everything in its sight, revealing every little action, such has hand gestures and body posture. As such, every actor, if in frame, needs to be constantly in character. Two examples of that are Kid Ink's "Mochi"[92] and Galvanized Souls' "New Generation"[93].

Perhaps it is inherent of this technology to be this revealing. Another aspect that might reveal the acting is the high framerate that some videos have. John P. Hess, the host from the YouTube channel dedicated to filmmaking, Filmmaker IQ, in his video "A 24fps Filmmaker Reacts to Gemini Man in 120fps" talks about the use of high frame rate (120 frames per second) in the film Gemini Man from 2019 and how it damaged the performances of the actors: "…when actors start showing up on screen it becomes as clear as day that they're actors". (Filmmaker IQ, 2019). And later he talks about his reaction to the same film, but seen at 24 frames per second: "All those acting issues that that I had problems with before, evaporated at 24[frames per second]" (Filmmaker IQ, 2019).

A characteristic that, unfortunately, some videos have, is unnecessary camera rotation. Unless the video is 180°, there is no need to rotate the camera, since it is the user who needs to rotate and explore the environment. Two examples are Redfoo's "Booty Man" and Cut Throat Finches' "Boundaries". This also happens when the video, even though is in 360°, does not take full advantage of that feature and ends up feeling like it should have been a 180° video instead.

Besides rotation, some videos feature very uneven camera movements such as short bursts in speed, which happens in Luke Brian ft. Karen Fairchild's "Home Alone Tonight", for example, and which can be disorientating and perhaps help induce motion sickness.

A common characteristic of VR music videos is the division of the set into 4 or 2 sections, which is probably correlated with the fact that some cameras have 4 cameras, like the Vuze Plus or the Z-cam S1, or have only 2 cameras, like GoProFusion, GoPro Max, Samsung Gear 360, YI 360 VR, etc. This way, it prevents stitching problems if the performers are within one of each 4 divisions. Also, some bands have only 4 members like U2, so it makes sense to distribute them across the 360 field.

[89] U2 – Song for Someone - https://www.with.in/watch/u2-song-for-someone
[90] Mamma Mia! Ci risiamo - Waterloo - https://www.youtube.com/watch?v=nfejIm71cBQ
[91] Mozart – Gloria - https://www.with.in/watch/mozart-360-gloria
[92] Kid Ink – Mochi - https://www.youtube.com/watch?v=tZR_Sv7cGVs
[93] Galvanized Souls – New Generation - https://www.youtube.com/watch?v=7XShBRYA43w

Figure 35 – Screenshot of NoMBe's "Freak Like Me"

Some examples of this feature are, U2's "Song for Someone"[94], NoMBe's "Freak Like Me"[95] (Figure 35), FOALS' "Mountain At My Gates"[96], YAO's "Unraveled"[97], Infinite's "Bad"[98], Imagine Dragons' "Shots"[99] and Run The Jewels' "Crown"[100].

The music video for Cut Throat Finches' "Boundaries"[101] (see Figure 36), features some aspects which are worth pointing out given their negative impact on the whole experience. There is the fact that in some moments the camera moves towards the actors, and it feels like it was compensating for the lack of the ability to use zoom. However, since the user is present inside the virtual environment, when the camera moves towards something, it is equivalent to a person walking towards that same object, which is very different. In traditional filmmaking there is a difference between moving the camera closer or farther away (dolly in/dolly out respectively) and zooming. Furthermore, there is a known camera effect used in Alfred Hitchcock's "Vertigo" [102], which is a combination of a dolly in with a zoom out, or the opposite.

[94] U2 – Song for Someone - https://www.with.in/watch/u2-song-for-someone
[95] NoMBe – Freak Like Me - https://www.youtube.com/watch?v=0XrcYiu-Ydo
[96] FOALS – Mountain At My Gates - https://www.youtube.com/watch?v=l_EIE5f2t6M
[97] YAO – Unraveled - https://www.youtube.com/watch?v=FLT5_REL0Rk
[98] Infinite – Bad - https://www.youtube.com/watch?v=BNqW6uE-Q_o
[99] Imagine Dragons – Shots - https://www.youtube.com/watch?v=81fer9ulOeA
[100] Run The Jewels – Crown - https://www.youtube.com/watch?v=JCNzOQ2Ok8s
[101] Cut Throat Finches – Boundaries - https://www.youtube.com/watch?v=PVp4Tn_5C1Y
[102] Vertigo Effect - 7 Examples - https://www.youtube.com/watch?v=sKJeTaIEldM

Figure 36 - Cut Throat Finches' "Boundaries"

At some moments, the camera moved closer to the actors, to a distance where it felt that the user was invading the personal space of the person. It is also strange that the couple in the video were in some moments staring right into the camera, while being uncomfortably close, especially considering that the user feels like he or she is in the middle of them, while they were supposedly staring at each other in a romantic context. There is a shot were the camera was placed beneath the sheet of bed were the couple were looking at each other. This experience was aggravated by the fact that it was easy to see right through the performance of the actors in some of these moments. Another example of a video in which it felt that the people were too close, was From the Ashes' "360 VR live video"[103] (see Figure 37).

Figure 37 - From the Ashes - 360 VR live video

In standard viewing there is a sense of distance between the viewer and the element, or person, being observed. But in VR, this distance does not exist. It is due to this aspect that it was decided to add a parameter in the analysis of the videos where there was pointed out what are the points of view represented in each video. Some of the most interesting uses of different points of view are ESPRIT 空

[103] From the Ashes – 360 VR live video - https://www.youtube.com/watch?v=tprAemaHQyQ

想's Remix of Satin Sheet's "Fashion"[104], in which we see a car crash and it final of the video we can notice that are wings on our back, which means that we are an angel watching the accident, or perhaps the victim of the accident. In Muse's "Revolt"[105] we are a drone from the government and the video ends when we are shot. In David Rosen's "Palindrone"[106] we are floating up inside a very tall room in which the very top is a mirror of the other extreme, hence a visual palindrome. So, at the same time we and the objects around us are both floating up and falling. In OneRepublic's "Kids"[107] we travel constantly between the room of a boy, the room of a girl, which is in front his window and the road that is between their rooms, in which there is the band performing. In Eden's "Drugs"[108] we experience abstract spaces and figures, some of which are geometric humans, like a person playing a keyboard, a woman, and a man sitting. And then there is a city at two points in the video, although an abstract one. The human figures are colossal, and a person feels like a fly, moving through mountains. It is interesting that these geometric figures are reminiscent of The Chemical Brother's music video for "Another World"[109] which also features a geometric human in black space. What is interesting is that both are set in environments void of objects, besides those present in scene although abstract ones, which makes the sense of scale ambiguous. However, since the video for "Drugs" is set in VR space, if viewed using an HMD we have close approximation of those geometric humans' actual size. Which is why a scene where we are swallowed by one of those humans in that video is so intense in virtual reality, rather if watched on a regular screen. In Gorillaz' "Saturnz Barz"[110], we start the video on a train where we have a tablet in our front. The video that the tablet was displaying, then becomes our reality and we accompany the characters, also band members, into a haunted mansion. At a certain point we find ourselves floating in the ring of Saturn with the characters floating around. Finally, just to finish this section as there are many interesting VR videos, Shigeto's "Hovering" featuring Josef Deas (see Figure 38) is as described in its Within page, "A transcendent tale of life-giving water brought to a dying planet. Overrun by a singular organism's relentless proliferation, a massive celestial event sets the cycle of extinction and re-birth in motion" (Within, 2017).

[104] Satin Sheets – Fashion (ESPRIT 空想 Remix) - https://www.youtube.com/watch?v=A95IHaUN7qw
[105] Muse – Revolt - https://www.youtube.com/watch?v=91fQTXrSRZE
[106] David Rosen – Palindrone - https://www.youtube.com/watch?v=26kcl20ESp0
[107] OneRepublic – Kids - https://www.youtube.com/watch?v=eppTvwQNgro
[108] EDEN – Drugs - https://www.youtube.com/watch?v=HCpnhMH1vXs
[109] The Chemical Brothers – Another World - https://www.youtube.com/watch?v=fhzkeFiXfPI
[110] Gorillaz – Saturnz Barz - https://www.youtube.com/watch?v=lVaBvyzuypw

Figure 38 - Shigeto's "Hovering" ft. Josef Deas

A difficulty that the user might feel while watching VR music videos, is that sometimes there are too many things happening at once, which makes it hard to follow what is being shown, especially when this happens in a very short amount of time. This is true for the "Boundaries" music video as well. At a certain point, half the space has a scene with the couple in their room, and the other has the band performing. The user is then limited to looking at just one of those scenes and then re-watching the whole video watching the other, or to look interchangeably between both but risking losing information. Another video that has the same kind of division of the space in two throughout most of its duration, but that manages to accomplish a clearer experience in that sense is Odd Mob's "All Of Your Heart"[111]. In this video we experience the story of a girl and a boy, each living in its world represented by each half of the world.

From all the videos analysed, Malaa's "Revolt" featuring Jacknife[112], was unique in its use of stereoscopy in that, instead of showing a slightly different perspective of the same image to each eye in order to create the illusion of depth, it showed very different images to each eye with a similar aesthetic, which are then overlapped through our perception, hence an image that can only be seen through that technology.

In conclusion it was observed that the music video in VR still has a lot of unexplored potential, especially if we consider the possibilities of interaction. Some technical aspects should be taken in consideration such as using a steady camera movement, avoiding camera rotation or other unnecessary movements, which might cause discomfort to the user. Additionally, it should be taken in serious consideration the camera placement and how it represents the subjective perspective.

The use of the space and points of interest around the user should be considered. As even a simple single steady can be interesting with the appropriate content.

[111] Odd Mob – All Of Your Heart - https://www.youtube.com/watch?v=ABD3VSCZ1tM
[112] Malaa – Revolt ft. Jacknife - https://www.youtube.com/watch?v=s1gbGUEO8uA

Furthermore, the use of 3D might be useful in order to avoid problems like stitching, camera, movement and other problems associated with VR filming, while being aware of hardware requirements. Lastly, it is highly recommended the recording and use of spatialised sound as it will enhance the experience of the user and which is essential for capturing a concert in VR accurately.

In this theoretical framework, we analyzed the history and development of the music video, VR, and music video for VR, as well as giving insight into the fundamental characteristics of each topic. Also, we provided our own table for the characterization of music videos by having as basis other characterization methods provided by the literature. Furthermore, considering the lack of literature concerning music videos in VR, we provided a table with an analysis of various music videos made for VR, which was itself analysed as to help further understand the characteristics and potentialities of the music video for VR.

In the next chapter we will describe the development of the music video made for this investigation.

3. The development of a music video for Virtual Reality

3.1 Methodology

3.1.1 Methodological approach

Considering that the objective of this project is to develop a music video for Virtual Reality, the methodology used was that of Design Based Research. The goal of this methodology is to create artifacts and interventions which deal with "real-world problems by generating and evaluating innovative artifacts to solve them" (de Villiers & Harpur, 2013, p. 253).

The ADDIE model was chosen as the approach for the development of the music video. This model is an iterative and cyclical process in which a problem in the design is passed through the model as to provide a solution. The model is composed of 5 phases: analysis, design, development, implementation, and evaluation, and "It allows feedback based on continuous assessment throughout creating material" (Nadiyah & Faaizah, 2015, p. 1805). It should be noted, however, that being this method iterative, the phases overlap at some point, being that some of them will be developed at the same time (Reinbold, 2013).

The first phase, the Analysis, is where the problem is identified, and where it is determined what should be done to solve the problem. This requires extensive research as to understand the problem and to plan the steps to be taken in order to solve the problem (Reinbold, 2013). In this investigation, this phase is constituted by the theoretical framework regarding music videos, VR, and music videos for VR.

The second phase, the Design phase, is where the solution will be conceived based upon the theoretical material. The focus here, is to understand what needs to be accomplished in order to reach the desired outcomes (Reinbold, 2013). For this investigation this phase was developed alongside the theoretical framework.

The third phase is the Development phase, which for our investigation corresponds with the pre-development of the music video through the pre-production material conceived for this purpose as it will be shown in the following chapter.

The fourth phase, which is the Implementation, where the actual steps planned for the production in the previous phase will be taken in order to reach the desired solution (Reinbold, 2013), which will correspond to the production and the post-production phases of the development of the music video discussed in the following chapter.

Lastly, the fifth phase, the Evaluation, as the name suggests, is an evaluation of the product, which is done at every step of the process (Reinbold, 2013). However, in this case, since the product is a

music video, it requires a certain level of refinement as to fully perceive its characteristics. And, because of that, it will only be tested after completion with user tests.

3.1.2 Phases of the field work

In this section it will be presented all the phases conceived for the development of the field work. Each phase corresponds to a chronological step in the development of the music video, being the first for the choosing of the band, the second the pre-production of the music video, the third to the production, the fourth to the post-production, and lastly, the fifth for the evaluation of the music video with user tests. All the steps of every phase will be presented in the following table, which represents a broad overview of the project, and where the data collection tools were used. Then after there will be an in-depth explanation of each step presented in the table.

Phase	**Objectives**	**Data collection methods and tools**
1st phase – choosing the band/artist	Collecting a list of musical bands/artists	-
	Evaluating which is the most fitting choice of musical band	Questionnaire
		Interview
2nd phase – pre-production	Choosing a song from the band for the music video	-
	Talking with the artists to understand their artistic vision, and from then creating a plot for the video, and the necessary pre-production documents, such as the storyboard, conceptboard, moodboard, and concept art.	-
	Understanding, based on the plot, if the music video will be made with computer graphics and/or live action footage	
	Gather all the necessary tools for the development of the music video	-
	Doing the necessary preparations for the live action content if needed	-
	Filming 360º content	-
3rd phase – production	Creating low fidelity prototype for the music video also known as an animatic	-

	Creating computer graphics content	Low fidelity prototype
	Adding interactive elements	-
	Editing the music video	
4th phase – post-production	Compositing the CG elements with the live action footage	-
	Creating an ambisonics version of the music	-
	Publish. Deploying video (VR, 360, etc) on a digital platform	-
5th phase – Evaluation with users	Preparing user tests for the music video in 3 different formats	-
	Creating the pre and post-test questionnaires	-
	Conducting the user tests	Questionnaires
	Analysis of the results from the user tests	User tests

Table 3 - Phases of the field work

1st phase – Choosing the band/artist

The 1st phase is directed to the gathering and choosing of the musical band or artist who will have a song adapted to music video. The criteria for the band or artist is that it needs to be one from Aveiro because that will allow the flexibility to work with the band really closely, without the need travel large distances, if that will be the case. Likewise, this will also help promote local, uprising artists.

There will be interviews with the artists as to explain what the investigation is, what is a music video in VR and to understand their interest in it, as well as to learn about their musical project.

Interviews are a qualitative research method commonly used in social sciences as to understand what people in a determined group being researched think, do, and think about what they do. In other words, its emphasis is on the understanding of individuals and their ideas about themselves and about the world (Hannabuss, 1996). Furthermore, the interview

> *has its natural basis in human conversation and allows the researcher to adjust the pace and style of asking questions so as to bring out the best in the respondents. (…) It has the advantage, too, of providing responses in the form in which respondents think and use language* (Hannabuss, 1996, p. 22).

A questionnaire will be submitted to the artists which will have questions exploring details regarding their musical acts and their interest for a music video in VR. Afterwards, based on the interviews and the questionnaires an artist or band will be chosen.

2nd phase – Pre-production

The 2nd phase is the pre-production phase, in which all the production of the music video will be prepared. This preparation includes choosing a song from the artist to be adapted to a VR music video, derived from conversations with the artist to understand what their preference is and what could work best as a VR music video. Creating a plot for the video based on the song, and creating all the necessary documentation to help preparing and plotting the music video such as storyboards, moodboard, conceptboard, concept art. This plot will dictate what elements are necessary, such as if there will be a need to record live action footage, or if the music video will be entirely made with CG for example. This will also provide information on what tools will be needed to develop the music video, such as gear to film, and to do the necessary preparations such has location scouting, wardrobe, and set design for example, in the case of recording live action, which are elements that are done in this phase.

3rd phase - Production

The 3rd phase is the production phase, which is when the final content will be produced. In the case of recording live action footage, there will be necessary the use of a 360º camera to film the scenarios chosen in the 2nd phase. Otherwise, the production of a CG music video, will imply in the first place, the creation of a low-fidelity prototype named animatic to help visualize how the music video is going to be. Secondly, the actual production of an animation in CG requires the following elements: modeling, texturing, illuminating, animating, and rendering. Finally, the creation of a music video for VR might imply adding interactive elements, with software such as Unity 3D.

4th phase – Post-production

The 4th phase is the post-production phase, which will be constituted by the video editing, the compositing of the CG elements, and the creation of a version of the music of the band or artist in ambisonics.

5th phase – Evaluation with users

Finally, the 5th phase, will be the evaluation phase. In this phase there will be made usability tests, which is a common UX (user experience) research methodology for evaluating the participant's

behavior with an interactive product. This type of tests will allow to uncover problems in the design, discover opportunities to improve the design, and to learn about the user's behavior and preferences (Moran, 2019). There are three types of usability tests that can be made to evaluate an interactive digital graphic interface, being those: explorative, assessment, and comparative (Churm, n.d.). For this project, the tests will be of the latter two types: assessment, as it is the music video that will be evaluated, and comparative, as there is going to be a comparison between three distinct groups, since in this case, the music video will be evaluated in three different formats – desktop-360-2D, mobile-360-2D and VR – with the users, who will then answer to a pre and post-test questionnaires, which, in turn, will be analyzed and discussed to gain insight from the comparison of the formats.

A questionnaire is a document which has "open and closed questions to which the respondent is invited to provide answers" (Rowley, 2014, p. 308), and which is a widely common resource for collecting data for research, being usually distributed online as an online survey or provided by hand in presential scenarios. An important characteristic of questionnaires, as compared to interviews, is that they are meant to be answered without assistance of the researcher (Rowley, 2014).

The questionnaires will gather both quantitative and qualitative data. The quantitative data will be gathered through Likert scales and multiple-choice questions, and the qualitative data will be gathered through open-ended questions. Furthermore, the user tests will be recorded, which will provide additional qualitative data to analyze, discuss, and compare with the data gathered with the questionnaires.

3.2 The development of the music video

It was decided that to better understand the difficulties, the possibilities, and the fundamental aspects of the creation and conceptualization of a music video, and in order to provide an effective and immersive experience for the user, and to provide a basis for the creation of music videos in this medium that take advantage and explore its inherent qualities, it would be better to create one.

The first step for the creation of the music video was to find a band or a single musical artist that would be interested in having its music accompanied visually. Since this project was developed in the city of Aveiro Portugal, it was more convenient given the proximity with the artists and the researchers, and interesting, in that this was made to support a local artist, whilst helping a master dissertation project.

Profº and AV artist Nuno Barbosa, kindly, created the contact with many artists from Aveiro who were interested in the production of a music video. There were made reunions with the members of each project as to better explain the idea of the project and the potentiality of producing a music video for VR.

A total of 11 artists were contacted, and after this, there was a selection process which was made with the help of a questionnaire, in which the artists explained if they had music videos for their musical projects, including VR ones. If they were interested, and how, in the possibility of having a VR music video for their project. Furthermore, in that questionnaire, we explored if they would be interested in having a version of their songs in ambisonics, and if they would like their music video to have interaction.

Following, we present a table with different criteria considered for the contacted bands

Artist's ID	Genre	Year of the project's launch	Does the artist/band have any music video?	Is any of the music video for VR?
1	Alternative Electronic	2019	Yes	No
2	Experimental	2016	Yes (visualizers)	No
3	Progressive metal	2017	Yes (visualizers)	No
4	Electronic	2013	Yes	No
5	Blues/rock	2011	Yes	No
6	Rock	2015	Yes	No
7	Traditional	2019	Yes	No
8	Electronic	2013	Yes	No
9	World fusion	1999	Yes	No
10	Folk	2018	Yes	No
11	Indie rock	2008	Yes	No
12	Jazz-rock	2018	Yes (live performance)	No

Table 4 – Contacted bands

Ultimately, we opted to create a music video for a band named J U P I T E R, which features an alternative and experimental electronic sound, through which it is explored a science fiction narrative present in their EP, EVA XV (see Figure 41). That release was their first and only so far, being released in 2019, the year of the project's launch.

Figure 39 - Cover art of J U P I T E R's EP: EVA XV

They characterize themselves as a "portuguese electronic music group made up by producer Xavier Marques and singer/writer Bruno Tavares.

Their sound transports the listener on a journey filled with ambient soundscapes and electronic synth ridden beats through the deeps of space." (J U P I T E R, 2019).

The EP was produced under in *Casa da Lenha*[113], the studio and publishing house of this and many other projects, owned and created by Xavier Marques, one of the band members. It is available in many streaming platforms such as Bandcamp, Spotify, Google Play Music, Apple Music[114], and YouTube[115].

[113] Retrieved 22 december, 2020: https://casadalenha.net/home/bio/ (In Portuguese)
[114] Retrieved 22 december, 2020: https://ampl.ink/WBnVl
[115] Retrieved 22 december, 2020: https://www.youtube.com/channel/UCybxdkBPqPoNu_rKJZHzGuw/videos

The music group is active and doing live performances to this date (see Figure 40).

Figure 40 - J U P I T E R's live performance photo

Then the process followed the usual production of audio-visual content, which is formed by three phases: the pre-production, production and post- production. (Ohanian & Phillips, 2013). Pre-production is the planning and the preparing of every element being created in the production and post-production phases (Cartwright, 1996). The last phase, the post-production is the one that includes the editing (Wages, Grützmacher, & Conrad, 2004).

3.2.1 Pre-production

In the pre-production phase, the whole concept for the video is conceived and the whole production is planned. This phase includes the storyboard, which is extremely useful for conceiving the work visually, and how the whole action is going to play. Additionally, there is another important element of the pre-production, often used in animation, the animatic, which is similar to the storyboard in which it is composed of crude drawings representing the action, but in which the drawings are edited and played back with the appropriate timing.

Brainstorming

The pre-production phase for this project started with discussions with the band members about which music of the EP, *EVA XV*, would be ideal for the project and which ideas would be fit for the music.

There were made 3 videocalls, the first and both members present and the other 2 were with only Bruno Tavares who created the concept and lyrics behind the music. There were other conversations

via instant messaging to both members of the band, and one initial conversation in person with both members at a coffee shop in Aveiro called Zeca in March of 2020.

The concept behind the EP is that in an undefined time in a distant future the sun was dying, which, in the process, made it radiate more heat. Consequently, life on earth struggled to survive, and because of that humans had to find ways to survive, being one of which the construction of huge domes, the Kelaamiseens, that supported inside them cities and even countries. During the process of the earth heating up, many continents ceased to exist due to desertification and to the rising levels of the sea, and only Europe and Asia survived. These continents amidst the passage of time, and with the existing conditions were restructured internally in all aspects. Europe was then called Nova Europe and Asia the Grand Asian Empire. Amidst the critical climate crisis, a signal of life was discovered in deep space in an area that would be called Clatterlex 5. Nova Europe and the Grand Asian Empire reunited in an assembly called the Meeting of Pelastus. In this meeting it was decided that a ship with numerous families would be sent to Clatterlex 5 in a voyage that would last centuries, and the mission would be inherited from generation to generation. Numerous ships had been sent to that location, as was the case with the last ship EVA XIV, which disappeared. So a new ship was prepared to be sent called EVA XV. With the conditions of life on earth decaying, EVA XV ship would be the final hope of humanity. At the time EVA XV encountered Clatterlex 5, the one commanding that ship was the captain Alex Meyer. In the first song the main events are narrated by Alex Meyer's daughter Anya, and the narration is the following:

> *The sun is dying. Life on earth is struggling to survive. African, Australian and American continents ceased to exist. While the sun still continues to expand, temperatures increase. We are protected from these weather conditions in what we call "Kelaamiseen", huge domes able to sustain life of entire cities and even countries. 691 years ago, while searching for a new planet to live, a clear sign of life was spotted in an area called Clatterlex - 5. After the "Meeting of Pelastus" between the Grand Asian Empire and the Nova Europe, the ship EVA XIV was launched into deep space. A voyage that would take 163 years to complete. Entire families embarked on this vital journey. Although in the day 1728, all communications with the ship were lost and in the day 1729, EVA XIV disappeared completely.*

A new ship, EVA XV was launched to the same location. We were humanity's final hope...

Afterwards Bruno Tavares sings the following lyrics:

"Liaisons de l'air

Nous sommes tes frères

Tasses de mer

Coups de mére"

The narration the continues by Anya in the final moments of the track:

"I was born in that ship 7 years ago. My name? Anya: the 28th daughter of the 3rd generation of "Titan Children". My mother?...Captain Alex Meyer, the last commander of the EVA XV."

In the subsequent songs of the EP, the lyrics focus on the internal struggles of Alex Meyer, who is thinking about the future of humanity and her role on the mission towards Clatterlex 5. In parallel the ship EVA XV arrives to Clatterlex 5, and surprisingly, they encounter the ship EVA XIV in what could be described as an alternate reality in the end of the story. Details like this were purposefully left open as to interpretation, and likewise, there was given a large creative liberty as to the production of the music video.

Since the band already had a music video (although a live performance) for the second music of the EP, *Clatterlex 5*[116]*,* in which the lyrics focus on the voyage of the ship towards Clatterlex 5*,* one of the original ideas was to develop a music video for another song of the EP. At the time the band suggested the theme, *ATOM & EVE*, which is the fourth track of the EP. The song mentions themes and ideas of life and death, suffering and hope, but it is very vague about specific contours of the story, since that the lyrics focus on the internal living of the characters in the story. The details were explained through conversations with Bruno Tavares of the band.

The idea conceived for the track ATOM & EVE, was that of following the experience of Alex Meyer, the commander of the EVA XV at the time the ship encountered Clatterlex 5, in that the point of view would be that of Alex. At a certain point in the experience, the user enters inside her head (see Figure 41) and is able to visualize her thoughts, worries, hopes, and desires in a sequence (see Figure 42) that would drive the user from the birth of a human all the way through the origins of life on earth, on an existential reflection in the mind of Alex.

The themes and narrative of the track revealed to be far too complex for a first viewer without any context of the story and themes of the music. Because of that, the song being adapted to music video was changed for the introductory track for the EP, *L'AIR*, given that it features a narration that

[116] Retrieved 22 december, 2020: https://www.youtube.com/watch?v=279Mf-5GHM0

contextualizes the listener of the events that underline the lyrics of the whole EP. This becomes much accessible to whoever will be watching the music video. At some point there was considered the possibility of having the first music. *L'AIR*, played before *ATOM & EVE,* as to contextualize the story, but that would require a much longer production that would not fit into the time available for the investigation.

Many liberties were given to produce the music video, so the visual aspect of the elements of the story were all conceived from scratch, as such, concept art (see Figures Figure 41,Figure 42Figure 43) was made both for *ATOM & EVE* and for *L'AIR*, since, at the time, both songs were considered to be adapted. The whole concept art can be seen on Appendix B.

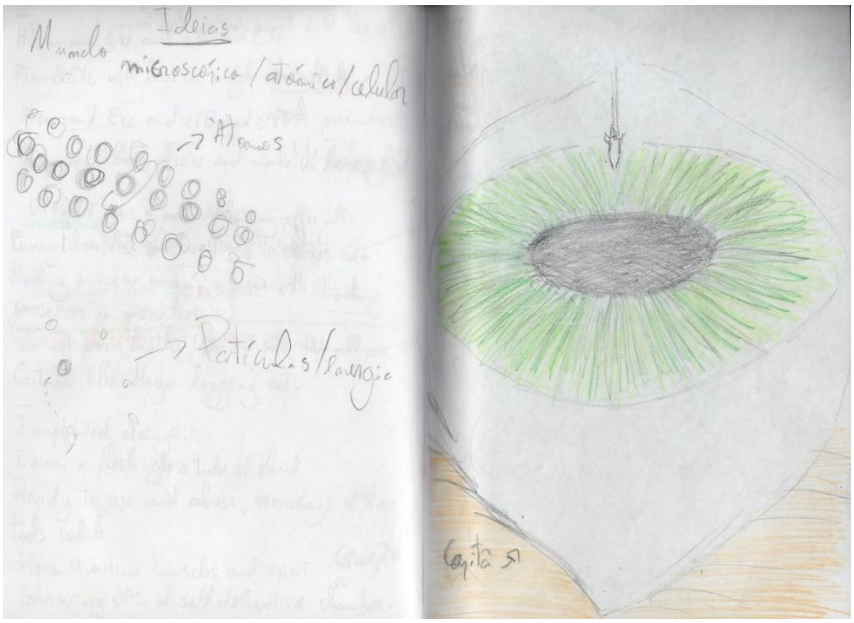

Figure 41 - Concept art for the song ATOM & EVE

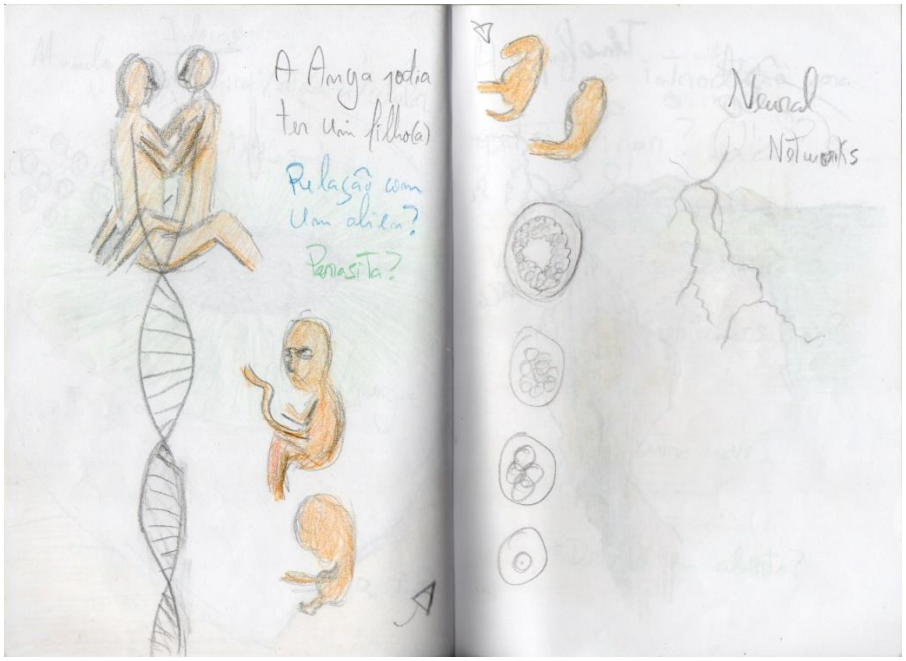

Figure 42 – Second concept art for the song ATOM & EVE

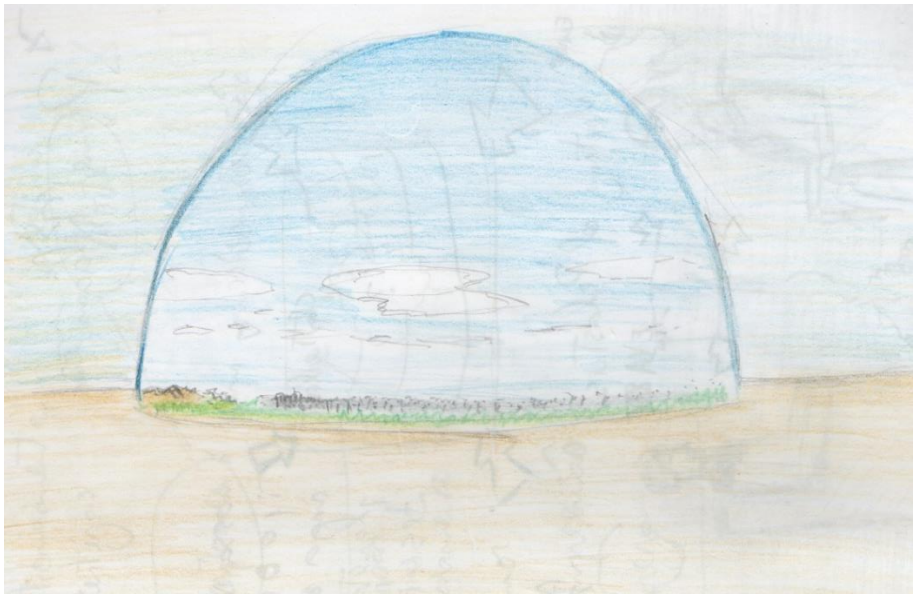

Figure 43 - Art for the music L'AIR with the concept for a Kelaamiseen

Storyboard

After music being chosen, the next step was to develop the storyboard, which was made in a cube mapping arrangement as can be seen in Figure 44. This arrangement is comprised of 6 views each representing a direction - left, top, bottom, front, right, and back- of all the 360º space. Each page of the storyboard featured a space to write a brief description of the scene and the page number. The entire storyboard is available in Appendix D – Music Video Storyboard.

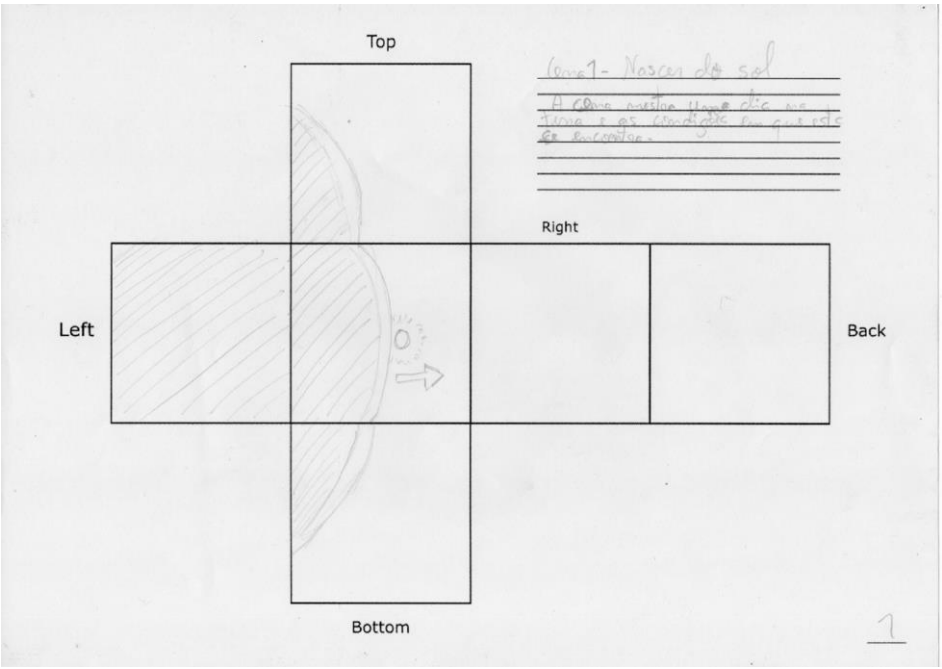

Figure 44 - First page of the storyboard

The music video portrays the events being described by the narrator, which is a character of the story named Anya. As such, it was evident that this project would be needed to be made in 3D given the science fiction elements.

The animatic

After the storyboard, an animatic was made, which is a tool for pre-visualization, used both in animation and live-action storytelling. This allows each shot to be carefully planned as to avoid unnecessary costs (Chang & Chang, 2018). The animatic was made in 3D, in a software called Blender. The choice of doing the animatic in 3D is that it was easier to do a rough base of the animation, and because the animation made for the animatic could be used as the basis for the subsequent animation, as was the case. Once this was done, the animation was shown to the advisor of the project, Mário Vairinhos, and to the band as to be reviewed.

As mentioned before the animation and the elements that it was composed of such as lighting, textures, models, etc, were continuously refined, perfected, and reviewed until the final product.

In the first version the videoclip was composed of 7 different scenes. The first was one corresponded to the following sentence of the narration: “The sun is dying. Life on earth is struggling to survive. African, Australian and American continents ceased to exist. While the sun still continues to expand, temperatures increase”.

Figure 45 - Animatic: text intro

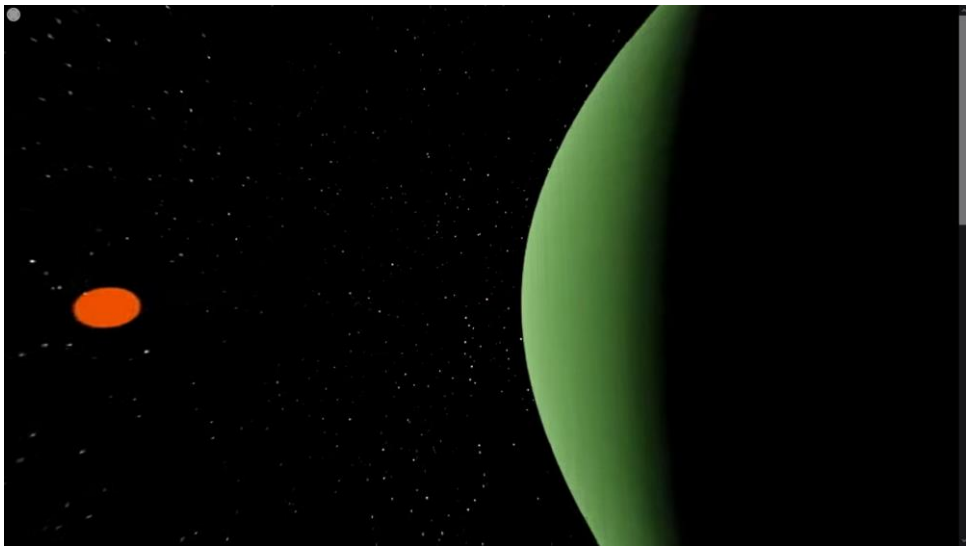

Figure 46 - Animatic: Scene 2 - Sunrise

3.2.2 The scenes of the music video

In the following sections the scenes that compose the music video will be described and explained for the production process behind them, but before that, a table summarizing every scene will be shown in Table 2. Then the process of production will be explained as some aspects of the process will be more easily understood after describing each scene.

Scene	Name of the scene	Description
1	The Sun	An image of the doing sun
2	The Sunrise	A portrayal of the current state of the earth seen from above the earth
3	Kelaamiseen	An image showing the desertic landscape of the earth the Kellamiseens where life on earth is being preserved
4	Digital Map	A digital map showing a hologram of Clatterlex 5

5	Meeting of Pelastus	The portrayal of the Meeting of Pelastus as a reunion between two individuals in a strange futuristic space
6	Launch of the EVA XIV	The launch of the EVA XIV towards space as seen from the launching site
7	EVA XIV disappears	A digital map showing the path of EVA XIV to Clatterlex 5, and its eventual disappearance
8	Launch of the EVA XV	A view of the earth being eclipsed by earth from space and the launch of the EVA XV who flies towards its destiny

Table 5 - Music video scene summary

Scene 1 – The Sun

In the process of the creation of this video, it was decided that it would be interesting to have a scene showing the sun in large scale, as, otherwise, the spectator would have only a glimpse of it. In this way its role as the catalyst of the story is emphasized. The scene was later added as the first scene of the video after the initial credits with the band and the song's name.

Figure 47 – Scene 1 - Sun

Scene 2 – The Sunrise

In this scene it is shown a complete rotation of earth, while the sun rotates around it, so that the spectator can take a glance at the state in which earth is in.

In the figure 38 it is represented the original texture for earth which was later modified to look like the one in figure 40, which shows the African, Australian, and American continents submersed by the water as suggested in the narration. The only parts visible of the continents are its highest picks. To do this, it was used a height map of the earth (see figure 39), to serve as a basis to where to show what should be visible.

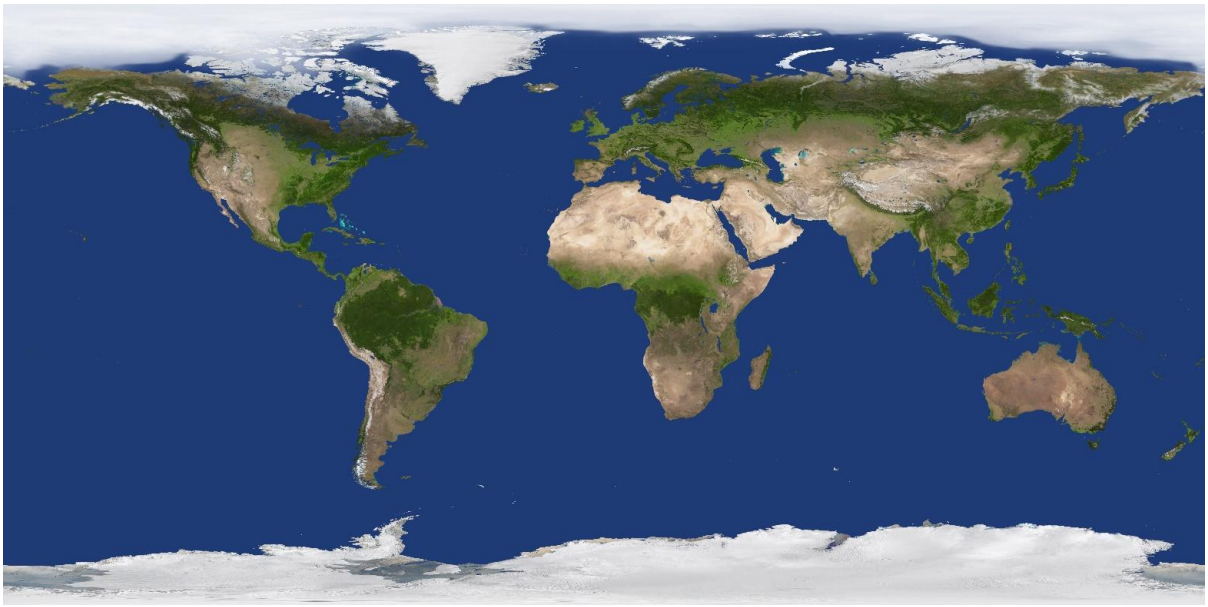

Figure 48 - Original Earth texture

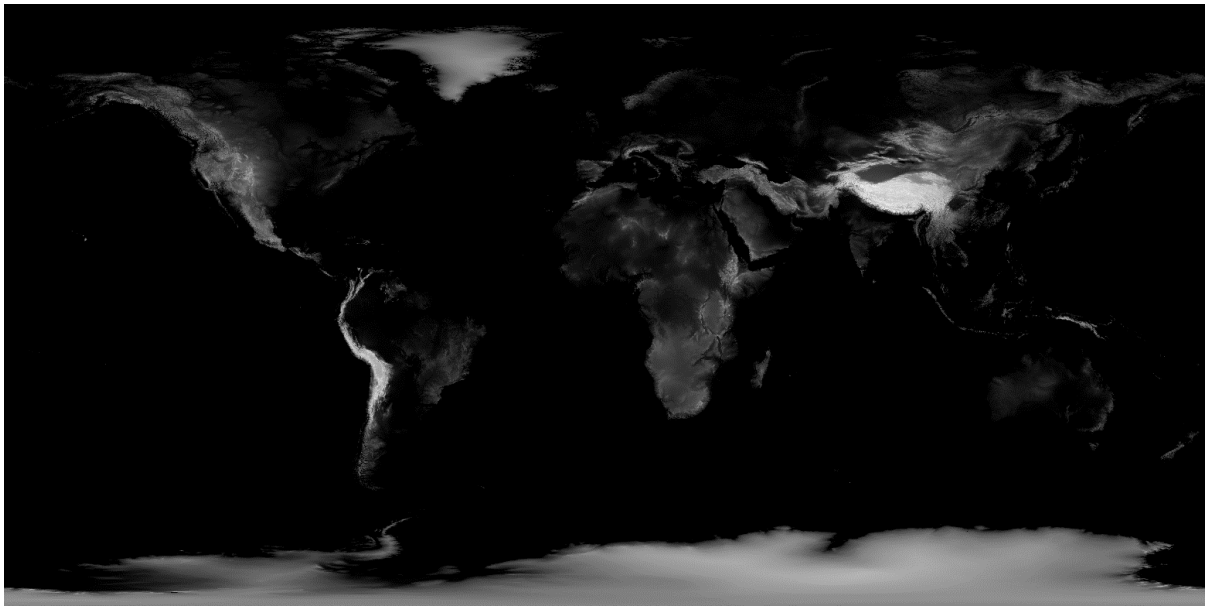

Figure 49 - Earth height map

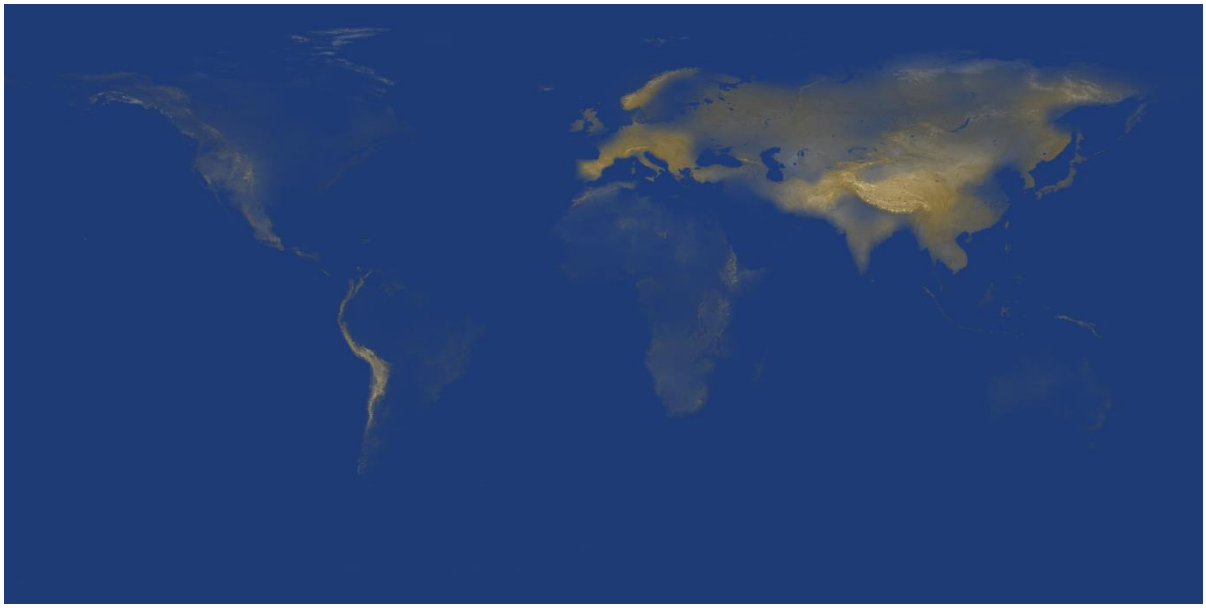

Figure 50 - Modified Earth texture

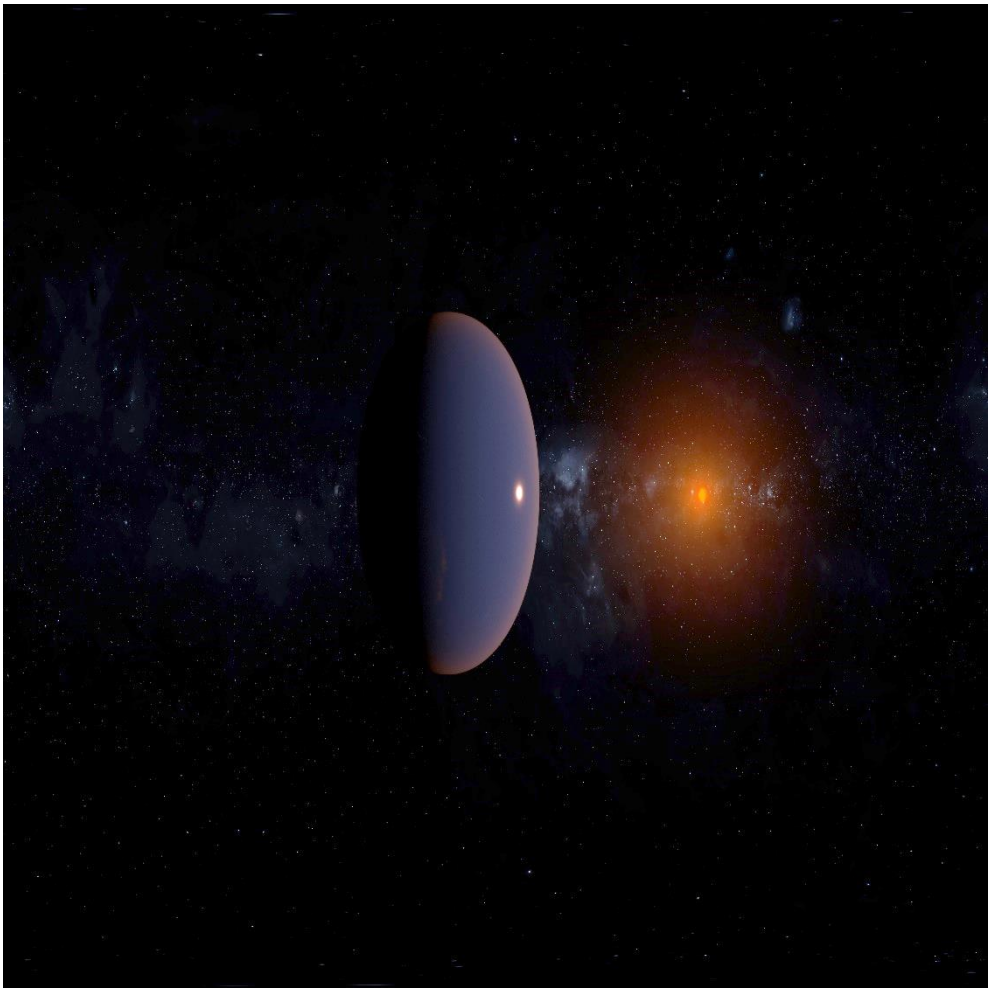

Figure 51 – Scene 2 -The Sunrise

Scene 3 – Kelaamiseen

In the second scene, it is shown what in the narration is called a Kelaamiseen. Since these structures can encapsule whole cities, it was made one in at scale in the 3D software. This was done as to ensure that sense of scale was properly conveyed.

The dome was portrayed as having a clear and peaceful aspect, which would contrast with the outside ambient which is desert and inhospitable. In later iterations of the scene, it was added two more domes farther in the distance.

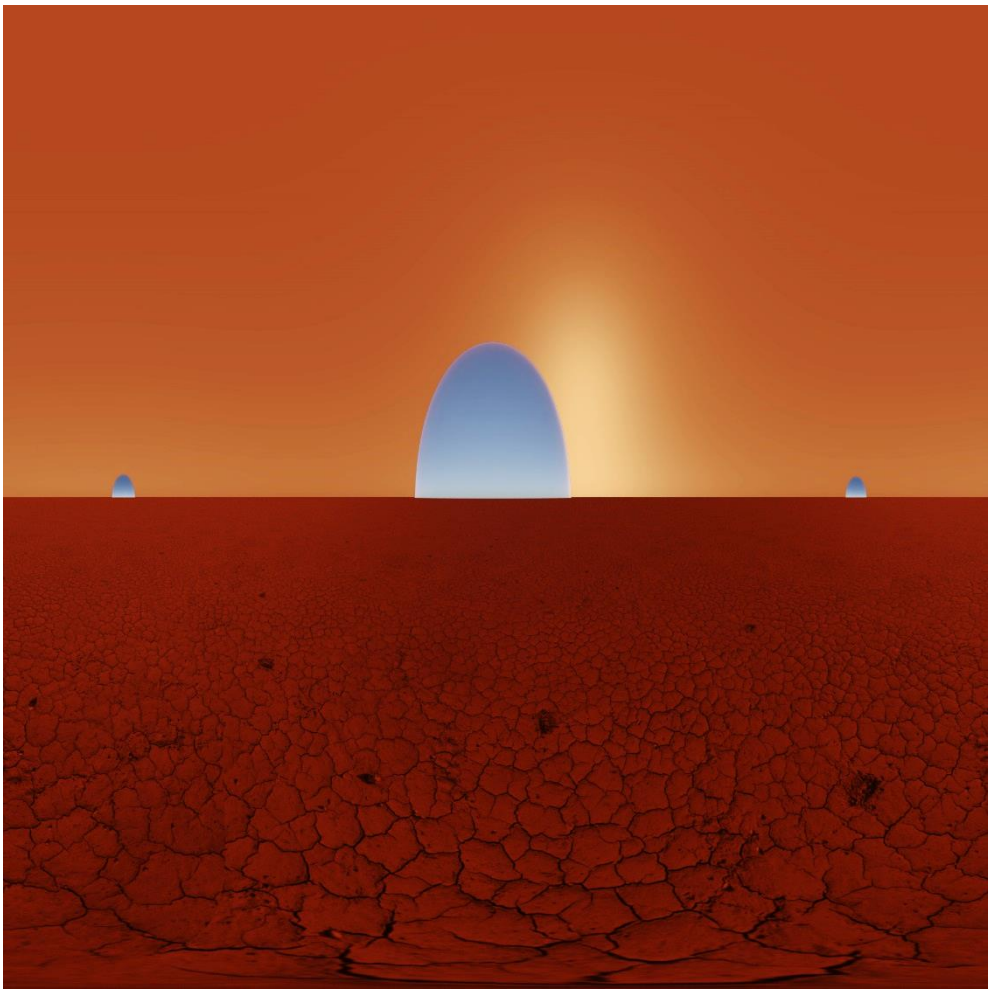

Figure 52 – Scene 3 - Kelaamiseen

Scene 4 – Digital Map

The third scene is a 3-dimensional map which portrays Clatterlex 5, the area in which intelligent life was spotted in deep space.

For this project it was given a large creative liberty for the representation of the visual ideas. As such, Clatterlex 5, was represented in a formless shape, much like a cloud which morphed continuously into different shapes.

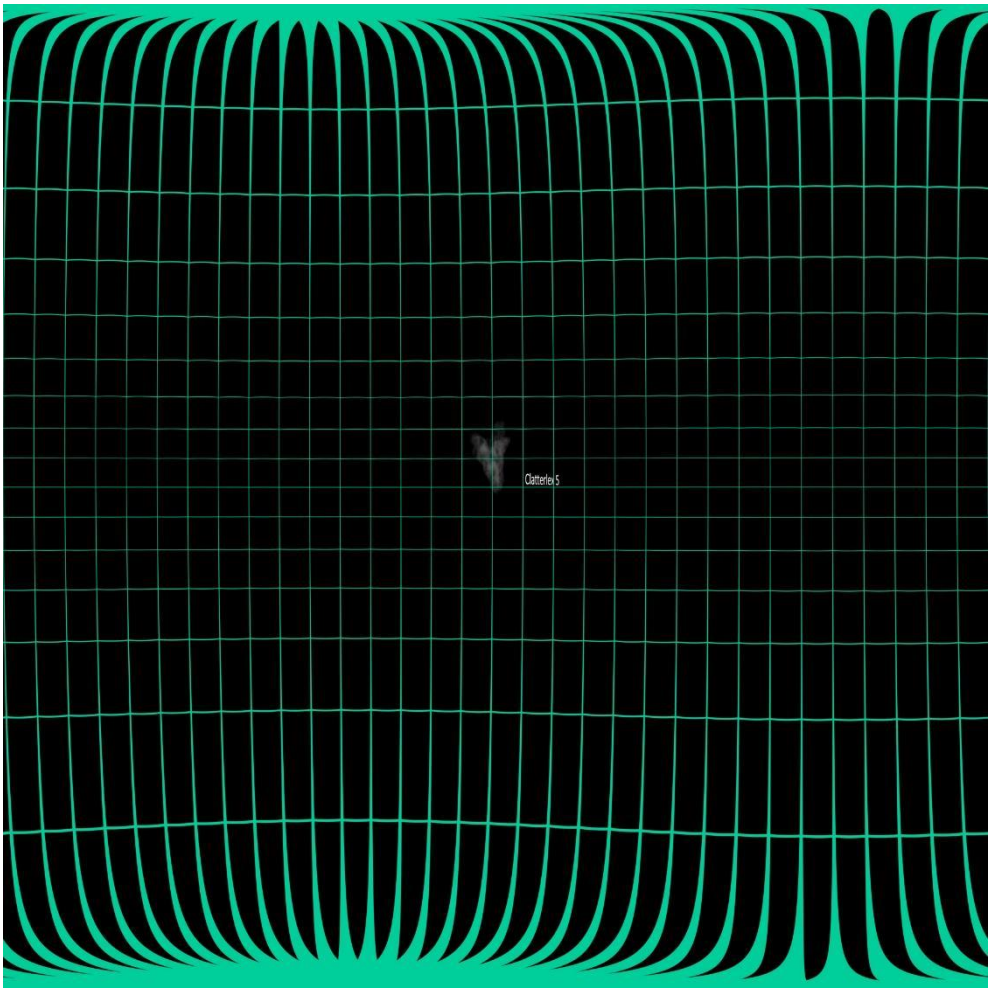

Figure 53 – Scene 4 - Digital Map

In the background of the scene there is a grid, which wraps around the empty black space. This was inspired by the film, Treasure Planet (2002), which features an object which can project a holographic map, with a grid shaped like a stretched sphere.

Scene 5 – Meeting of Pelastus

The fourth scene is the Meeting of Pelastus. In this part of the story, "the Grand Asian Empire and the Nova Europe" meet as to discuss the future of humanity. The concept for this scene was that of two seated people facing each other, in a futuristic setting.

Originally, this scene was set up so that each person was in each respective chair, and between them there was a semi-globe, illuminating the room, which was completely dark and empty, so that one could not perceive its size and shape.

Later, this scene suffered major changes. The characters were changed from two men, to a woman on the left side, wearing an armature, reminiscent of ancient Greek ones, representing Nova Europe. That women is seated on an oval shaped chair floating above ground. And in the left side, a bald man,

wearing a garment, inspired by the ones used by Tibetan monks. Seated cross legged on what resembles a cushion. Furthermore, the semi-globe was removed and replaced with a sun hovering above the characters in the middle of the room. Rotating around the sun there is a full globe of earth.

Below the seat of each character there is matter flowing from the ground to the bottom of it. Also, the floor as the same glossy finish as the seats, which, along with the flowing matter bellow them, provides a sense that they came from the ground.

There is also a ball floating and rotation around each character, each, of a different colour. And lastly, the background was changed.

All the moving and abstract elements provide an organic nature to, what would be an, otherwise, uninteresting scene without movement, while also, giving the participator, a motivation to look around the scene.

Figure 54 – Scene 5 - Meeting of Pelastus

Scene 6 – Launch of the EVA XIV

The fifth scene is the launching of EVA XIV, the spaceship that transports many families, on a journey towards Clatterlex 5, the place that holds life in the universe. The final result of this scene is

not much different from the original. The major changes were made to the environment. The scene is comprised of a colossal structure that extends to the point where you cannot see its edges. In the. That structure is characterized by indentations on the surface, equally spaced from each other, forming a star if seen from above. In the centre of that star there is a hole from where the spaceship is launched. In the first iterations of this scene, those indentations were purely aesthetical, but later they were used as corridors for energy fields. These corridors are empty at first, but then, from outside, comes this blue energy, that converges in the centre, precisely, when the ship launches. Giving the idea that that energy is powering the ship's launch.

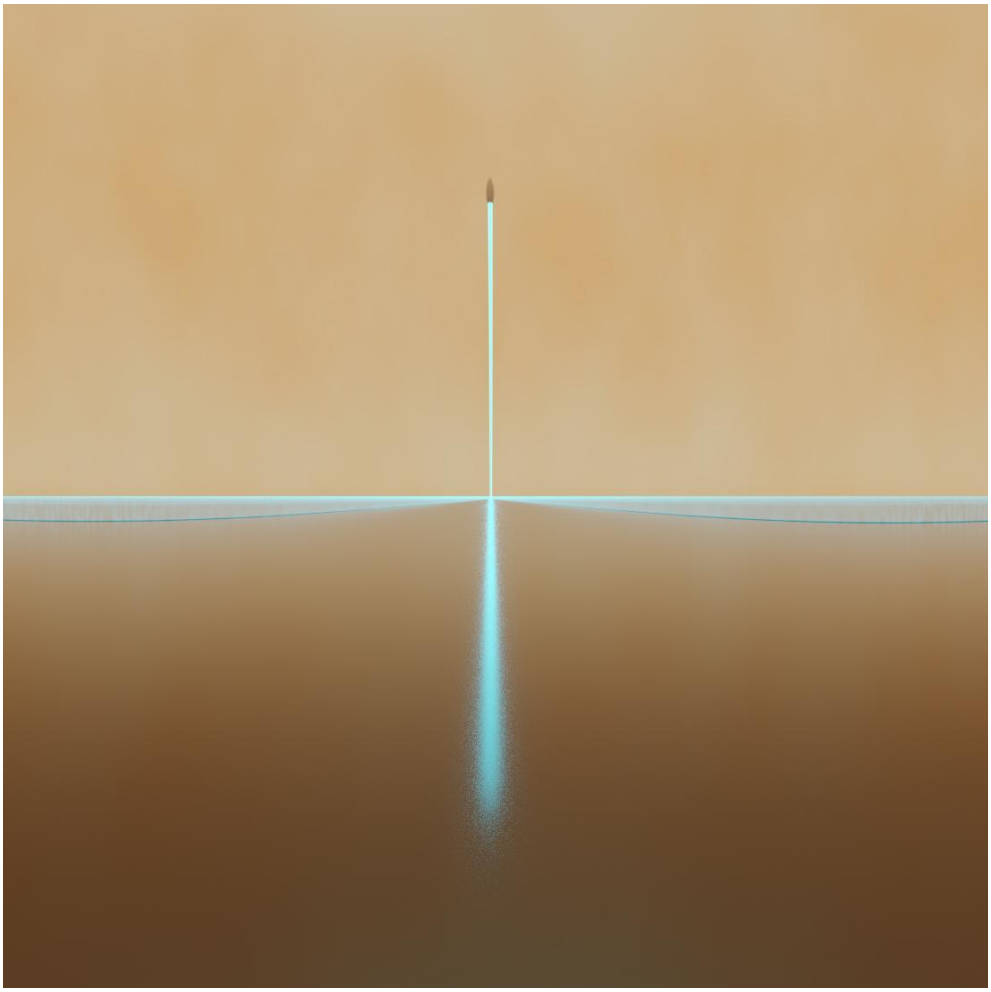

Figure 55 – Scene 6 -Launch of EVA XIV

Scene 7 – EVA XIV disappears

The sixth scene is the in the same environment as the third scene, the one with a virtual map with the location of Clatterlex 5. This time there is a representation of EVA XV in a sized down version, and its path to Clatterlex 5, displayed in orange. As it is narrated, earth, loses its contact with the spaceship which, eventually, disappears. To represent this process, the spaceship and its path vanish from sight.

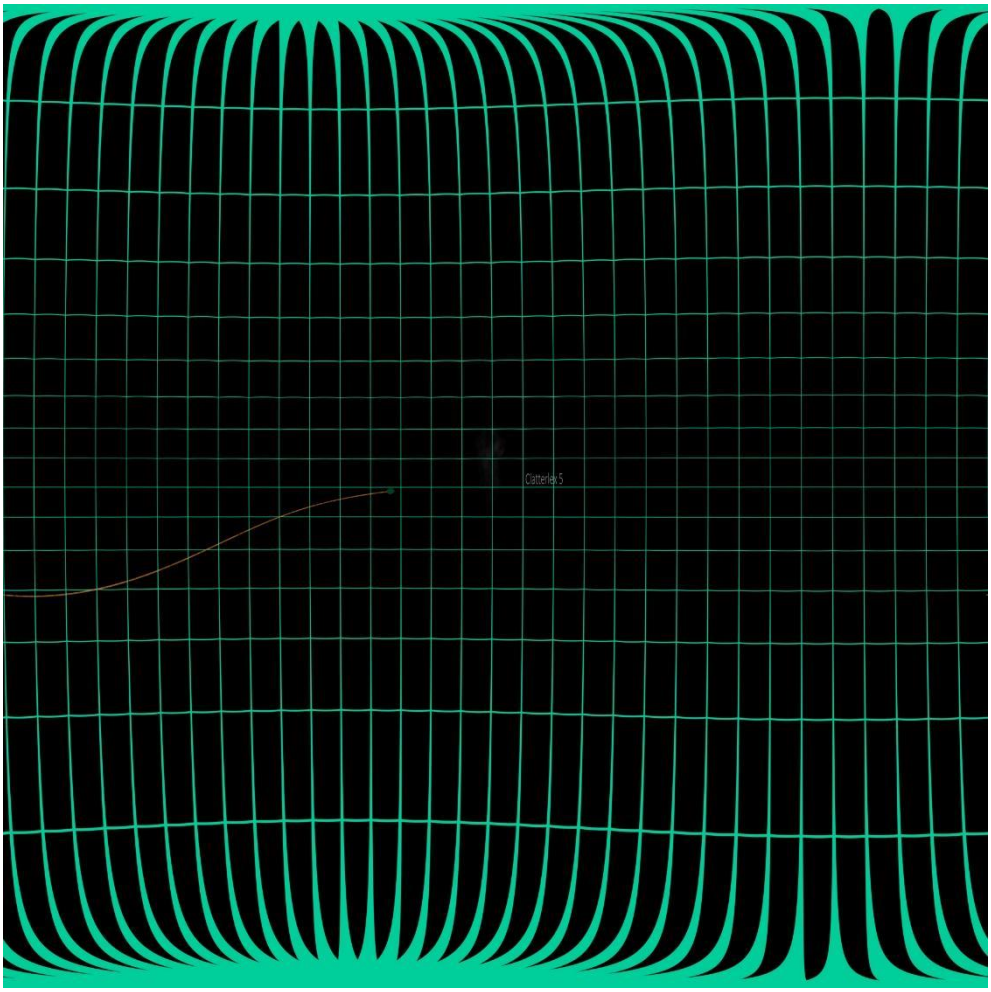

Figure 56 – Scene 7 - EVA XIV disappears

Scene 8 – Launch of the EVA XV

The seventh and last scene is of the launch of EVA XV, which is the successor of EVA XIV. The previous scene ends with a fade out, leading to moment in pitch black with only the music and the end of the narration. Right afterwards, the music changes suddenly to a more upbeat sound, punctuated by the drum sounds, and leaded by the main vocalist singing the following lyrics:

"look into the need
look into the needle
look into the need, dull skin, the dark beneath your feet

look into the need
look into the needle
look into the need, dull face, the light beneath your feet"

Like the change in the music, the video cuts simultaneously to a view of earth getting farther and farther as the ship, EVA XV, travels past the spectator into deep space.

This whole sequence was made to grab the viewer's attention and to create expectation to what comes afterwards in the story and the experience.

In the end the video fades to black as the music ends in a lush atmosphere.

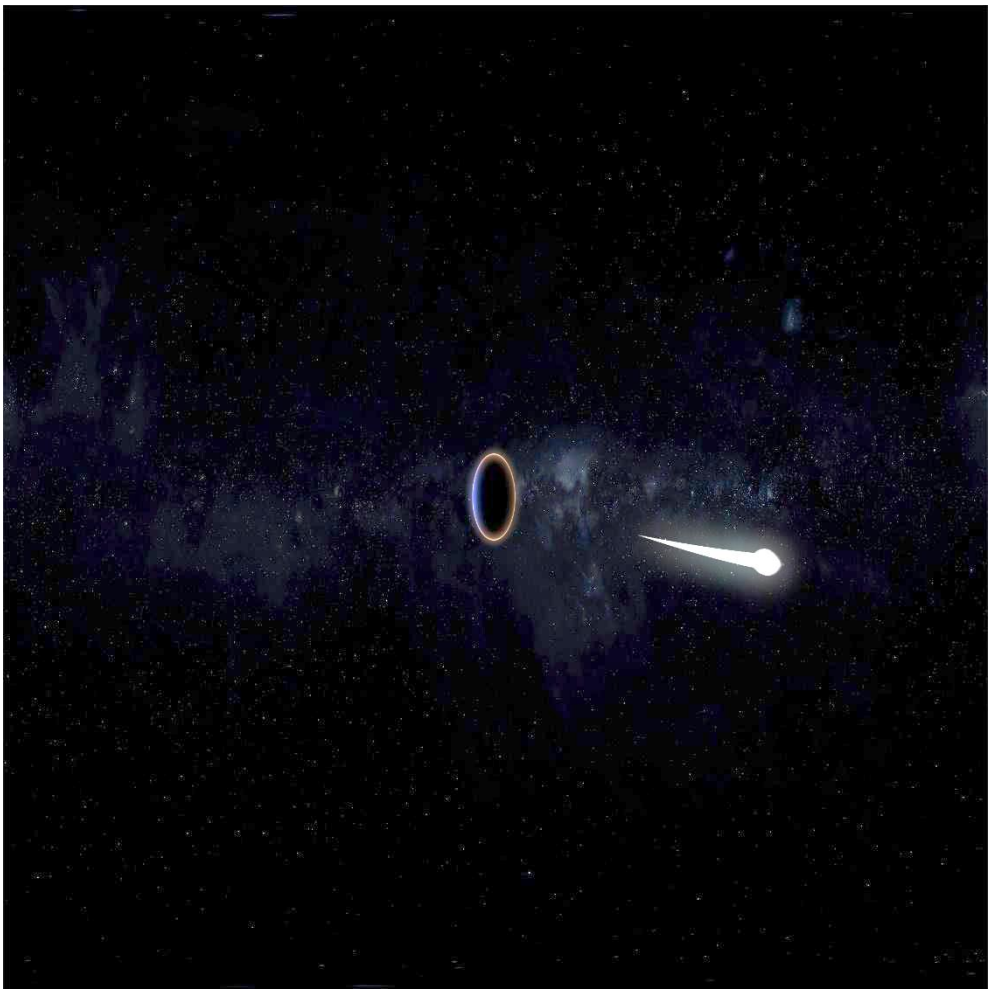

Figure 57 – Scene 8 - EVA XV launch

3.2.3 The production

The production of the music video was almost entirely in Blender, having as basis the animatic as was mentioned earlier. The production went through various phases. The first, the modelling and placing of the objects had already begun because of the animatic for which some objects were made. Then the models were refined when needed. The next step was the texturing process. For example in Figures Figure 58, Figure 59Figure 60, it is represented the process of the texturing of the sun. Nodes are used to create materials and textures in Blender as can be seen in Figure 59.

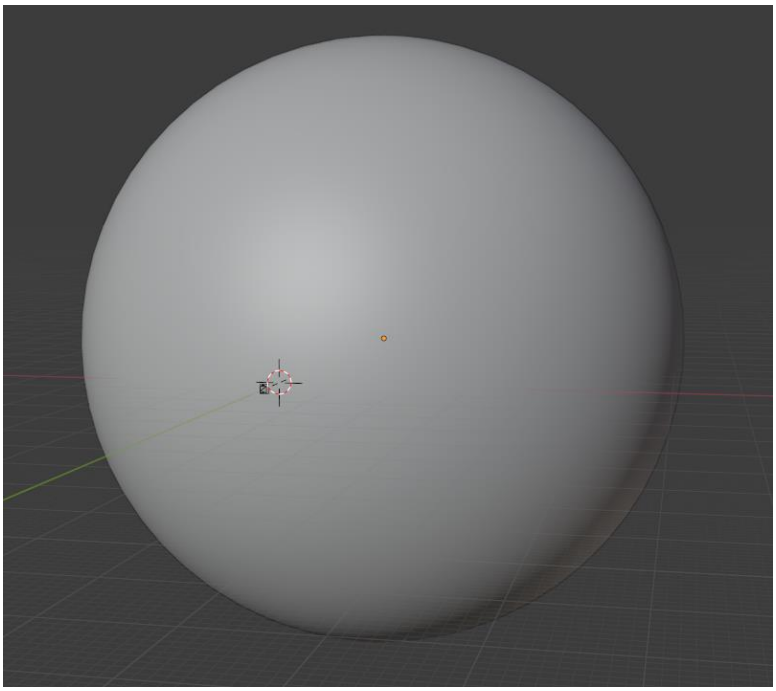

Figure 58 - 3D model of the sun

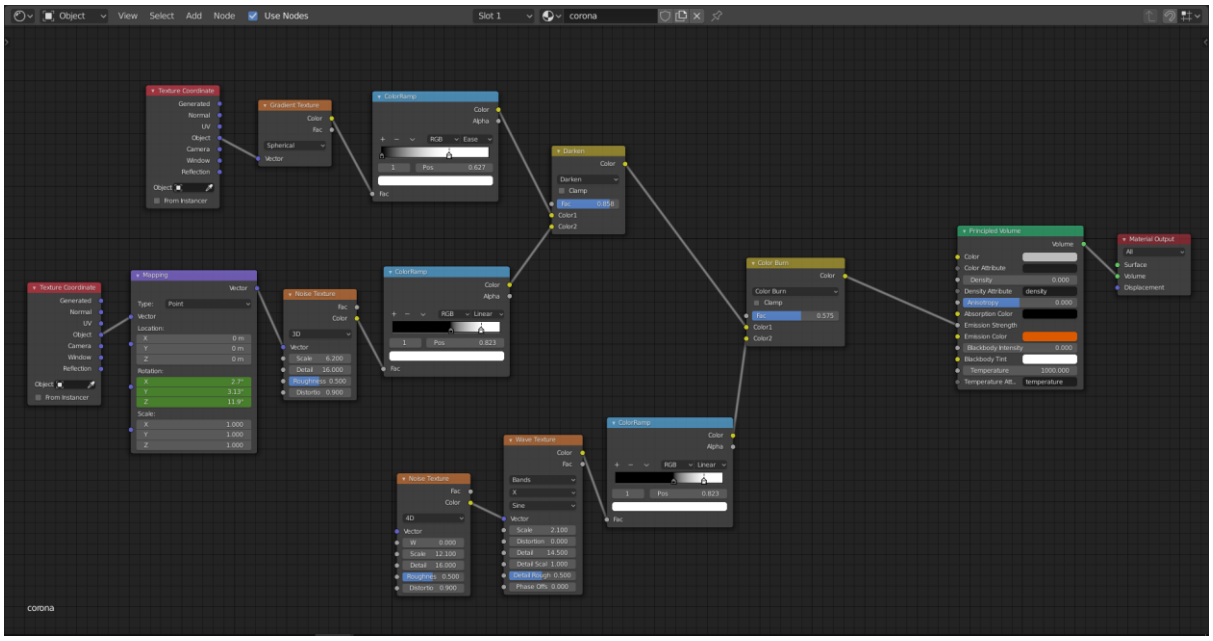

Figure 59 - Node tree that creates the texture of the sun

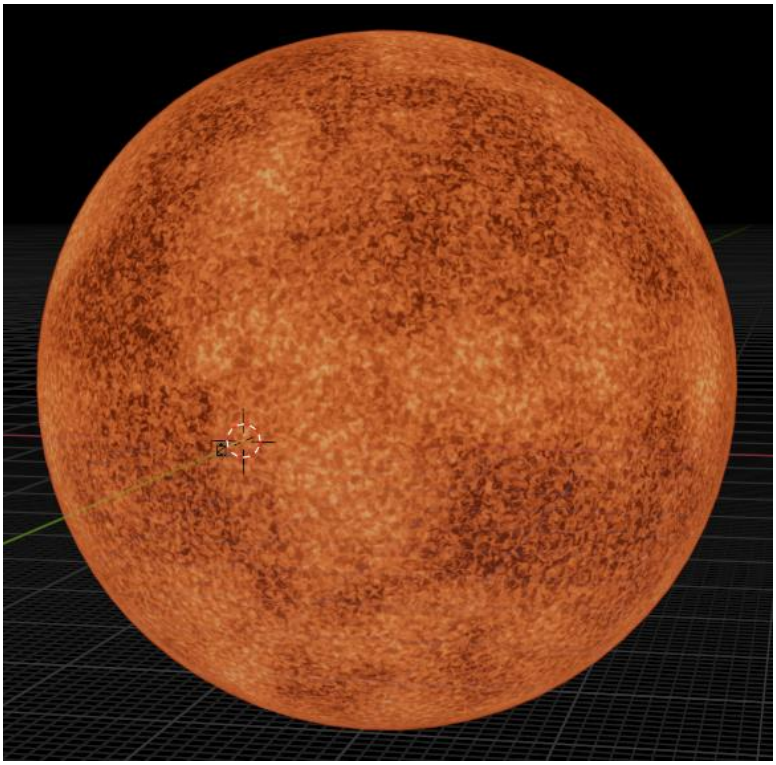

Figure 60 - The sun with the texture

After the texturing process, it is fundamental to light the scene. The scenes are lighted with virtual lights that simulate the behaving of light in the real world.

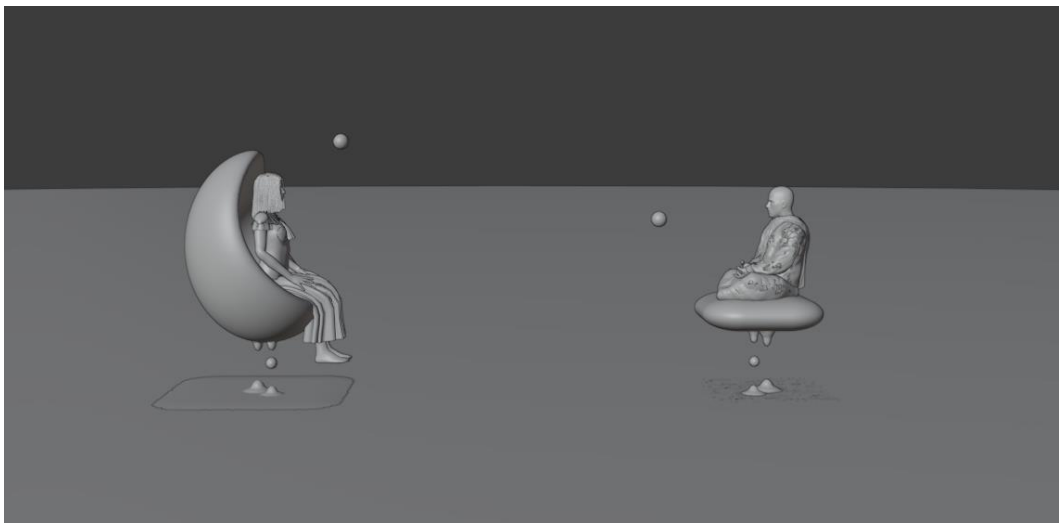

Figure 61 - 3D scene without lighting

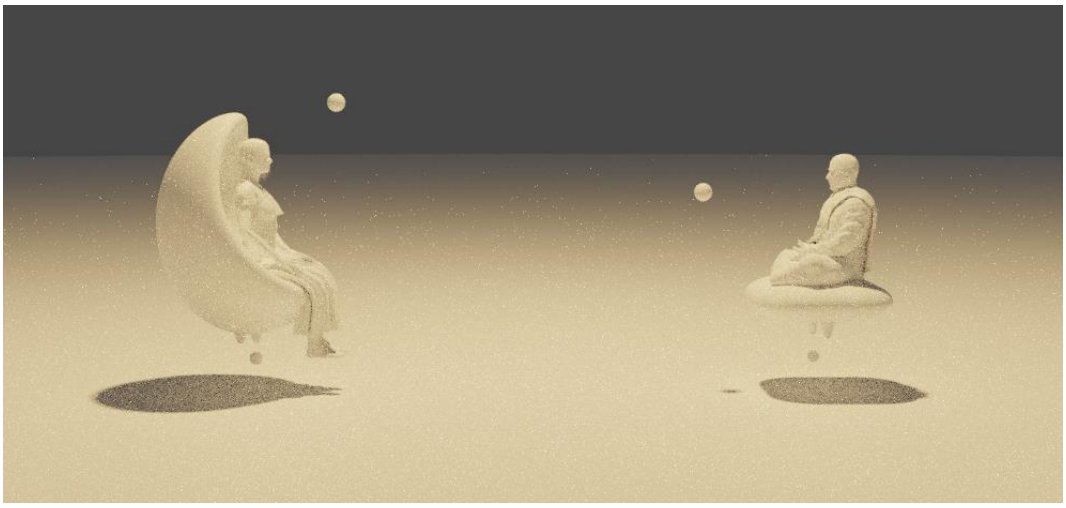

Figure 62 - 3D scene with lighting

Simultaneously the animation was being either made from scratch or improved over the animatic. For example, in scene 2, The Sunrise, the sun was rotating in the wrong direction (see Figures Figure 45 - Animatic: text intro Figure 46) rising from the west and setting in the east. This was corrected in the final version (see Figure 51).

In scene 3 of the Kelaamiseen, the animated element was the camera which slowly moves forward and the clouds in the sky which were made in the post-production phase in After Effects as this was much easier to change if needed.

In the scene 4, the Digital Map, the object representing Clatterlex 5 was animated as to suggest that it was somehow alive, changing, and having an identity of its own. Additionally there is a movement towards the 360 camera that is more perceptible in VR due to stereoscopy. A text with "Clatterlex 5" written on it was animated next to Clatterlex 5 in the Digital Map as to contextualize the viewer. In scene 5, the Meeting of Pelastus, there were many animated elements, firstly there were spheres rotating around each of the characters; then there were spheres coming from the ground and to the chairs were each person was seated which suggested that the chairs were somehow part of the floor. Above the characters were the earth in small scale rotating around a small-scale sun, and around itself like the earth moves.

In scene 6, the Launch of the EVA XIV, there are two animated objects, the energy converging into the centre of the space, and the launching spaceship flying up towards the clouds. In the ship there was added a slight irregularity to its movement to the sides as to add a more realistic feel of a spaceship being propelled up rather than the look of an object that is just moving up. In the energy converging into the middle of the scene there is a moving pattern in its surface as to give the idea that there is energy flowing through it.

The seventh scene is identical to scene 4 of the digital map with Clatterlex 5 moving towards the camera, and with the additional element of a spaceship travelling through a path towards Clatterlex 5, and the path of the spaceship moves past the camera, which is to take advantage of stereoscopy to provide an additional level of immersion.

In the final scene, the launch of the EVA XV, there is the movement of the camera moving away from earth and the spaceship which travels past the camera into deep space. This makes the user follow the spaceship which adds an additional level of depth.

3.2.4 Post-production

Sound design

The first element that is shown before the initial credits is a recommendation to watch the music video with headphones on, as the music for the final video was mixed in 1st order ambisonics[117], which is the format supported by YouTube. This version of the song was created with the various elements of the original song separated, each in its respective audio track, that were later combined and mixed in a program named Reaper (see Figure 63), with the help of a suite of plugins, named Spatial Workstation, which was made with the aim to create spatial audio from scratch. The main plugin from that suite used to create this is the Audio360Spatialiser which has a graphical interface with which one can place the sound source anywhere in the 3D space (see Figures 64 and 65).

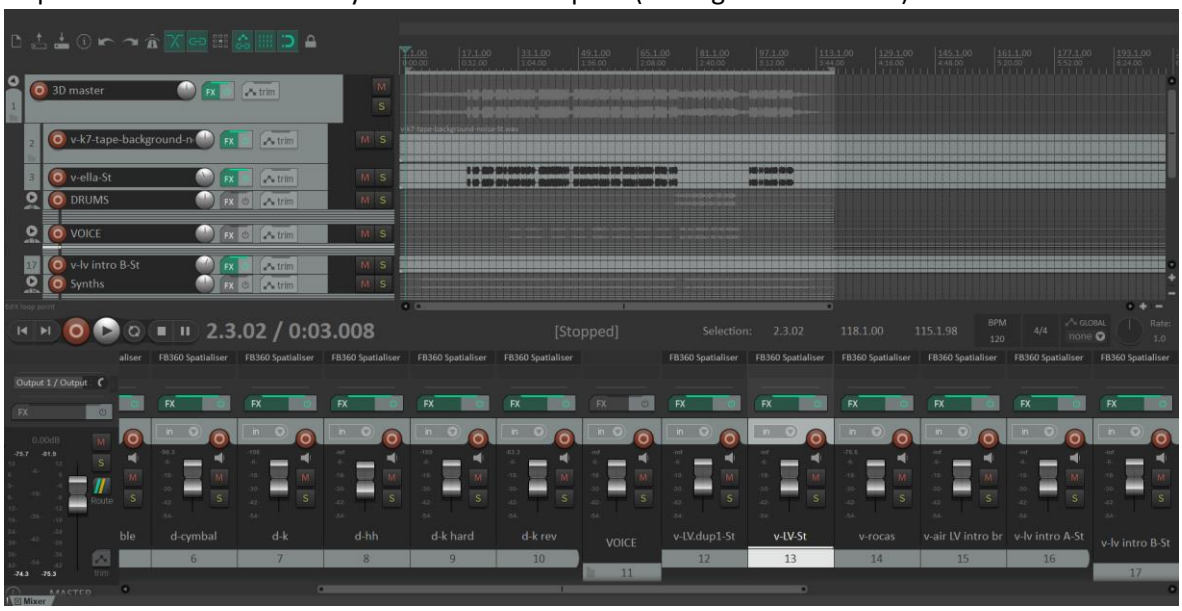

Figure 63 - Mixing in Reaper for spatialised sound

[117] This format only supports 4 channels of audio

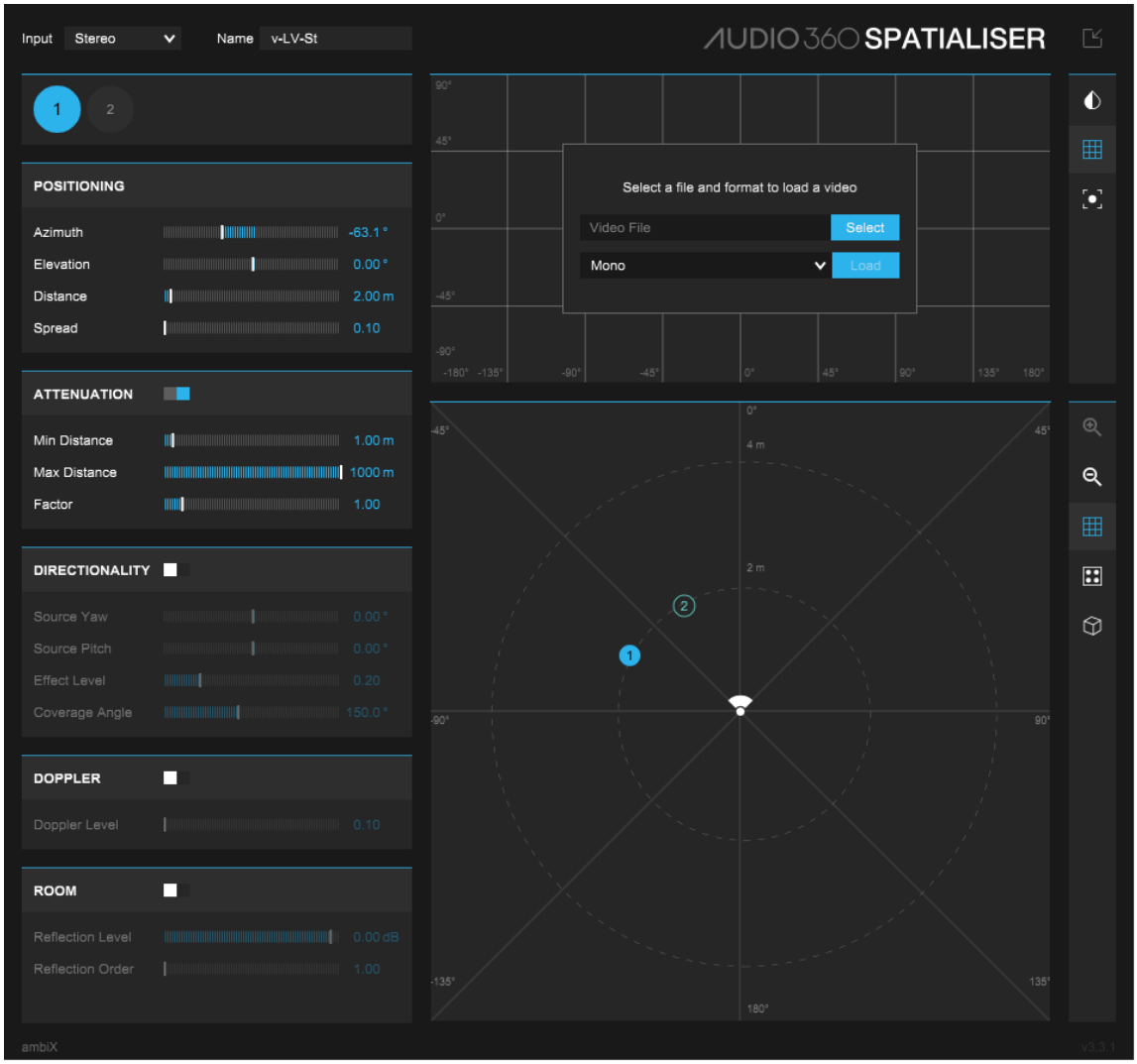

Figure 64 - The audio spatialiser plugin

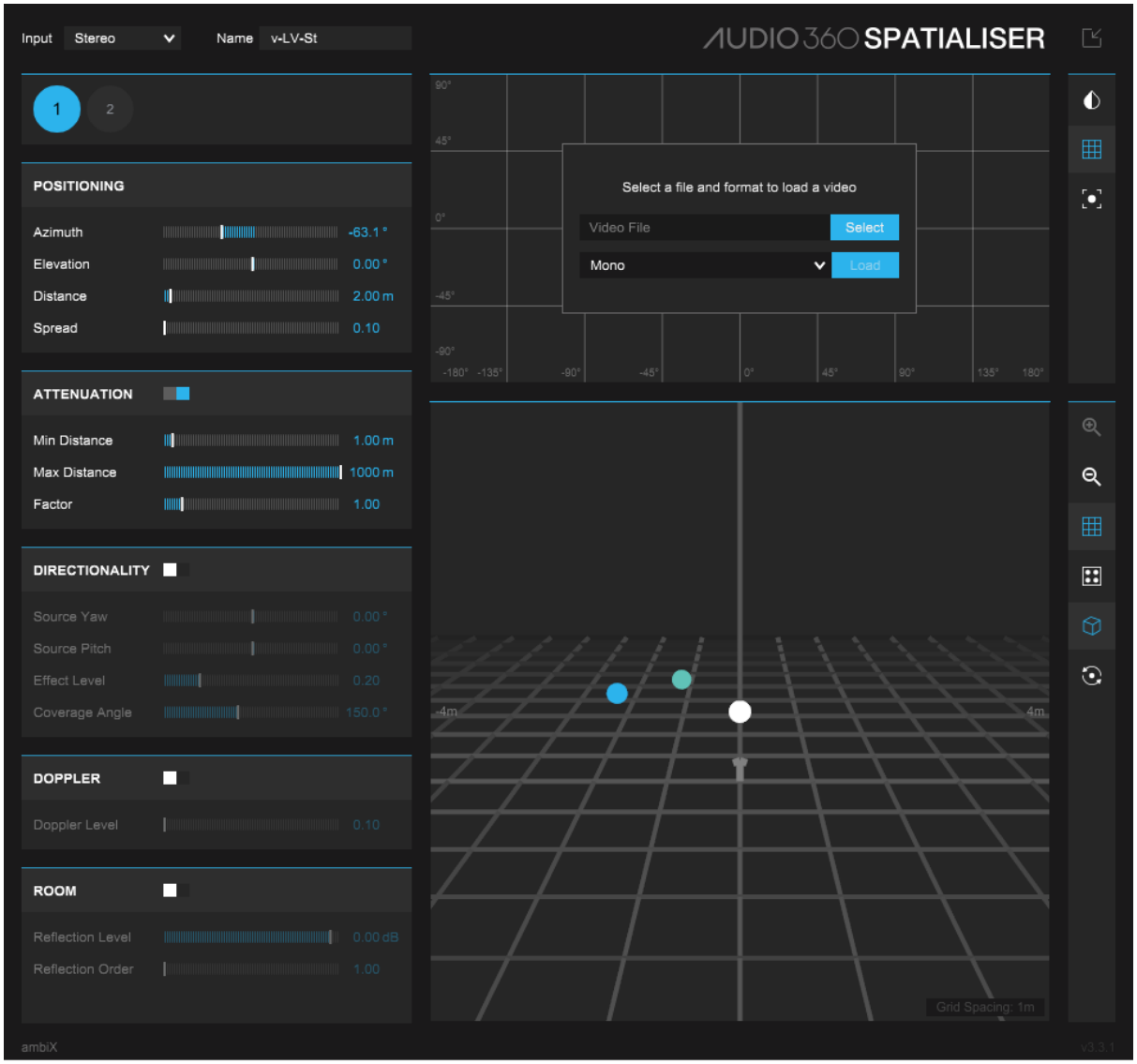

Figure 65 - 3D interface of the plugin Audio360Spatialiser

The post-production work was done in a software called After Effects (see Figure 68) which allows to work with stereoscopy and 360º images. Each scene of the music video was rendered from Blender in a PNG stereoscopic (top-bottom) image sequence. That sequence was then imported to After Effects as an image sequence¸ that way the software interpretates the images as if they were a video. Each scene was then colour graded as seen fit. Some scenes benefited from effects such as added contrast, exposure adjustments, and added saturation for the colours. Then there were effects added when needed such as glow (see Figure 66Figure 67) to make the lights, the objects emitting light such as the energy trail of the spaceship, and the highlights of the objects looking more natural, or changing the hue of a certain colour for example.

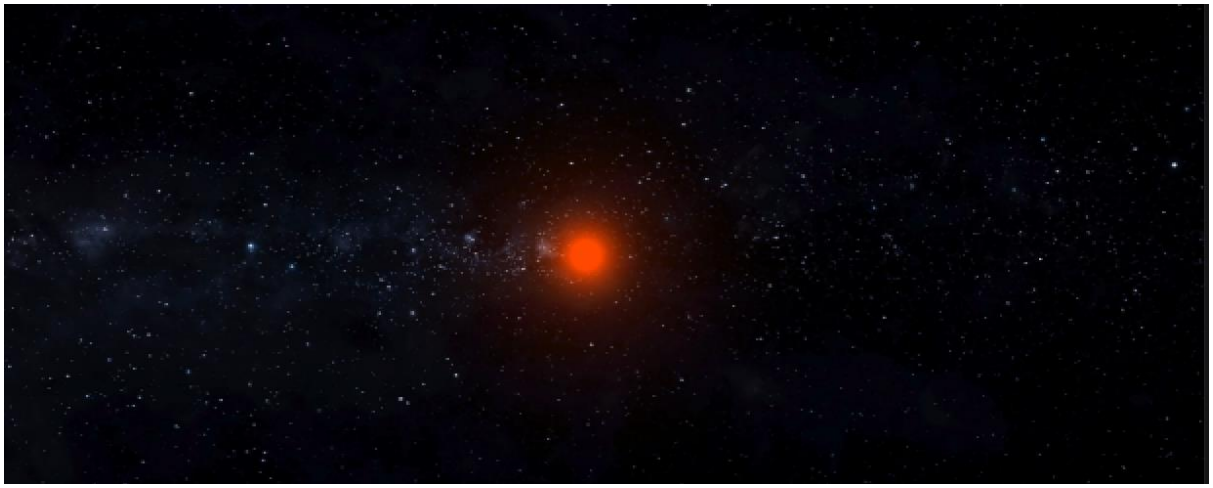

Figure 66 - Sun from the 1st scene without the glow effect

Figure 67 - Sun from the 1st scene with the glow effect

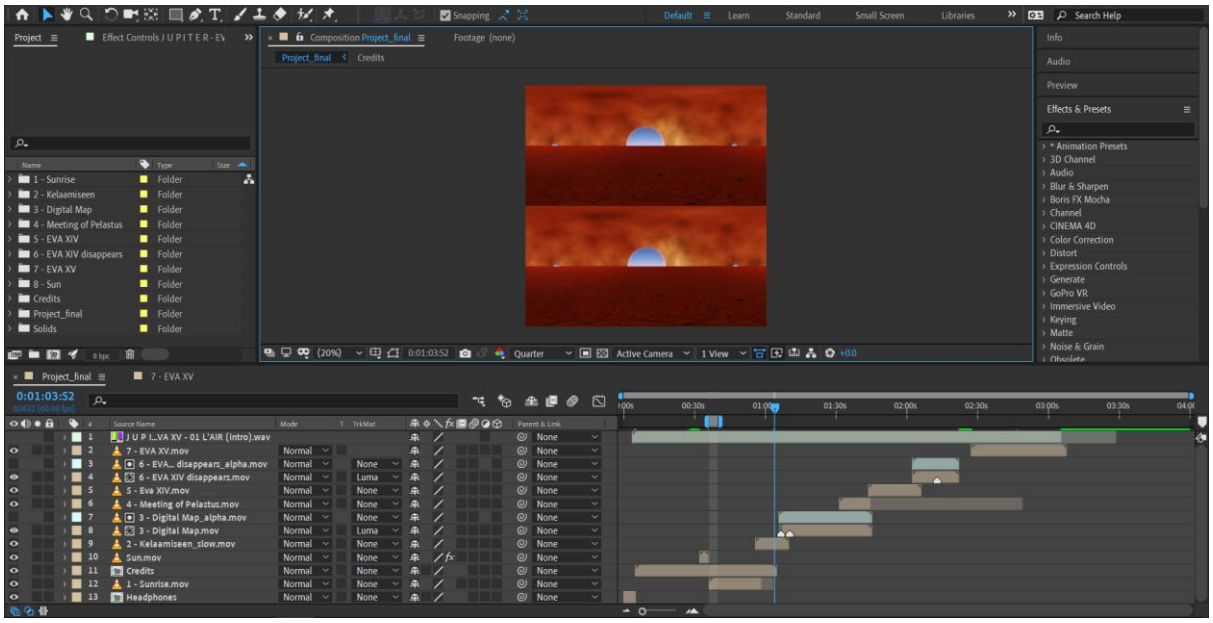

Figure 68 - Post-production in After Effects

The final video was rendered in a resolution of 1920 by 1920, in top to bottom stereoscopic format, in 60 frames per second. The spatial sound was embedded into the video after being exported from After Effects using Facebook's Audio 360 Encoder (see Figure 52).

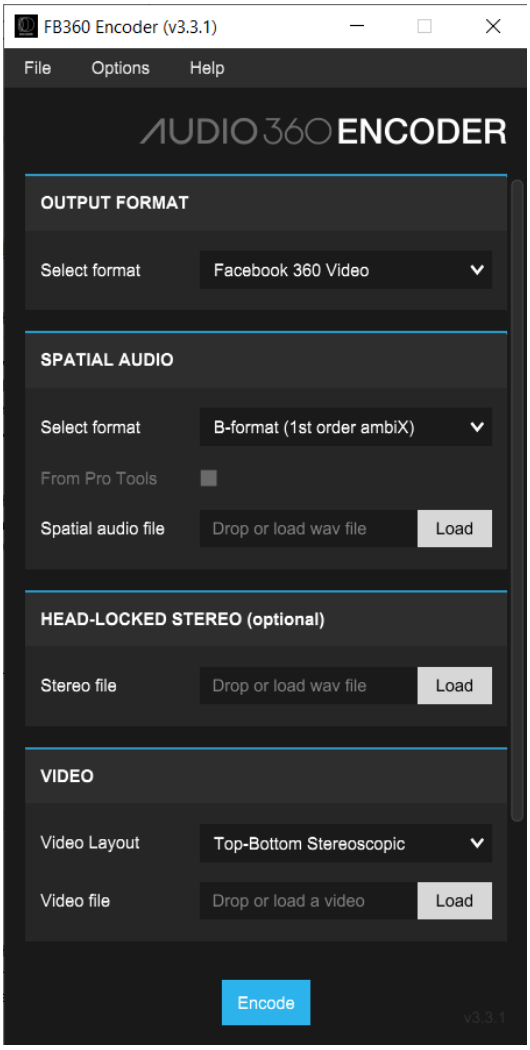

Figure 69 - Audio360Encoder1

3.2.5 The final product

The music video was then exported to YouTube on the researcher account as unlisted, so that only the people with the link could access the video, since that the film, to that point, was ready for research purposes only, and the possibility for distribution was not discussed so far.

The link to the music video is available here: https://www.youtube.com/watch?v=cvNUORWfEu0

It should be noted that the different formats through which the music video was evaluated – desktop-360-2D, mobile-360-2D and VR - differed in what devices were used to display the music video and not in the original source, which is the YouTube video linked above. In order to view the

stereoscopic version one needs a VR headset. Also, headphones are recommended for the viewing experience as to fully perceive the effects of the ambisonics audio.

3.2.6 The challenges

There were many challenges faced during the production of the music video, starting with the rise of the global pandemic of the virus COVID-19, which delayed the project development due to location restrictions, and personal issues triggered by the virus outburst.

The fact that the music video was made solely on computer graphics brought numerous challenges with the process, namely, the rendering time to produce a single image. Since a video is composed of thousands and thousands of images, this was a very time-consuming process, which was made fast according to the results pretended. However, this was not always was the case, as 360, stereoscopic images need to be inherently large as to provide sufficient detail for the viewer. As such, lowering the size of the images was not always an option, as this would have shortened the time rendering the images. Many times, this process was needed as to perceive how the scenes would be displayed on the HMD. The larger image sizes meant that more size in disk space would be used, which, at some points, was complicated to manage. Although technical, to give a better idea of how heavy these files were, the raw renders in PNG format occupies 1.6Tb.

After rendering, the images were edited in After Effects and exported as video to be uploaded to YouTube. These clips could be whole scenes or small sequences that were exported just to be experienced in the final format, as it is impossible to have an idea of how things are going to feel, rather than just looking, with the headset and headphones, as it is a completely different experience, in that it is way more immersive.

Another challenging factor was stereoscopy, which, besides adding additional time to the rendering process, as each frame of the video needs two independent images, was difficult to be set up correctly. The reading of the webpage “Understanding Comfortable Stereography” by Affonso Beato (2011), helped to clarify many of the doubts and misunderstandings about this process, and to understand some of the errors committed during the production of the music video, such as camera placement, the distance to objects to the camera, and adjusting the correct point where both the image of the right and left eye converge.

3.2.7 Possible improvements

The music video could have had more animated elements and a more present camera movement. The name of the band and the title of the song could have been shown in the end of the video, which would give more time for the scene with the sun, giving the possibility of a more dynamic animation

showing the growth of the sun and a dramatization of its death. Furthermore, this could help with the timing of the scenes.

Another possible improvement would be the inclusion of additional or alternative scenes showing inside the domes for example, or showing the families entering EVA XIV. These improvements could show a more human side of the story instead of showing almost exclusively the scenery. The state of earth could have been more perceptible has the rotation only lasted a small amount of time.

Perhaps, if done on a game engine, the music video could have had other potentialities such has subtitles which could be always visible to the user, interactive elements, and the possibility to travel in the scenery.

In the next section we will be describing the user tests made for this investigation, including how they were made, how the volunteers were chosen, and how the questionnaires were implemented.

4. Evaluation of the music video

Although this VR music video does not feature interactivity, given its immersive characteristics and the liberty of head rotation which VR allows, we adopted a testing methodology very close to Usability testing. There are three types of usability tests that can be made to evaluate an interactive digital graphic interface, being those: explorative, assessment, and comparative (Churm, n.d.). For this project, the tests will be of the latter two types: assessment, as it will be the music video that will be evaluated, and comparative, as there is going to be a comparison between three distinct groups, as it will be explained later.

After creating the music video, it was necessary to evaluate it as to understand the benefits of immersive VR, such has the visualization of music video made to be watched in an HMD as opposed to a 360-2D video, and to understand how the music video performs in terms of immersion, engagement.

As such this chapter will focus on the user tests that were conducted to evaluate the before mentioned aspects.

4.1 The user tests

There were made various user tests for this project, which were made for three different formats: desktop, smartphone, and HMD as to compare the experiences with each other, and most importantly, to HMD, which has the highest degree of immersion of the three. The desktop version was presented on a laptop, the model was a Lenovo Legion Y540. The smartphone was an iPhone 6S and the HMD was the Oculus Go. All the testers listened on headphones. Most users listened on the Superlux HD681, and others on the Audio-Technica ATH-M20 X, depending on what was available at the time. The video source for all these devices was one uploaded to YouTube as unlisted, which meant that it could only be seen by the researcher and its advisor. The tests were recorded with a Canon 550D on a tripod.

Figure 70 - Oculus Go[118]

Figure 71 – Oculus Go controller[119]

Figure 72 – Superlux HD-681[120]

[118] Retrieved 27 December, 2020: https://www.techradar.com/reviews/oculus-go
[119] Retrieved 27 December, 2020: https://www.oculus.com/go/accessories/
[120] Retrieved 27 December, 2020: https://www.thomann.de/pt/superlux_hd681.htm

Figure 73 - Audio-Technica ATH-M20 X

Figure 74 - iPhone 6S[121]

[121] Retrieved 28 December, 2020: https://www.macworld.com/article/2986703/iphone-6s-and-6s-plus-review-the-best-iphone-ever-by-a-wide-margin.html

Figure 75 - Canon 550D[122]

Figure 76 - Lenovo Y540[123]

The Oculus Go (see Figures 70 and 71), developed by Facebook and Qualcomm Xiaomi, was released as a standalone VR headset[124] in 2018. It has 32 GB of internal memory, It has a single sceen with a resolution of 1280 for 1440 per eye, and a refresh rate of up to 72Hz, with a field of view of 101 degrees, providing a fidelity of 12.67 pixels per degree. It features built-in speakers, and a controller that functions as a laser pointer to interact with the interface.

The Superlux HD-681 (see Figure 72) are studio headphones with an over-ear design and a semi-open system which allows for a more natural sound. It has an impedance of 32 Ohms and a frequency range of 10 Hz to 30 kHz. The Audio-Technica ATH-M20 X (see Figure 73) have an over-ear design has well but have a closed back system which prevents exterior noise. It has an impedance of 47 Ohms and 15 Hz to 20 kHz.

The iPhone 6S (see Figure 74) was released in 2015 by Apple Inc. It features an A9 processor, 2 GB of RAM, a PowerVR GT7600 GPU, 64 GB of storage, and a 4.7 inch display with a resolution of 1334 X 750.

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[122] Retrieved 28 December, 2020: https://www.techradar.com/reviews/cameras-and-camcorders/cameras/digital-slrs-hybrids/canon-eos-550d-677890/review

[123] Retrieved 27 December, 2020: https://www.pcguia.pt/2019/09/lenovo-legion-y540/

[124] It does not need any other device to function

The Canon 550D (see Figure 75) is an entry-level DSLR, featuring an 18 megapixel CMOS sensor and the ability to record full HD videos.

Finally, the Lenovo Y540 (see Figure 76) has a i7-9750H processor, 16 GB of RAM, an NVIDIA GeForce GTX 1650, 1 TB of internal SSD storage, and a full HD IPS display with 15.6 inches and a refresh rate of 144 Hz.

The tests were conducted on a controlled environment in a room in the Department of Communication and Art of the University of Aveiro, nicknamed the IDIoTLAB (Laboratório de Desenvolvimento de Internet das Coisas[125]). The room had 4 desks next to each other making an island in the middle of the room, the tests were made in one of those 4 desks. On top of it there was the HMD, the laptop where the questionnaires were answered as well as the desktop-360º-2D version of the video was seen, and the smartphone were the mobile-360º-2D version of the music video was seen as well. The camera to record the testing sessions was placed at eye level, and in a position that allowed to capture the person from below the waist to the top of the head, while allowing room for the person to move to the sides if needed.

Figure 77 - User test session

For the test attended 22 participants. Of those participants 7 were performed in a laptop computer, 6 for smartphone and 9 for HMD. A factor that helped to differentiate between which devices the volunteers would test with, was that those who wore glasses were asked to do the test in the laptop or the smartphone since the Oculus Go could not be worn with the interface foam due to the fact the all the equipment and objects needed to be disinfected before and after each subject. As such the

[125] Portuguese for "Laboratory of development of the internet of things"

foam could not be used given that it would not be properly cleaned. All these tests were performed from 2 to 6 of November 2020. The tests were made so that there would be a participant at a time. The tests took the duration of approximately 30 minutes. Given the restrictions due to the use of glasses in the part of the users and the global pandemic which limited the amount of people and accessibility, the recruitment was based on convenience, so there was no attempt at diversifying the sample (see figure 78).

Figure 78 - Oculus Go facial interface foam[126]

A document containing a script was made to structure and guide the test procedure (see Appendix B – Script for the user tests). It was composed in the following way: firstly, it was described where the test would take place, the equipment used to make the test, as well as the objects to disinfect the space. Secondly, in the space there should be only the responsible for the test and the tester. Thirdly, the person taking the test should be warned about the risks of using an HMD. Fourthly, the tester will do a pre-questionnaire, which is done before the experience of watching the music video, and its purpose is to collect data about the individual. In fifth place the tester will proceed to visualize the music video. In this part of the test, the researcher will prepare the equipment for the test, explain how to function with the respective device, and to help each person putting the HMD. Then the researcher will film the person taking the test as to gather data on its physical response to the music video. In the eighth part of the test, after the user sees the music video, he or she, will be asked to answer to the post-test-questionnaire, about the experience of watching the music video. Lastly, the user will leave the room and all the equipment will be disinfected.

Before any End User Test/usability test it is important to conduct a pilot test as to rectify any mistakes and notice any details that might be missing out, and that would be, otherwise, unnoticeable (Usability.gov, n.d.). Therefore, a pilot test was made, through which there were corrected some aspects of the questionnaires such as the branching of the questions and dispose the use of @ to

[126] Retrieved 27 december, 2020: https://www.oculus.com/go/accessories/

indicate gender ambivalence to a/o as this is necessary in the Portuguese language to distinguish between which gender it is being referred to.

4.2 The questionnaires

The pre-questionnaire (see Appendix F – Pre-test questionnaire in English, and Appendix G – Pre-test questionnaire in Portuguese) has 7 sections. The first is a consent form to know if the tester allows the recording of the test. The second is a characterization of the individual with questions regarding his age and sex. The third section starts with a question asking the participant if he or she has experienced VR previously, and if the person says yes, it is redirected to a subsection which contains questions regarding the person's experience with VR. If the person says no, he or she is redirected to a question about why not.

The fourth section has questions about the person's electronic skills, which is relevant has, a person with low competencies might have a worse experience with an HMD for instance, which might have a negative effect on the overall experience.

The fifth section has questions regarding the user's habits of watching music videos and their interest in them.

The sixth section follows the previous section structure but with questions regarding science fiction since the music video could be categorized has science fiction for its speculative view of earth and humanity's future. And lastly, the seventh section has questions about the user's interest in electronic music and regarding his or her experience with music, as the idea of having a music video in VR might be exciting to a person who has a band for example, and in turn influencing the experience.

The post-test questionnaire is also divided into 7 sections. The first has questions about the tester notion of the music video story and its themes. The second section is regarding the music and the sonic aspect of it, such has its spatialized characteristic. The third section has questions about the visual aspect of the experience, such has visual consistency, adequacy when it comes to the context of the music, and stereoscopy, for example. The fourth section has questions regarding how the users would prefer if the music video had interactive elements.

The fifth section has questions about the immersion factor and the individual's sense of it. The sixth section has questions about the emotional and physical aspects of the user's experience with the music video, such as if the person felt nervous during the experience, or even if he or she felt vertigo watching the video, has that is a very common symptom with HMD usage. The seventh, and last section is about the experience of watching the music video has a whole.

The questions in the questionnaires were based on the Likert scale, which is widely used, and is characterized by being a set of statements, typically 5, ranging from strongly disagree to strongly

agree, regarding the user feeling towards a hypothetical statement (Joshi, Kale, Chandel, & Pal, 2015). The questions regarding immersion and presence were based upon the ones created by Witmer and Singer (1998), which were made for evaluating presence in Virtual Environments, and on the questionnaire created by Tcha-Tokey, Christmann, Loup-Escande, & Richir (2016) for measuring the user experience in immersive virtual environments.

4.3 Results Discussion

In this chapter it will be presented the data obtained from the questionnaires and non-participant observation. The first data presented will be that of the pre-test questionnaire,

4.3.1 Pre-test questionnaire

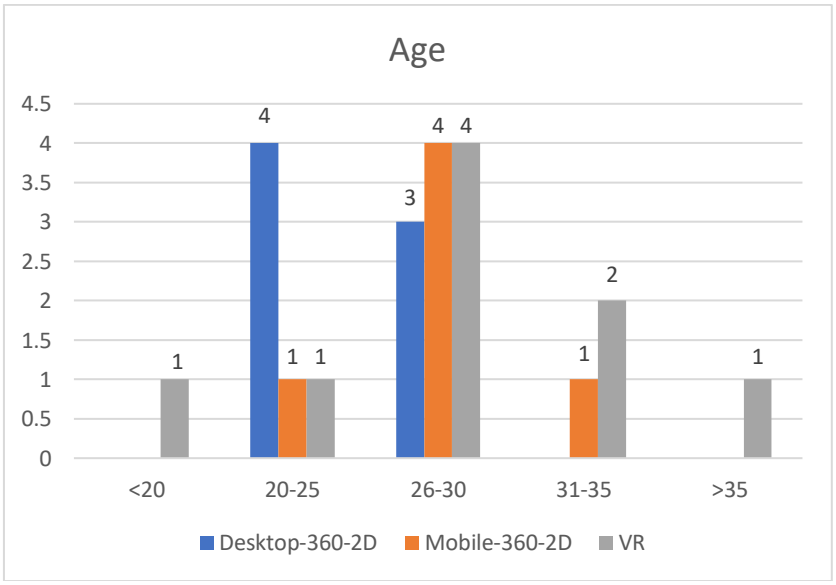
1 – Consent form

All the participants agreed on the recording of the testing session.

2 - Age

In Graphic 1 it can be noticed that most participants are between the age of 26 and 30 years old, with 10 people in that age span. The second biggest age span is between 20 and 25 with 7 people. And the third is between 31 and 35 with 3 people. Then there was only one person below the age of 20 and another above 35.

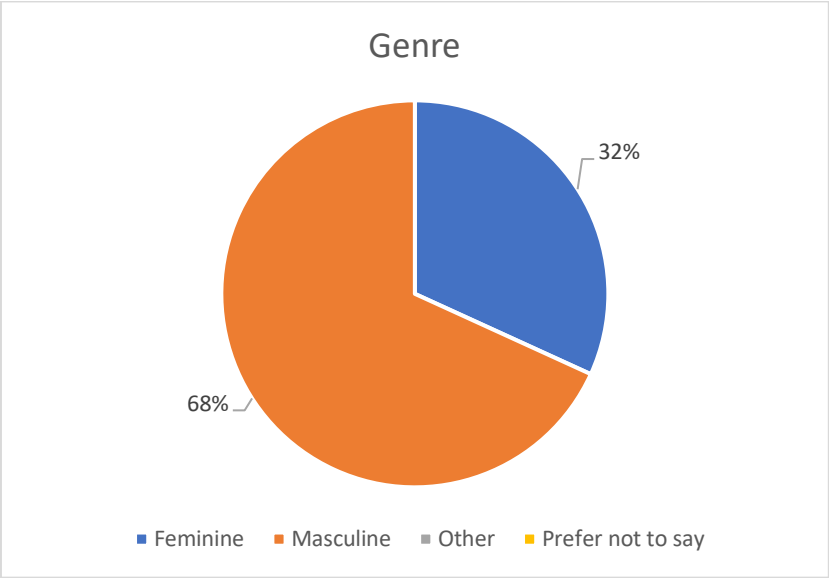
The participants were mostly people that were studying in the University of Aveiro which justifies their age span.



Graphic 1 - Age

3 - Genre

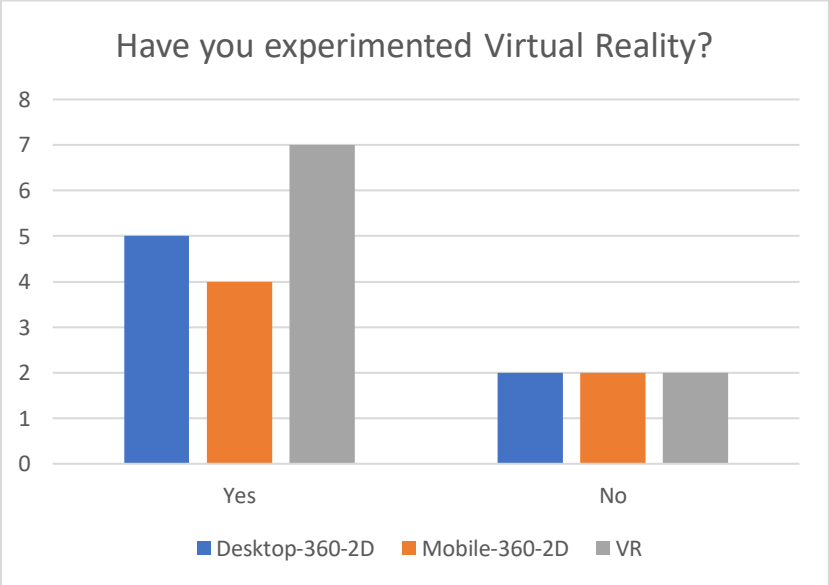
There were 15 male participants and 7 female ones.



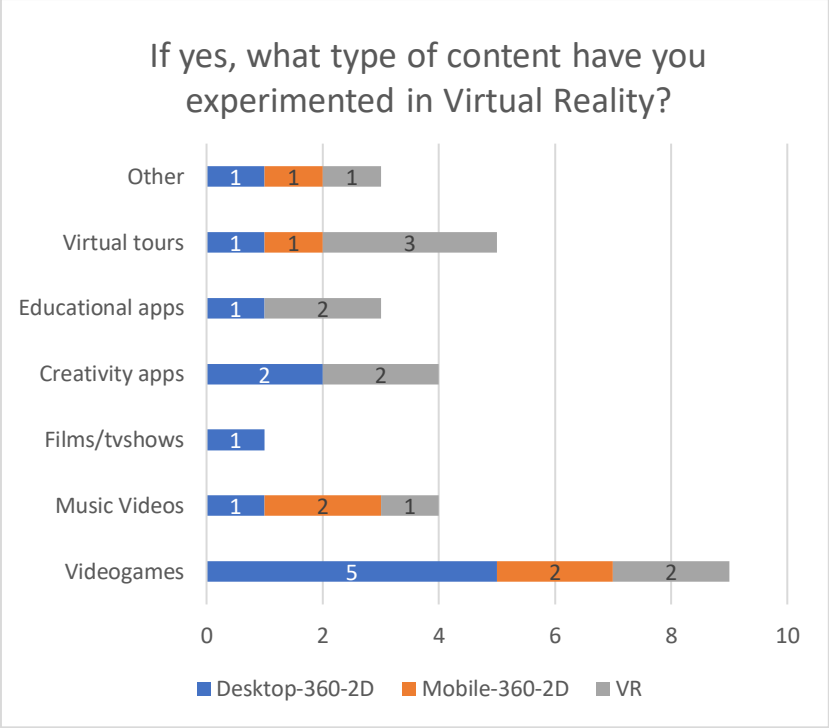
Graphic 2 - Genre

4 and 5 - Have you experimented Virtual Reality? / If yes, what type of content have you experimented in Virtual Reality?

In the Graphic 3, it can be seen that of all the participants, 16 had experience with VR. The most experienced content in VR, with 9 people, was video games. Then came music videos alongside virtual tours, both with 5 people, creative applications with 4, educational content with 3, and films/tv shows with 1. Other responses included art exposition, pornography, and entertainment.



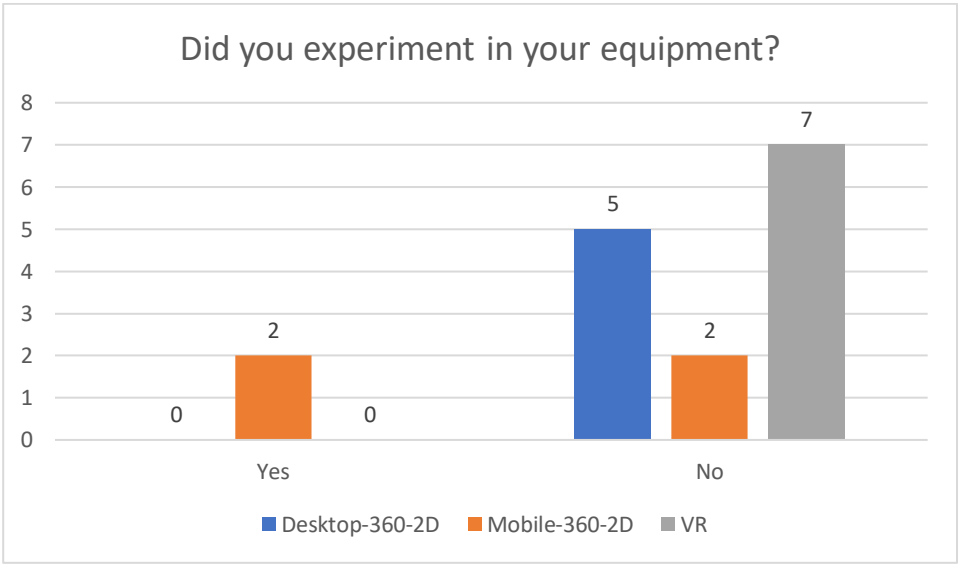
Graphic 3 - Have you experimented Virtual Reality?



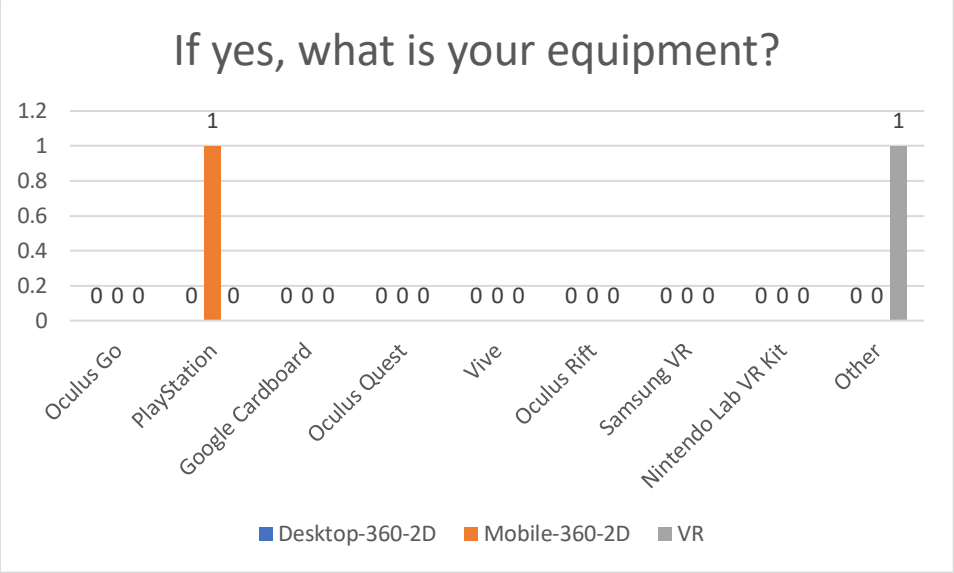
Graphic 4 - If yes, what type of content have you experimented in Virtual Reality?

6 and 7 - Did you experiment in your equipment? / If yes, what is your equipment?

In the Graphic 5, of those that had experience with VR, only two had their own equipment. In Graphic 6 the respective equipment for those two people was the PlayStation VR headset and the choice for another option besides those listed.



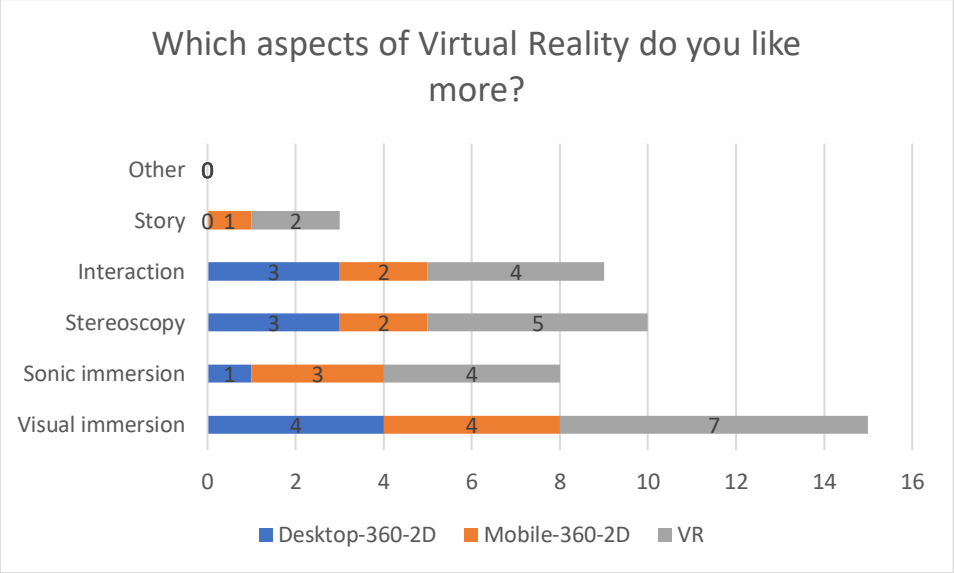
Graphic 5 -Did you experiment in your equipment?



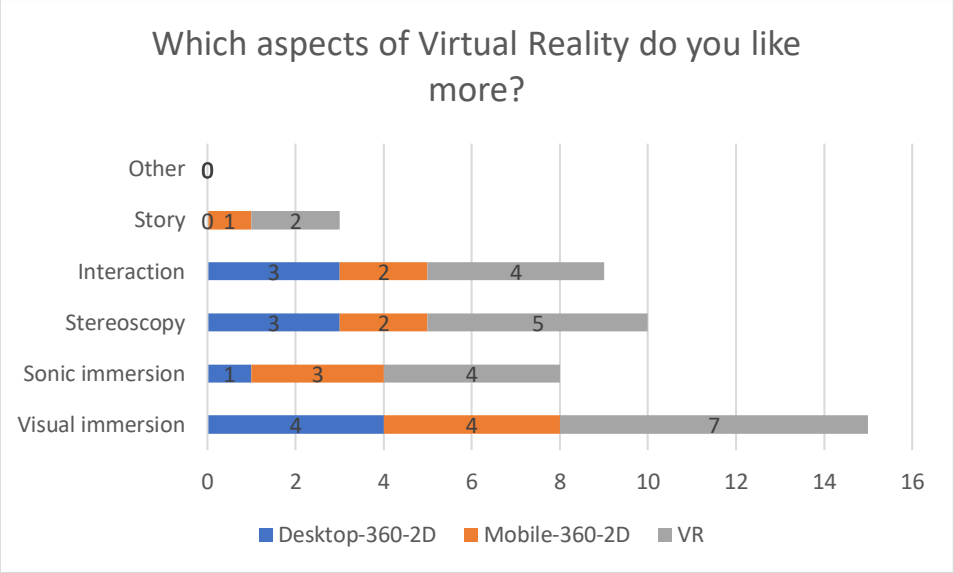
Graphic 6 - If yes, what is your equipment?

8 - Which aspects of Virtual Reality do you like more?

When asked what aspect of VR that people like more are: visual immersion with 15 people, stereoscopy with 10, interaction with 9, sonic immersion with 8, and then story with 3 (see



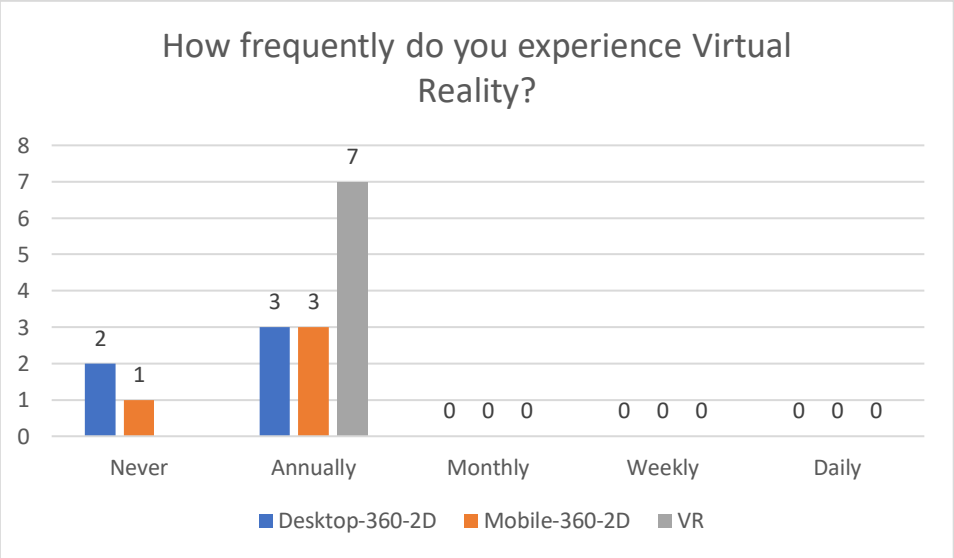
Graphic 7).



Graphic 7 - Which aspects of Virtual Reality do you like more?

9 - How frequently do you experience Virtual Reality?

In the Graphic 8 it can be noticed that it is very rare, for people to experience VR, since that of the people with experience, 13 watch annualy, and 3 never watched. It should be pointed out that the detail of having “never” in a question about frequency of use inside a section where it is necessary experience of use to access it was a mistake. Perhaps, by choosing “never”, the participants meant that they had only experienced VR once and did not have a frequent use of the medium, even in a sporadic fashion such as annualy.

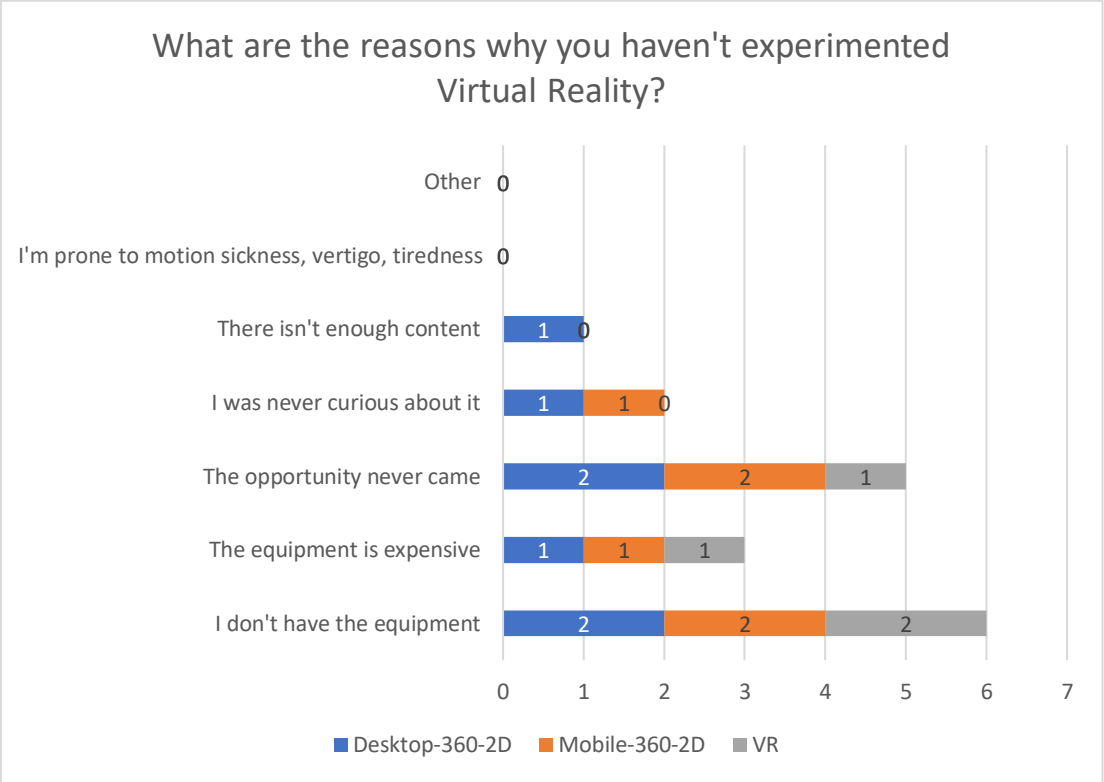


Graphic 8 - How frequently do you experience Virtual Reality?

10- What are the reasons why you haven't experimented Virtual Reality?

In the graphic 9 the reasons of why the participants had not experienced VR was, respectively, because they did not have the equipment, with 6 people, because the opportunity to do so never

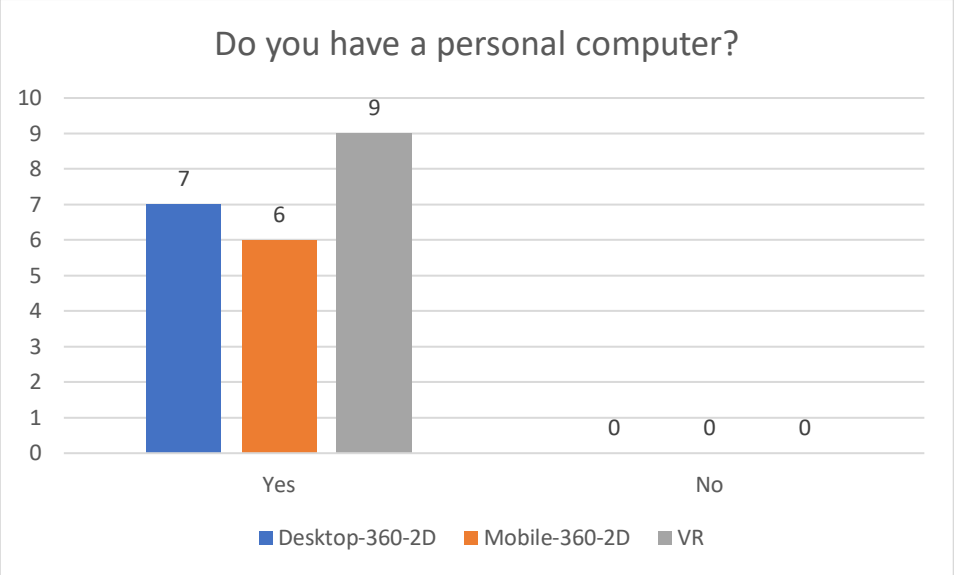
came, with 5 people, because the equipment is expensive with 3 people, because there was never curiosity about it, with 2 people, and because there is not enough content, with 1 person.



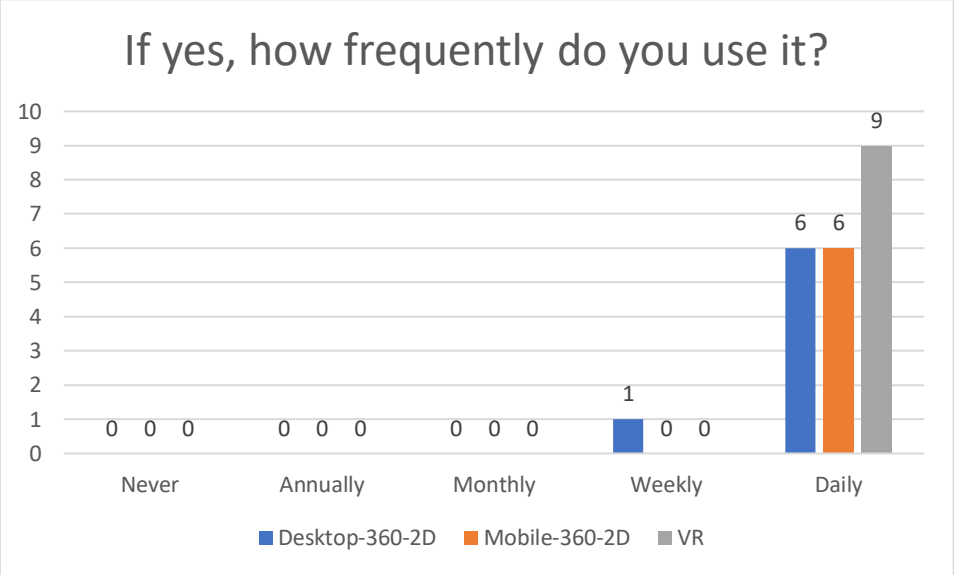
Graphic 9 - What are the reasons why you haven't experimented Virtual Reality?

11, 12, 13 and 14 - Do you have a personal computer? / If yes, how frequently do you use it? / Do you have a smartphone? / If yes, how frequently do you use it?

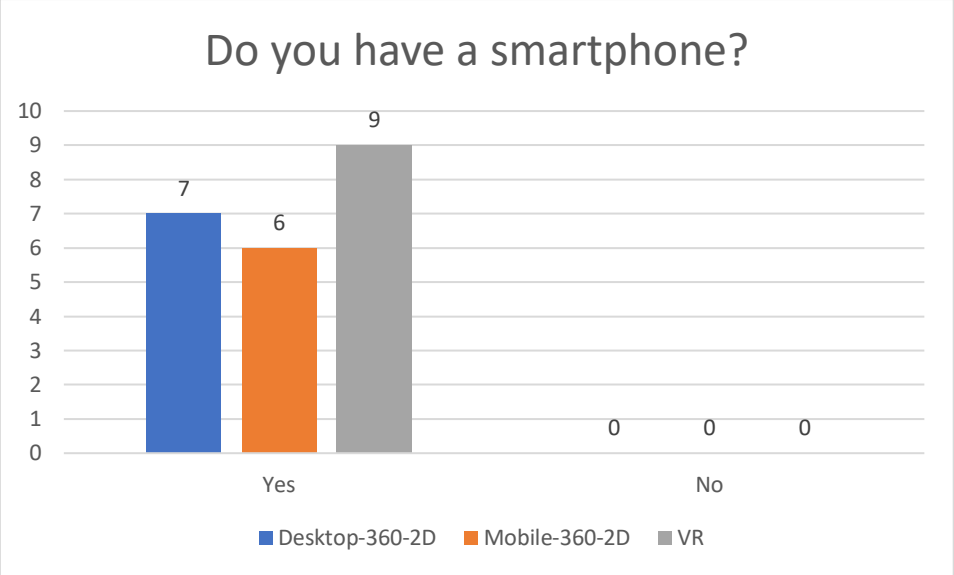
In the section four regarding people's electronic competencies, everyone had a personal computer and a smartphone. Everyone used the computer daily except for one case, and the smartphone everyone used daily with no exceptions. (see Graphic 10Graphic 11Graphic 12, Graphic 13). This data is unsurprising as it was expected from multimedia students to have a regular use of these devices.



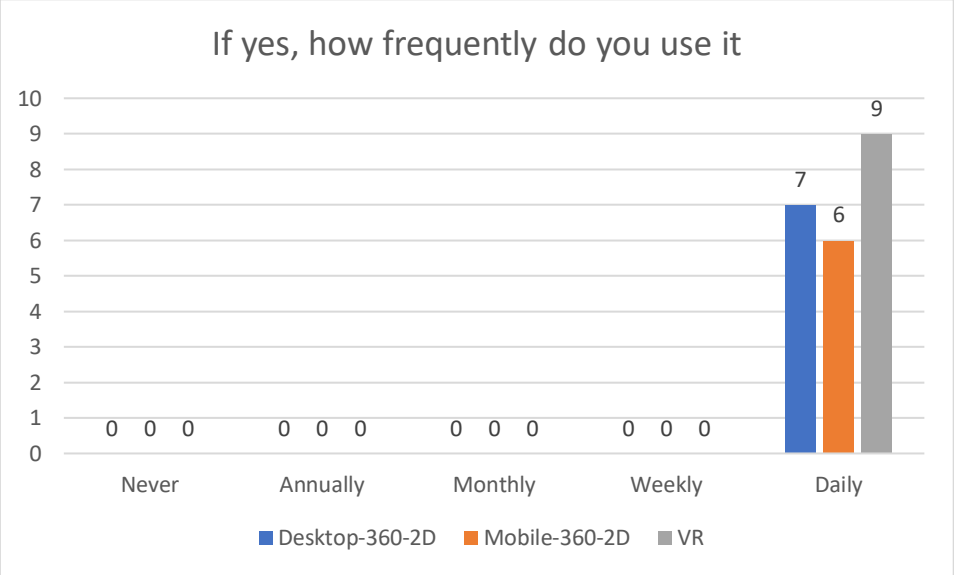
Graphic 10 - Do you have a personal computer?



Graphic 11 - If yes, how frequently do you use it?



Graphic 12 - Do you have a smartphone?

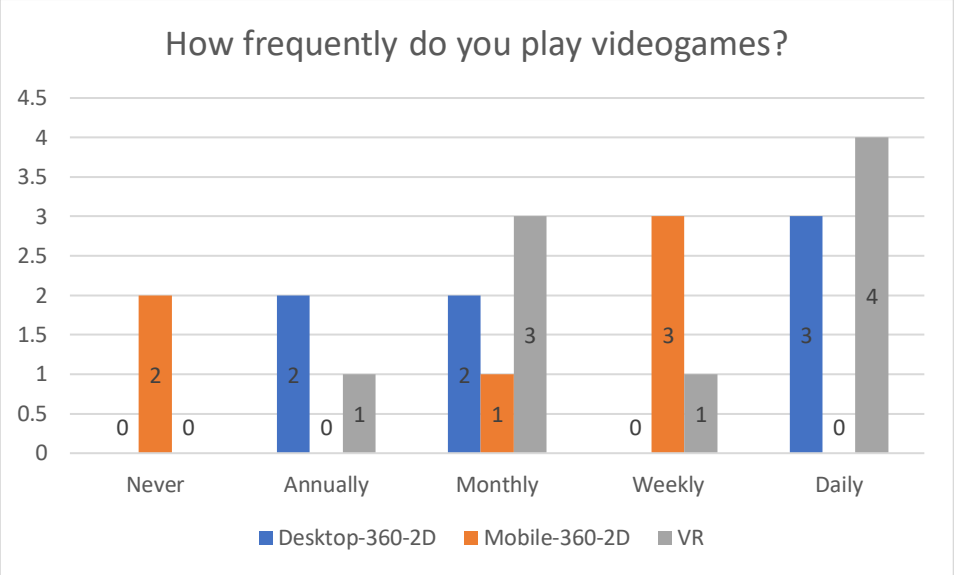


Graphic 13 - If yes, how frequently do you use it?

15 - How frequently do you play videogames?

The Graphic 14 represents how frequently the participants play videogames. 7 people play daily, 4 weekly, 6 monthly, 3 annually, and 2 had never played.

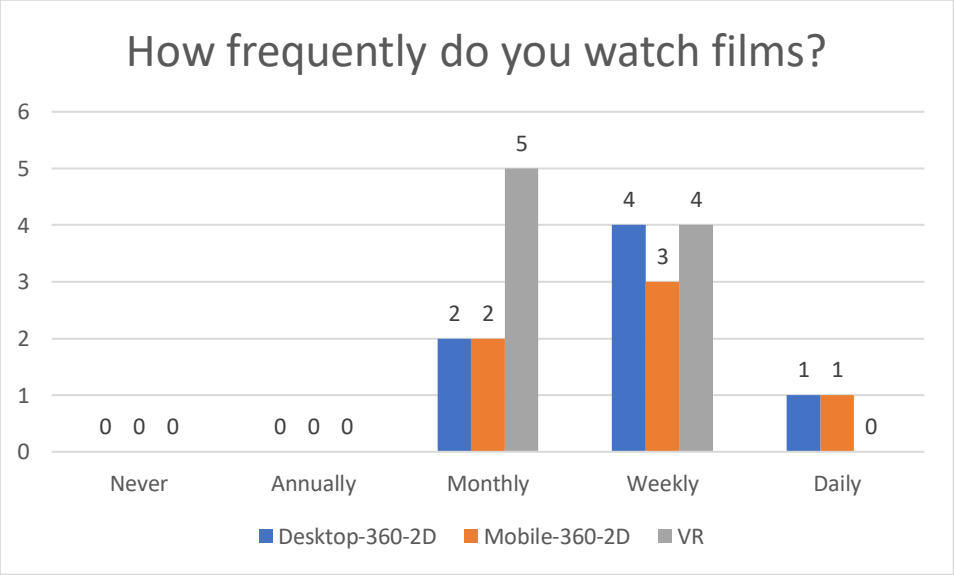
Although Graphic 14 represents a wide range of answers, with some people in each category, the majority have, and play videogames with some frequency, which is expected considering the demographic present in the tests.



Graphic 14 - How frequently do you play videogames?

16 - How frequently do you watch films?

In the Graphic 15 it is presented how frequently the testers watch films, and yet again, unsurprisingly, given the demographic and the academic field of the participants, most people watch films with some frequency, in this graphic there are no cases of people who have never watched or who watch annually. Only two people watched films daily, but most watch films weekly, with 11 people, and 9 who watch monthly.



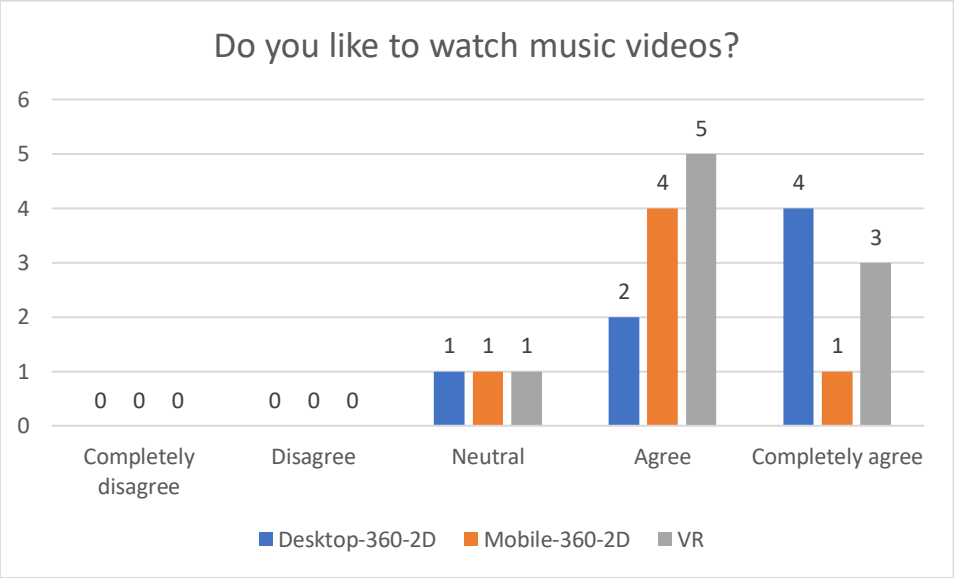
Graphic 15 - How frequently do you watch films?

17 - Do you like to watch music videos?

Concerning how much people like watching music videos, 8 completely agree with the statement, 11 agree with it, and 3 are neutral to it.

Since some of the participants are multimedia students or are musicians themselves (see Graphic 23), the music videos have an additional relevance to them rather than being generally appealing, as they can understand and have a bigger appreciation both from the music and the video.

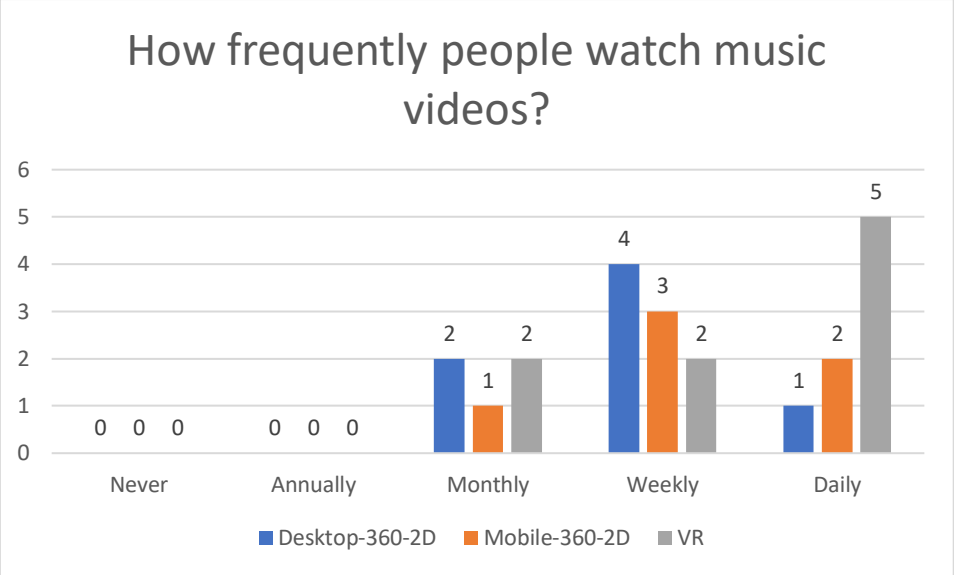
We noticed that this question was not well written as it should have been a statement to which the participant would express how strongly he or she would agree, such has “I dislike watching music videos”. This error happened in other questions of this questionnaire.



Graphic 16 - Do you like to watch music videos?

18 - How frequently do you watch music videos?

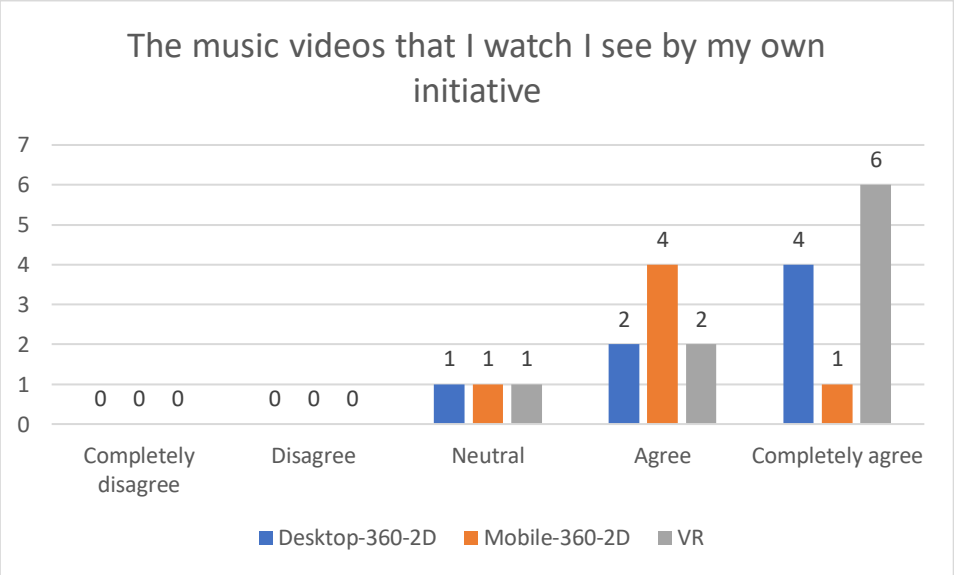
For how frequently people watch music videos (see Graphic 17), 9 see weekly, 8 daily and 5 monthly. A possible explanation for the number of people who watch music video might have to do with the fact that they listen to music on YouTube, which makes the experience of watching music video much more accessible as if someone were listening to music on Spotify while having YouTube closed for instance.



Graphic 17 - How frequently do you watch music videos?

19 - The music videos that I watch I see by my own initiative

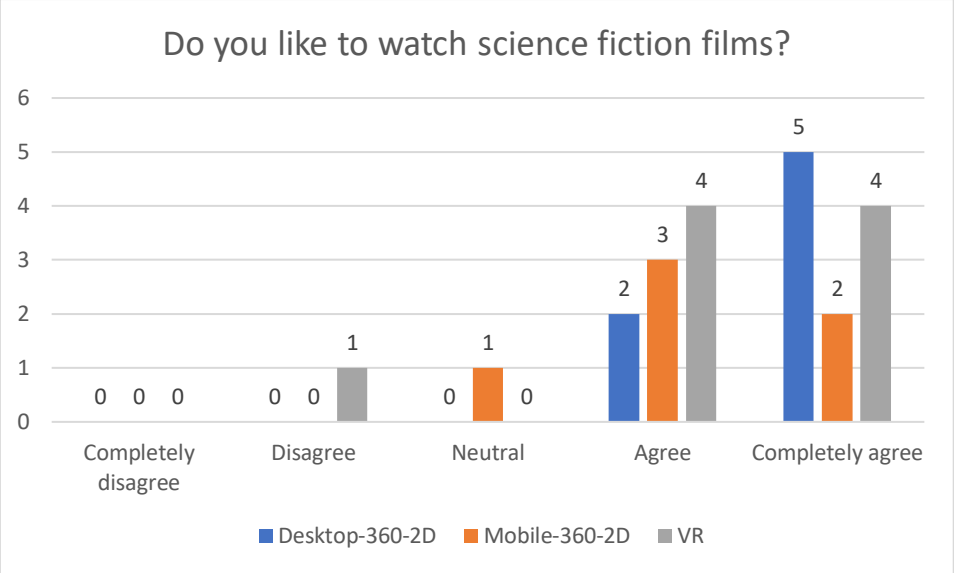
Regarding weather people watch music videos by their own free will (rather than being in a context were their playing in the background), 11 completely agreed, 8 just agree, and 3 were neutral about it (see Graphic 18). The reasons that were given on why the participants might like watching music videos may be the same reasons why they might consider watching music videos by their own initiative, which is their ties to multimedia and to music.



Graphic 18 - The music videos that I watch I see by my own initiative

20 - Do you like to watch science fiction films?

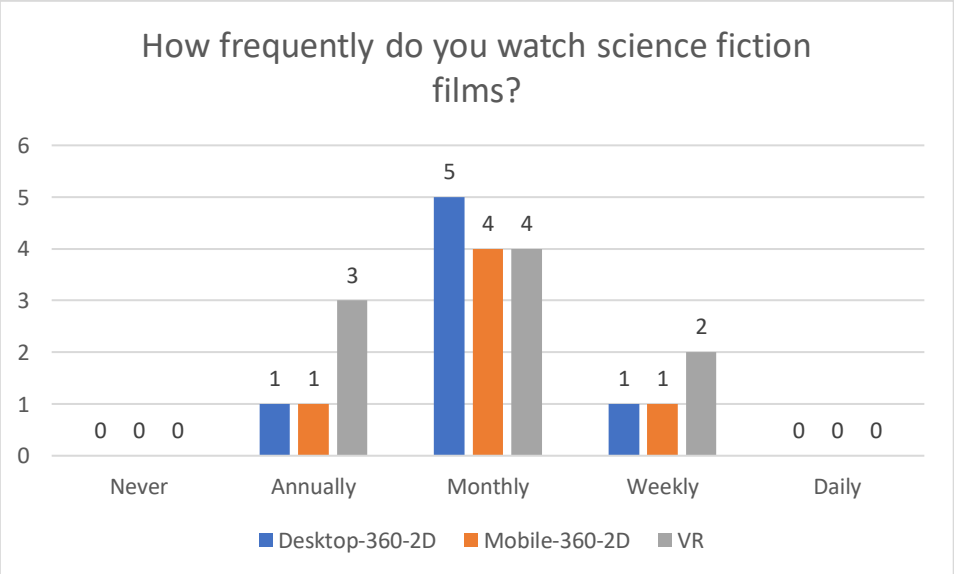
In the Graphic 19, are present the answers to how much people like watching science fiction films. 11 people completely agree with that statement, 9 just agreed, 1 person was neutral about it, and another one disagreed.



Graphic 19 - Do you like to watch science fiction films?

21 - How frequently do you watch science fiction films?

Regarding how frequently people watch science fiction films (see Graphic 20), 4 people watch weekly, 11 watch monthly, and 5 watch annually. Once again, the participants' background in multimedia and their connection to technology might explain their interest in science fiction, as well as the frequency to which they watch science fiction films, that they might divide the time with other film genres.

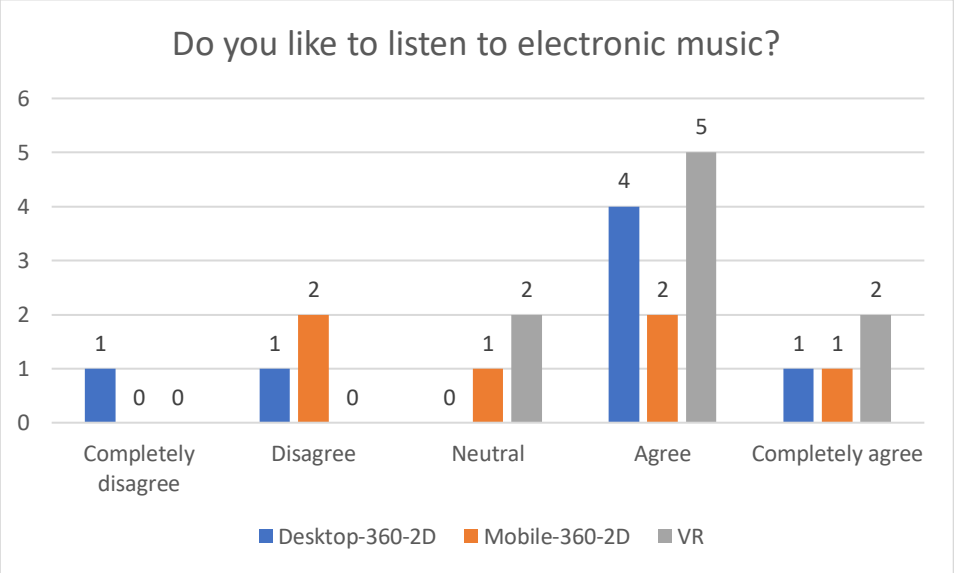


Graphic 20 - How frequently do you watch science fiction films?

22 and 23 - Do you like to listen to electronic music? / If yes, how frequently?

On whether or not people like listening to electronic music (see Graphic 21), 11 people agree, 4 agreed completely, 3 people were neutral, 3 disagreed, and 1 disagreed completely. Although there

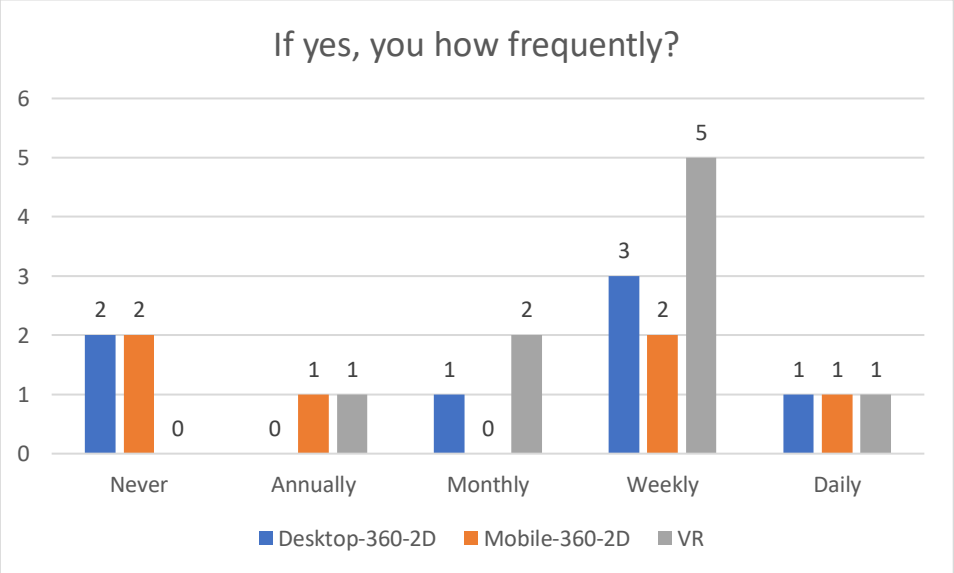
are mixed answers to whether or not people like electronic music, there is a large portion of people who agreed liking to electronic music, which, in a way, is not surprising given how broad the term is. However, this is also a problem for research as it can lead to misconception.



Graphic 21 - Do you like to listen to electronic music?

On how frequently people listened to electronic music, 10 listened weekly, 3 watched daily, other 3 monthly, and yet another 3 never listened to it, while 2 listened annually (see Graphic 21).

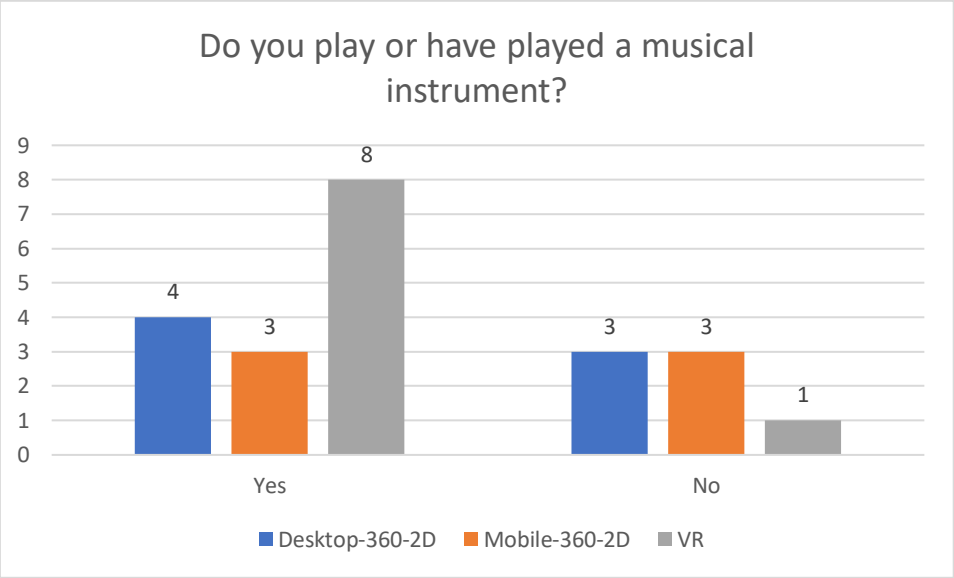
As stated before, electronic music is a very broad term, which is prone to misconception, and in turn allowing the participants to answer incorrectly.



Graphic 22 - If yes, how frequently?

24 - Do you play or have played a musical instrument?

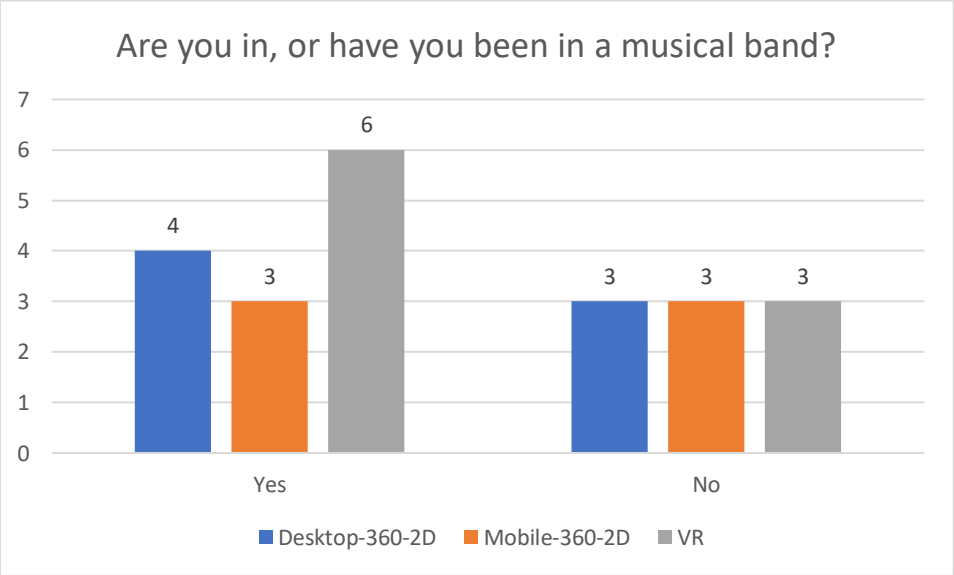
Regarding if people have played previously or played at the time of the test musical instruments, 15 had and 7 had not (see Graphic 23).



Graphic 23 - Do you play or have played a musical instrument?

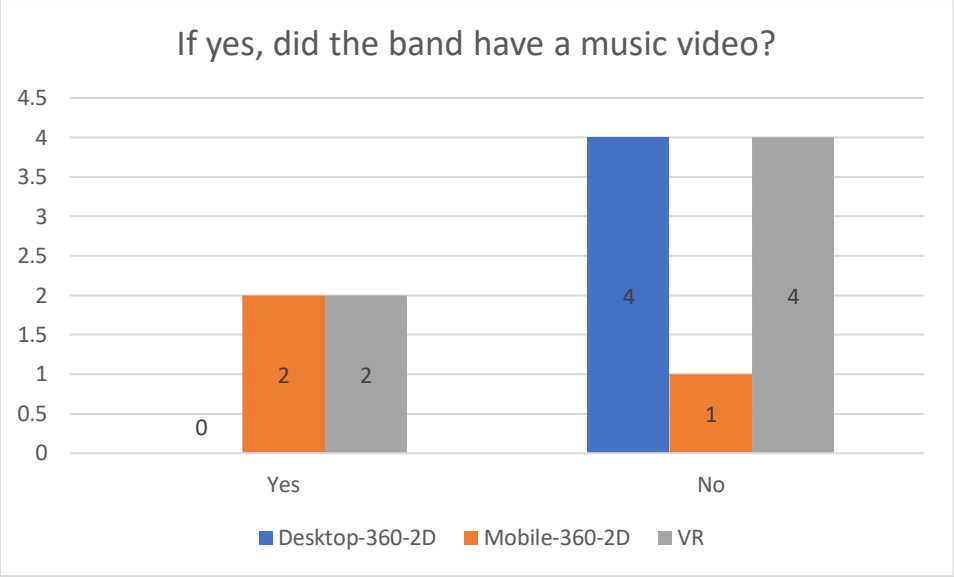
25 and 26 - Are you in, or have you been in a musical band? / If yes, did the band have a music video?

And regarding if people had been or were in a musical band, 13 had been, and 9 had not (see Graphic 24).



Graphic 24 - Are you in, or have you been in a musical band?

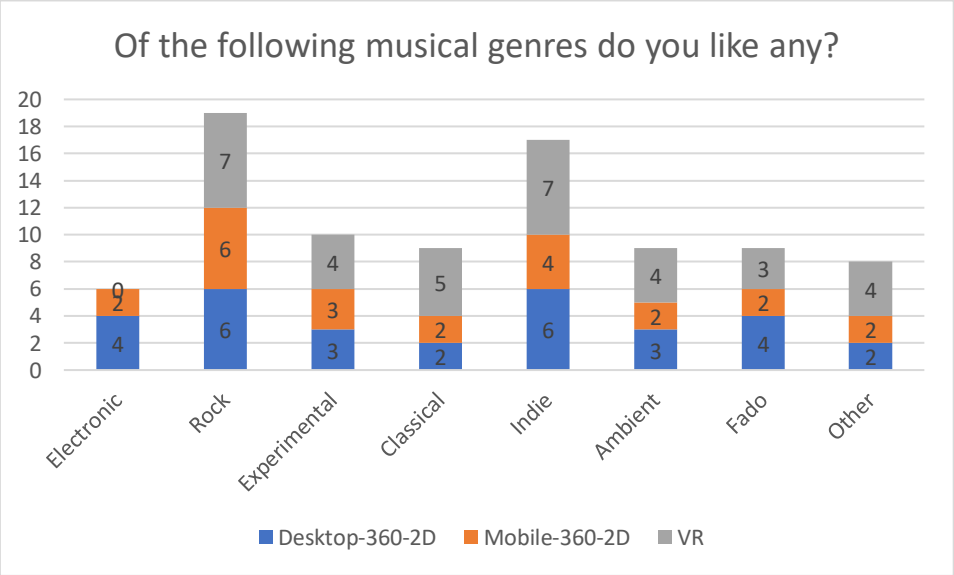
And of those that had a musical band, only 4 had a music video (see Graphic 25).



Graphic 25 - If yes, did the band have a music video?

27 - Of the following musical genres do you like any?

Lastly, about people's musical taste, of the list of musical genres, 11 people liked electronic, 19 rock, 10 experimental, 9 classical music, 17 indie, 10 ambient, 9 fado, and 8 other, of which MPB (of the Portuguese "Música Popular Brasileira", which stands for Brazilian popular music), pop, jazz, blue, bossa nova, RnB, Hip Hop, and Brit-pop (see *Graphic 26*)



Graphic 26 - I think the music video fits the music

Considerations from the pre-test questionnaire

From the data analyzed we could understand that the participants, were mostly college students from the University of Aveiro, which justified their age, being mainly between 20 and 30. Furthermore, this aspect and the fact that most of them were multimedia students from the course of Multimedia Communication, alongside their age, justified their interest in technology and in audiovisual content such as videogames, films and music videos, which they all consumed regularly. Additionally, these factors might explain the fact that they all had experienced at least once Virtual Reality, having 4 people experimented music videos in this format. However, this might create a tendency in the post-questionnaire results for people liking the music video, or having less problems dealing with the technical aspect of the test given the common background of the participants as opposed to people with less technical skills. On the other side, the fact that most people had some experience with VR might prevent the novelty of the medium to interfere with the experience, and to allow each user to answer more truthfully regarding their experience.

Moreover, some of the participants had musical background (some having been in a band at some point), and a varied musical taste (including electronic music) which might facilitate the possibility of them liking the song, and of having a liking or desire for the idea of having a music video in VR for a song, which might create in them a sense of empathy and appreciation for those aspects, creating a bias in the results.

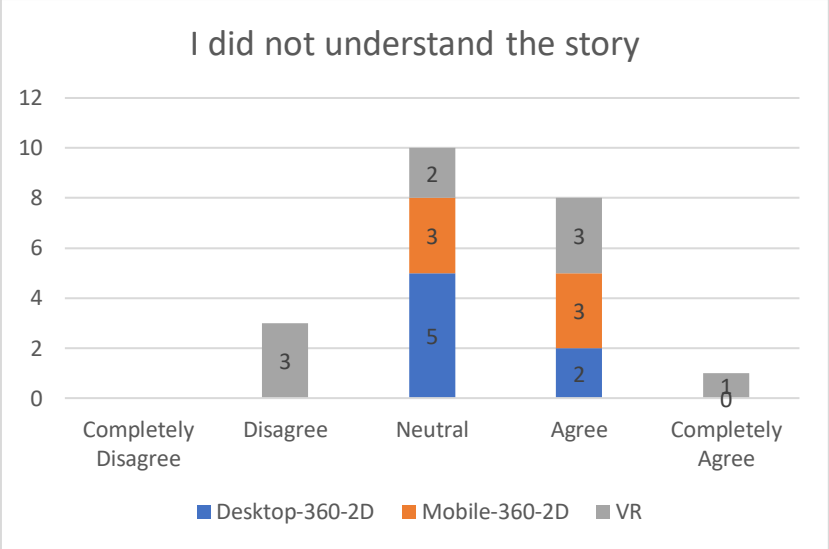
4.3.2 Post-test questionnaire

Since the post-test questionnaire was very extensive, with 58 questions, it was collected here what were considered the most important questions. The full English version of the questionnaire will be included in the Appendix H – Post-test questionnaire in English, the original Portuguese version will be included in Appendix I – Post-test questionnaire in Portuguese.

As there were many questions in this questionnaire, only what were considered the most important were included in this section of the dissertation, the rest will be available in Appendix J.

2 - I did not understand the story

In the Graphic 27 - I did not understand the story, 10 participants were neutral about their understanding of the story, 8 agree that they did not understand the story, and 1 completely agreed on that statement. On the opposite side 3 did not agree with that statement. Through this data it is clear that the understanding of the story of the music video was a problem for the participants.



Graphic 27 - I did not understand the story

3 – Succinctly describe the story

	Desktop-360-2D	Mobile-360-2D	VR
It looked like the person was in the matrix		1	
A little girl living in a spaceship	1	1	
Space travel	4	1	2
A little girl		1	
Expressing the lack of a clear narrative/or being lost	1	1	1
A spaceship being launched into space			
A person with Buda, who is renewed	1		
Something related with the cosmos	1		

The people of a planet discover a cluster of stars where they want to travel to	1		
A trip to Jupiter	1		1
Something transcendent referring to how insignificant humans are compared to the immensity of the time and the universe	1		
Humans are stuck to repetitiveness and to the little things	1		
A transcendental experience in which the person viewing the MV takes the place of one of various volunteers who experience simulations representing the imaginary of all the volunteers		1	
A desertic landscape		1	1
Empty space		1	
A girl and a boy seated in a chair		1	
A comet		1	
Something about existence		1	
Expressing inability to formulate a clear story			
I was focused on the visual effects and did not pay attention to the story			1
Interdimensional travel			1
Could only understand some themes and concepts			1
A story between two beings			1
2 individuals in spiritual thought travelling through the universe			2
A couple			1
A planet in a different galaxy than that of earth			1
Exploration of the cosmos			1
An introspective voyage in which we are confronted with the "galaxy" of our own sub-conscious			1

Table 6 - Succinctly describe the story

When asked to succinctly describe the story, the participants gave many different answers, but many could identify at least some aspect of the story. A table (see Table 6) was made with the identification of all the elements mentioned in the answers, and through it, it is evident that many of the users could understand that the story, at some point at least deals with space travel given it is represented very explicitly. They could also understand that the girl narrating the story was raised in the ship traveling through space but mistook her for the woman represented in scene 5 of the Meeting of Pelastus, having two people who thought the couple were the ones traveling in the spaceship. Furthermore, some people thought that the ship was going to travel towards Jupiter, most probably because of the introduction with the name of the band. Someone correctly understood that in the story the population of the planet had found a cluster of stars, although in the story it is never

expressed that Clatterlex 5 is a cluster of stars. However, it is understandable how that detail can be easily misunderstood.

Some people also commented on obvious elements that were present in the video such has the desertic landscape, the spaceship as mentioned before, the cosmos, empty space, which probably is referring to scenes 4 and 7 with the digital map, the two individuals in the Meeting of Pelastus, including one person who thought it was Buda being represented, which is also understandable how easy that misconception might happen.

Some participants even expressed that they had difficulty understanding the story, or that they were focused on the visual aspect of the experience and were not focused on the story.

Other participants mentioned more surprising ideas such as interdimensional traveling; traveling through the depths of one's mind and the sub-conscious; and a story in which the images in the music video are images of the imaginary of various volunteers taking part in a transcendental experimentation.

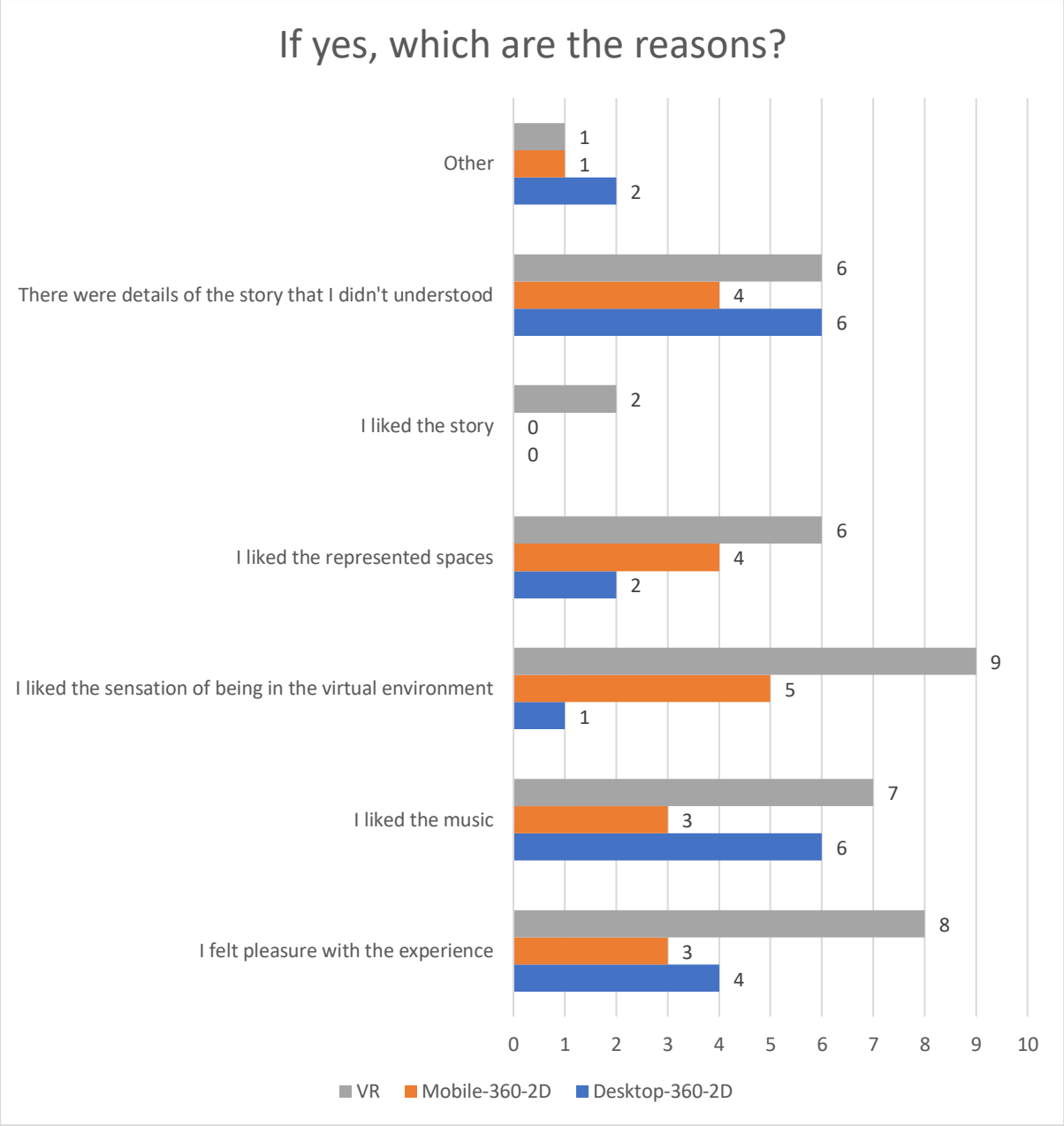
These results show that most participants could only understand a small portion of the story, or nothing at all, and in the cases in which they thought they understood, they imagined stories way outside of what the original was. It is also relevant to point out that some elements of the story were not mentioned like the domes, the digital map, the climate crisis on earth, the dying earth, the expansion of the sun, and, very importantly, the fact that the spaceship was travelling to Clatterlex 5 in hopes of saving humanity.

4 – I would like to rewatch the music video

100% of people answered affirmatively to this question.

5 – If yes, which are the reasons? (for rewatching the music video)

In the Graphic 28, we can see that 18 of the participants found that the fact that they liked the music was a factor to rewatch the music video, 17 found that it was because they felt pleasure with the experience, 16 because there were details in the story that they could not understand, 15 because they liked the sensation of being in the virtual environment, 13 because they like the represented spaces, 4 because of other reasons and 2 because they liked the story. Of those that pointed out other reasons for rewatching the music video, one person mentioned that the experience was relaxing, another that he or she liked exploring the 360º environment, one mention that he or she would like to notice consciously the spatiality of the sound, and lastly, another pointed out that he or she liked the feeling that he or she was physically in the represented spaces.

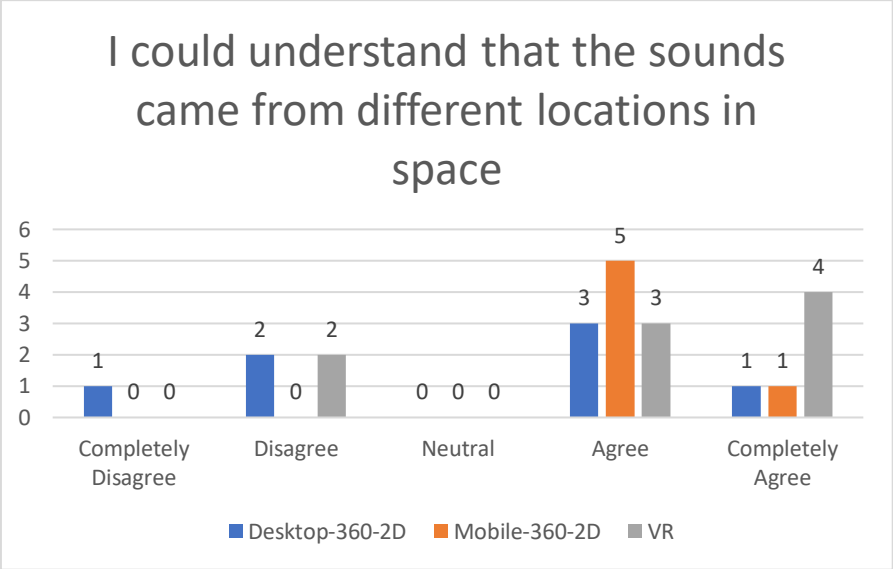


Graphic 28 - If yes, which are the reasons?

12 - I could understand that the sounds came from different locations in space

From the Graphic 29, we can tell that 11 people agreed that they could tell there were sounds coming from different locations in space. 6 completely agreed, while 4 disagreed and 1 completely disagreed. Although 17 people agreed that they could understand that the sound was spatialized, 5 did not. Perhaps, this was due to the fact that the sounds were evenly distributed across space which meant that the difference between the sounds was not has perceptible. Other factors might be the fact that many of the sounds, especially in the beginning, had a more soft and slow nature since they were created for atmosphere, and because of that it was more difficult for the participants to identify that this subtle sounds were coming from different locations. Furthermore, in the Graphic 46, about

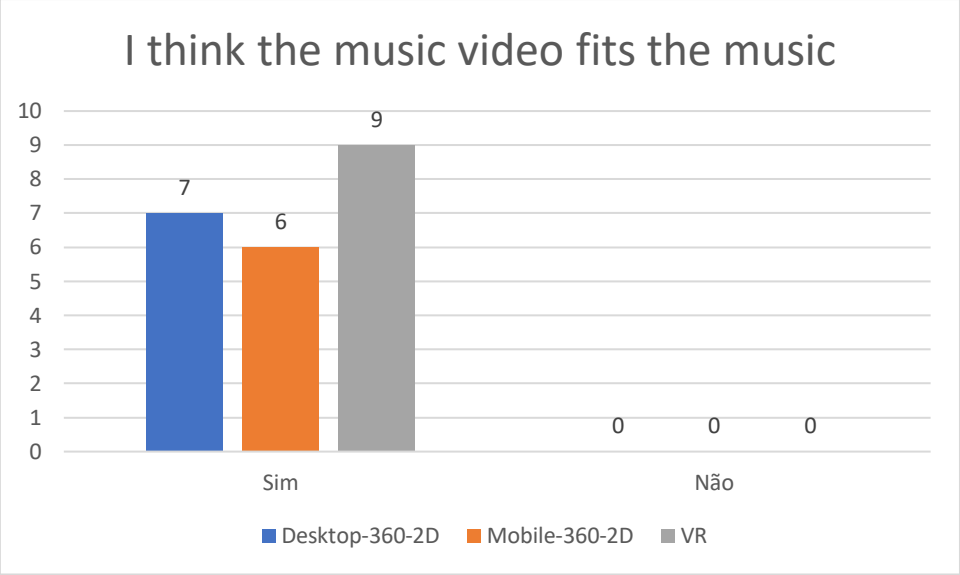
the negative points of the experience, one participant mentioned that the music was not very perceptible, indicating a possible problem with the mixing, and a possible reason for the lack of the perception of the sound.



Graphic 29 - I could understand that the sounds came from different locations in space

13 – I think the music video fits the music

Every participant thought that the music video fits the music even though they did not understand the story. In the Graphic 45 about what people though were the positive points of the experience, they mentioned various aspects of the visual elements of the video, and additionally, the most mentioned aspect was the combination of the visuals and the music. The fact that the music video featured slow moving animations which matched the slow and atmospheric beginning of the music, culminating in the final scene with the launch of the EVA XV when there are percussive elements introduced in the song, which is when the camera moves more quickly and there is the added element of the ship passing by into space.

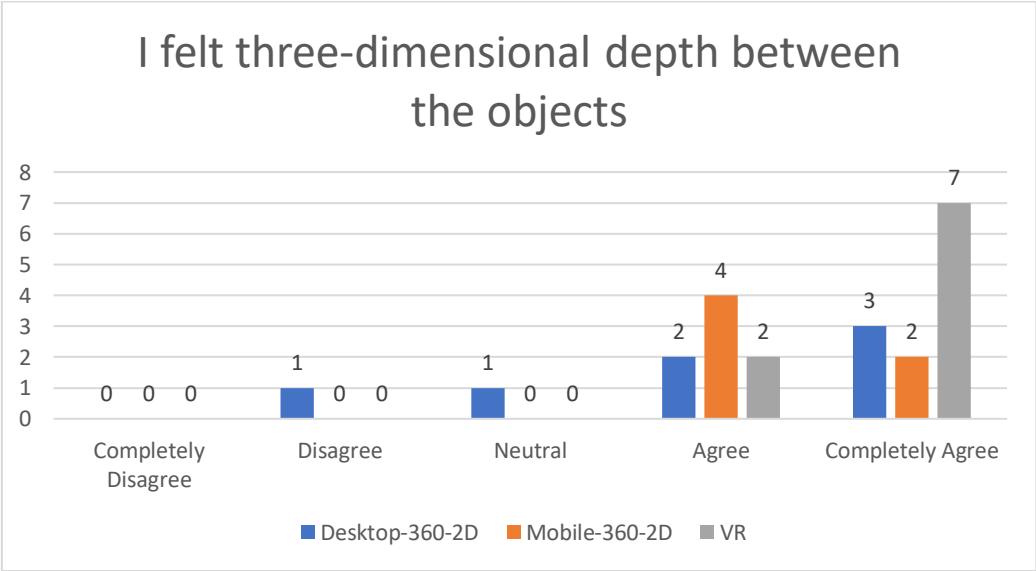


Graphic 30 - I think the music video fits the music

19 – I felt three-dimensional depth between the objects

In the Graphic 31, it can be seen that 12 people agree completely that they felt three-dimensional depth between objects, 8 agreed, 1 person was neutral about it and another one disagreed.

This question should have been posed only to the VR group.

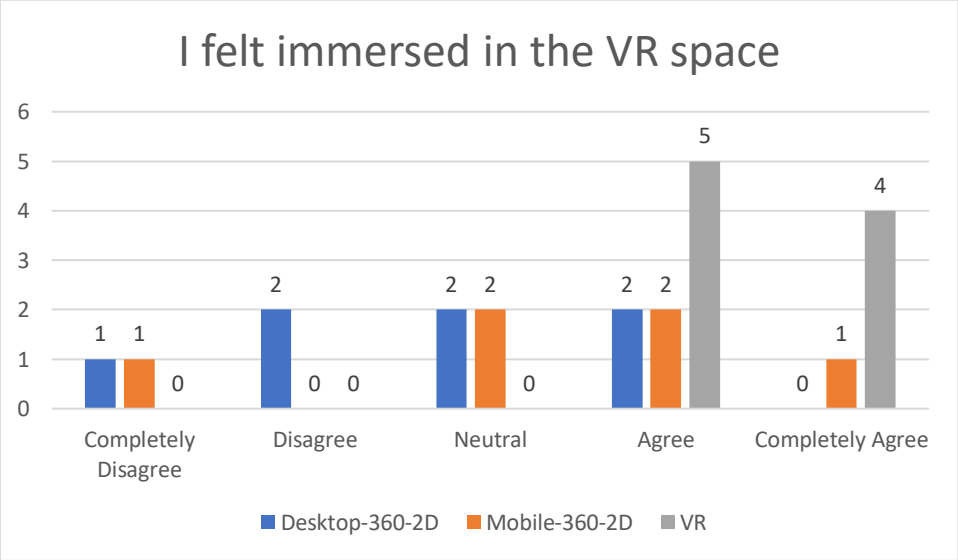


Graphic 31 - I felt three-dimensional depth between the objects

22 – I felt immersed in the VR space

For the 22nd question of the post questionnaire (see Graphic 32), 9 people agreed that they felt immersed in VR space, 5 completely agreed with that statement, while 4 were neutral about it, 2 people disagreed and other 2 completely disagreed.

Unsurprisingly the VR group had a stronger sense of immersion due to its inherent characteristics, while the two other groups had more divergent results. The desktop-360-2D version had mixed results with people disagreeing, neutral and agreeing with feeling immersed, with the same happening for mobile-360-2D, of which one person agreed completely with the statement. Two possible reasons for this disparity of results are screen size and interaction. In the desktop-360-2D version, the participants had a bigger screen, which covered a bigger percentage of their field of vision as compared to the mobile version, but on the opposite side, the people experiencing the mobile-360-2D version of the music video could orient the smartphone to where they wanted to see, which added a level of interaction, which mirrors that of the HMD, but without the full visual immersion. This level of interaction could be compared to watching the world through a window, being the smartphone the window. This could explain why, although, the participants for mobile where fewer compared to desktop, they voted higher on how much immersion they have felt.

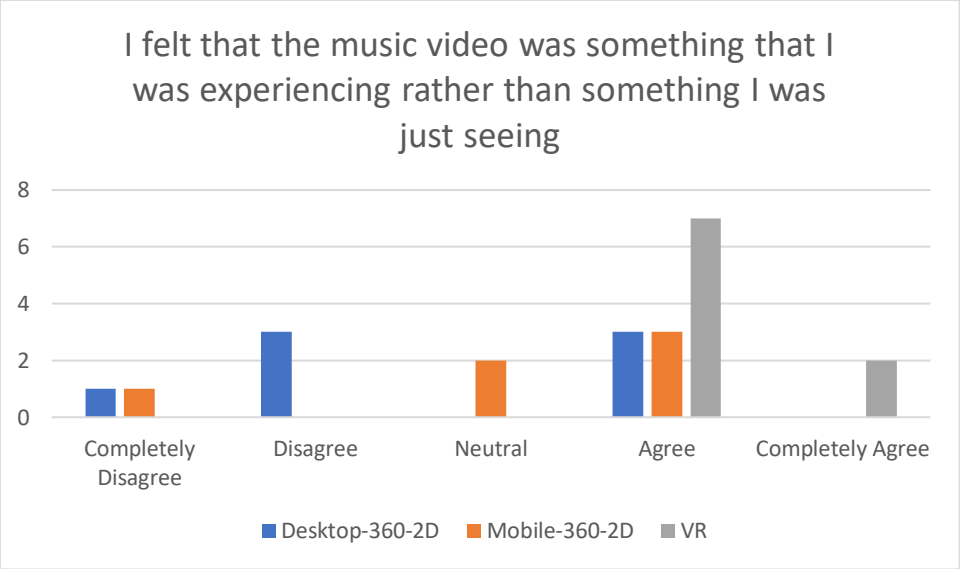


Graphic 32 - I felt immersed in the VR space

23 – I felt that the music video was something that I was experiencing rather than something I was just seeing

From the Graphic 33, we can tell that 13 people agreed that they felt that the music video was something that they were experiencing rather than something they were watching. 3 people disagree with that statement, 2 people completely disagree, other 2 were neutral, and yet another 2

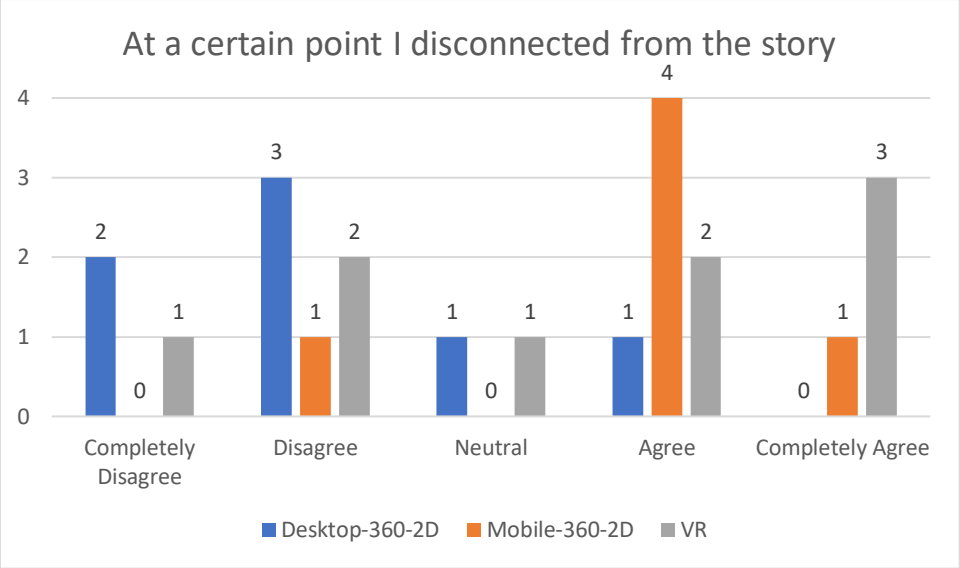
completely agreed. Naturally, given its nature, the participants of the VR group found the music video to be something they were experiencing rather than just a viewing session. There were also 3 people from the mobile-360-2D group as well as from the desktop-360-2D group that agreed with that statement, but in the other groups the results were mixed. Although immersiveness might have had an important role in making the music video feeling like an experience, other factor may be at play like engagement or how much people are liking the experience as a whole or its individual elements such as the video or the music.



Graphic 33 - I felt that the music video was something that I was experiencing rather than something I was just seeing

24 – At a certain point I disconnected from the story

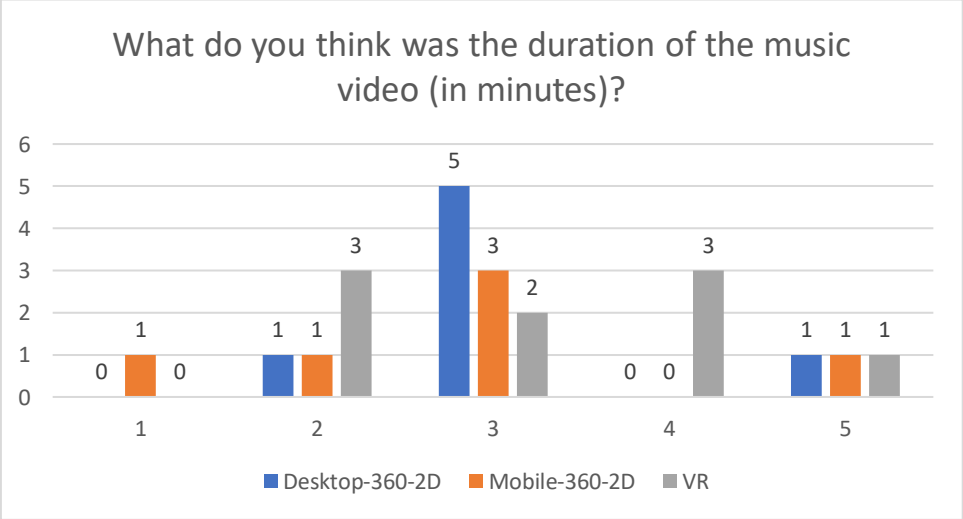
In the Graphic 34, it is shown that 7 people agreed that at a certain point they disconnected from the story, while 6 people disagreed, 4 completely agreed with that statement, while 3 completely disagree and 2 were neutral about it. The results were mixed on if people felt disconnected form the story at some point. What is interesting is how divergent the results are for the VR group given its immersive characteristics which could be very distracting.



Graphic 34 - *At a certain point I disconnected from the story*

26 - What do you think was the duration of the music video?

Concerning people's perception of the duration of the music video (see Graphic 35), 10 people thought that the music video lasted 3 min which was the actual duration of the video, 5 thought it was 2 minutes, 3 people thought it was 4, and other 3 thought it was 5, while 1 person thought it was 1 minute. 10 of the participants could understand that the music video had 3 minutes of duration. Although the player of the video in YouTube, unfortunately, has a progression bar with the duration of the video, but many of the participants did not remember the duration of the video (12 people).

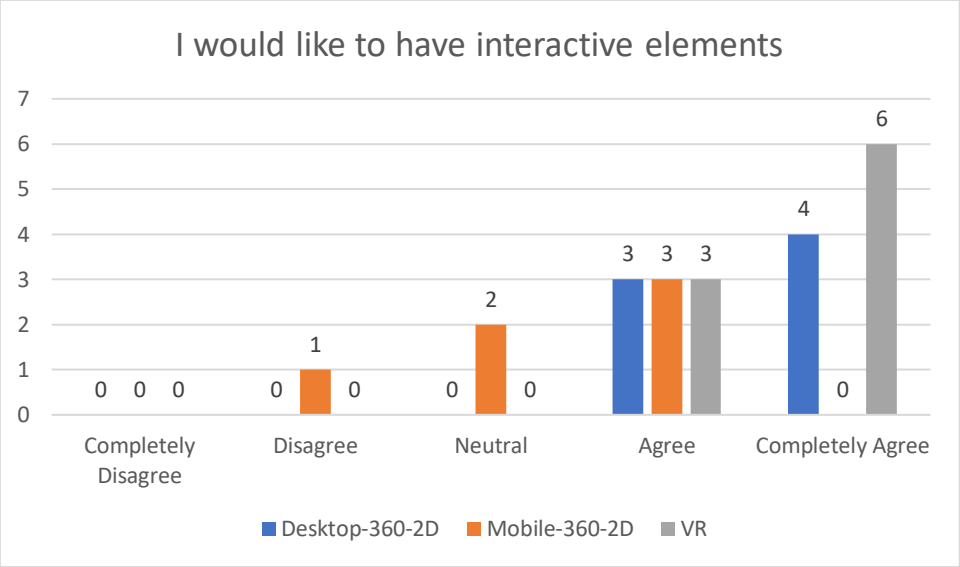


Graphic 35 - What do you think was the duration of the music video?

27 – I would like to have interactive elements

Regarding whether or not people wanted interactive elements (see Graphic 36), 10 people completely agreed that they would like to have interactive elements in the music video, 9 just agreed, 2 were neutral about it, and other 2 disagreed.

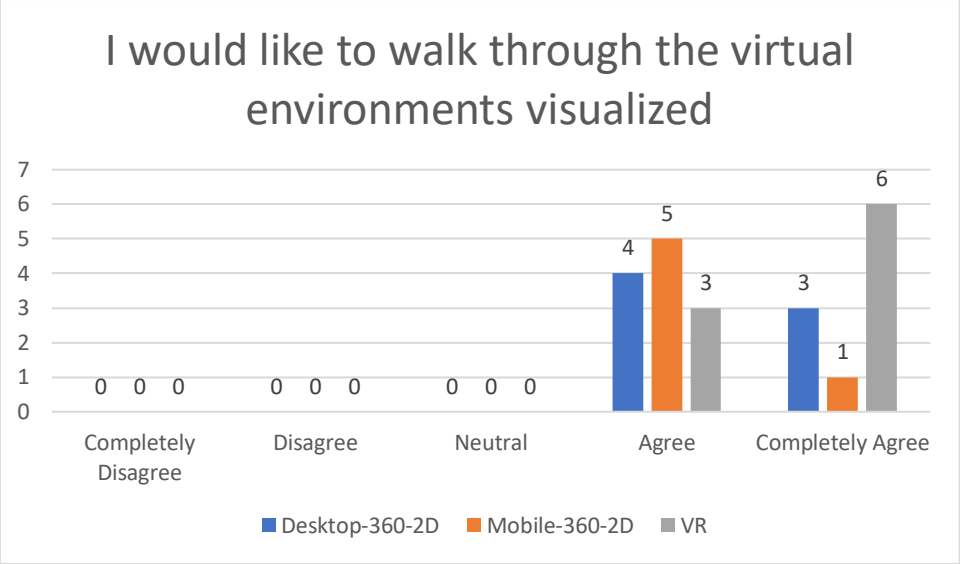
It is natural for people, especially those immersed in VR to feel inherently tempted to interact with the environment, which was behavior noticed in the user tests.. It should be taken in consideration that the majority of the participants had experience with VR, being that experience with videogames, and that most of participants played videogames with some regularity.



Graphic 36 - I would like to have interactive elements

28 – I would like to walk through the virtual environments visualized

12 people just agreed that they would like to walk through the virtual environments, while 10 people completely agreed (see Graphic 37). The elements of immersion and the experience the participants had with both videogames in VR and videogames generally, might explain the necessity of having this feature.

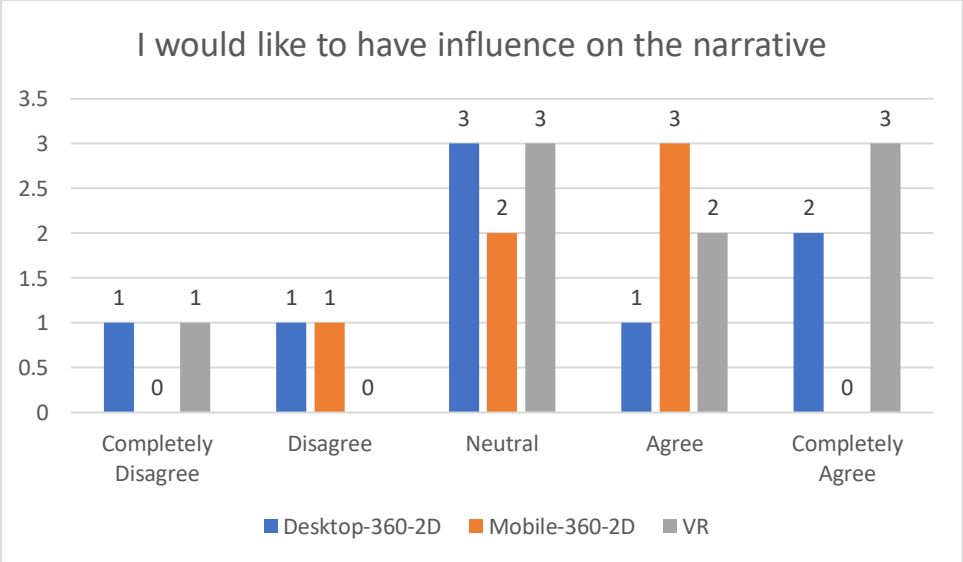


Graphic 37 - I would like to walk through the virtual environments visualized

30 – I would like to have influence on the narrative

8 people were neutral on whether they would like to have influence on the narrative, while 5 people agreed and other 5 completely agreed, at the same time, 2 people disagreed and other 2 completely disagreed (see Graphic 38)

In this questionnaire there was no question about why people would like to have or not influence on the narrative, but in conversations after the test was done, one of the participants expressed that the music video did not need that possibility as that person wanted to experience the music video as it was.

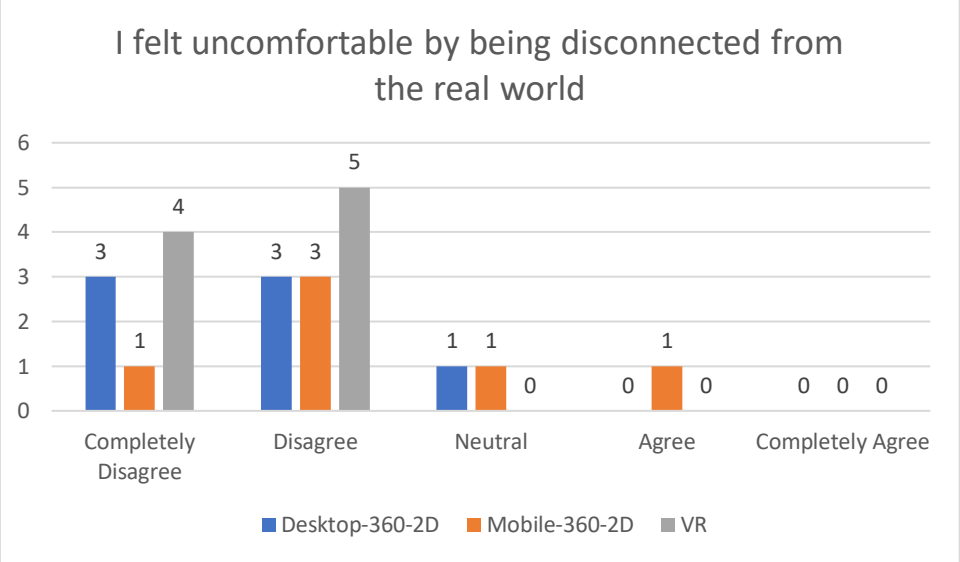


Graphic 38 - I would like to have influence on the narrative

32 – I felt uncomfortable by being disconnected from the real world

11 people disagreed that they felt uncomfortable of being disconnected from the real world, 8 completely disagreed, 2 people felt neutral about it and 1 person agreed with it (see Graphic 39).

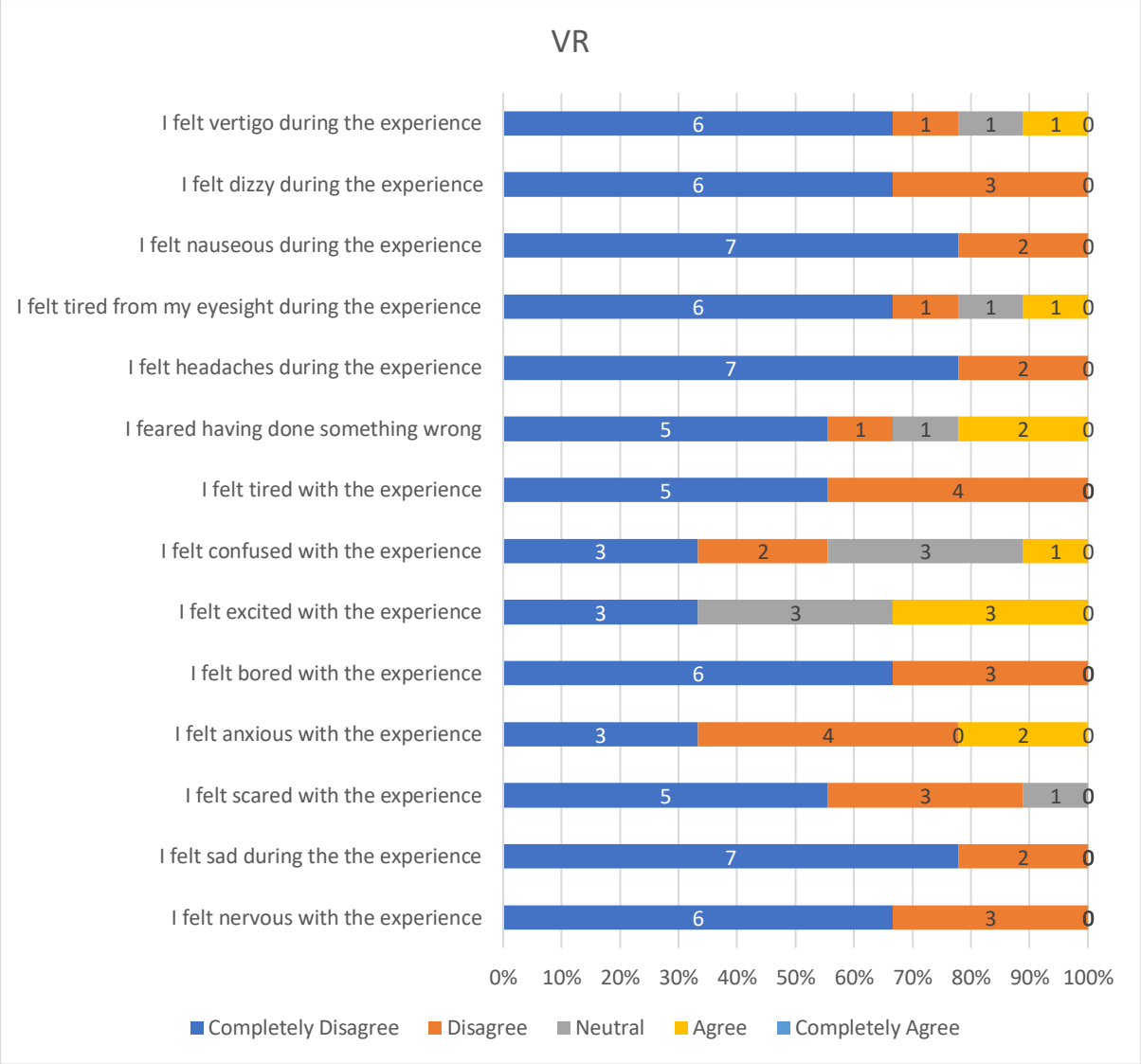
What is curious about these results is that none of the participants in the VR group expressed either neutrality or agreement in of feeling uncomfortable of being disconnected from the real world, as they were the ones having their visual sense almost completely surrounded in the HMD.



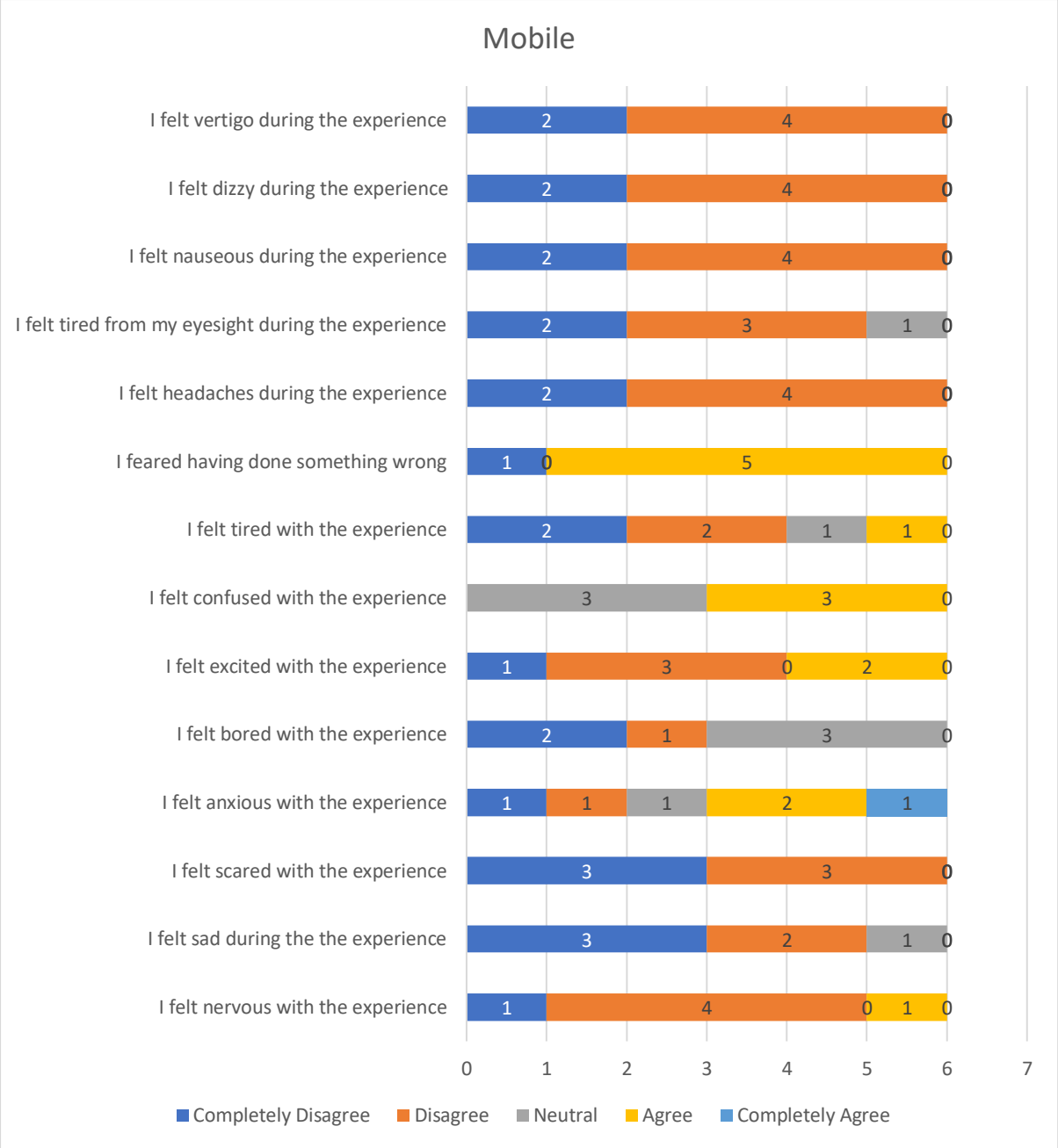
Graphic 39 - I felt uncomfortable by being disconnected from the real world

The questions 34 to 47 are directed to the person's emotional and physical symptoms during the experience, because of that they were grouped together in the following three histograms (see graphics Graphic *40*, Graphic *41*, and Graphic *42*).

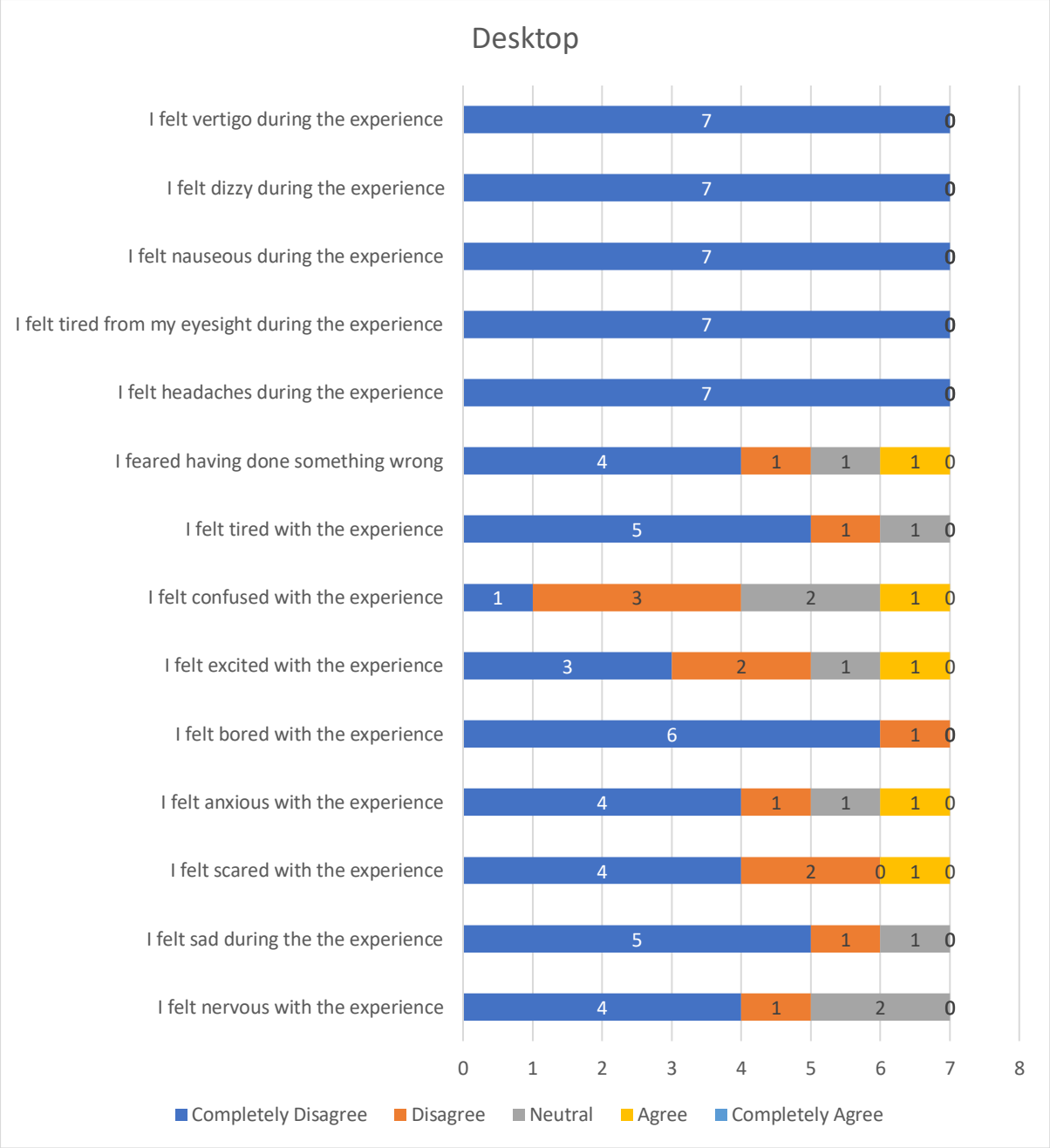
It can be noticed that most people did not feel any side effects such as headaches or feelings such as sadness. Some symptoms did not even have positive feedback, being such as agree or completely agree, which is the case for dizziness, nausea, headaches, boredom, and sadness. What most people agreed on was that they felt they might have done something wrong with 8 people, followed by excitement, and the confusion and anxiety, which, in turn, has one person that completely agreed with that statement (which might be correlated with the fact that there was one person who mentioned being discomfortable with being disconnected from the real world). Followed by those were the case of one person that felt vertigo (although the person expressed being a "good" feeling of vertigo), one that felt tired from his or her sight, another that felt tired, one that felt scared and another one that felt nervous.



Graphic 40 – Emotional and physical symptoms -VR



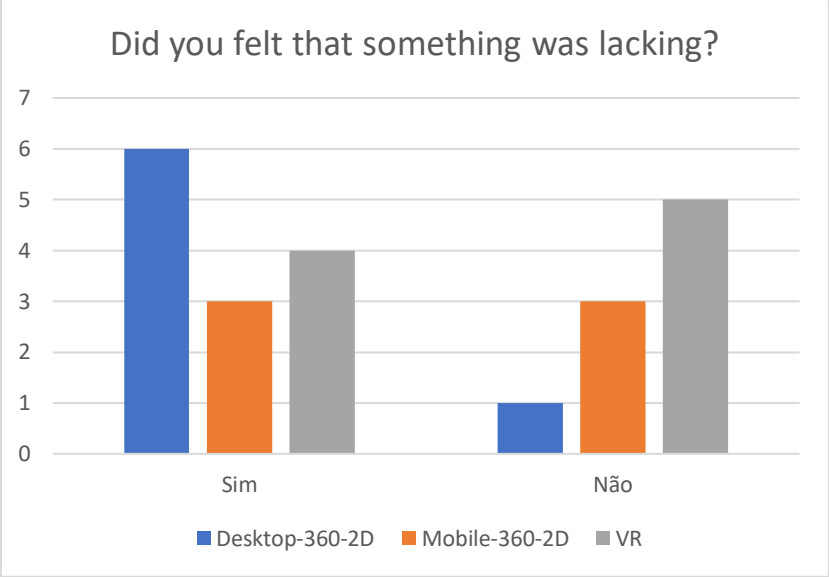
Graphic 41 - Emotional and physical symptoms – Mobile-360ª-2D



Graphic 42 - Emotional and physical symptoms - Desktop-360º-2D

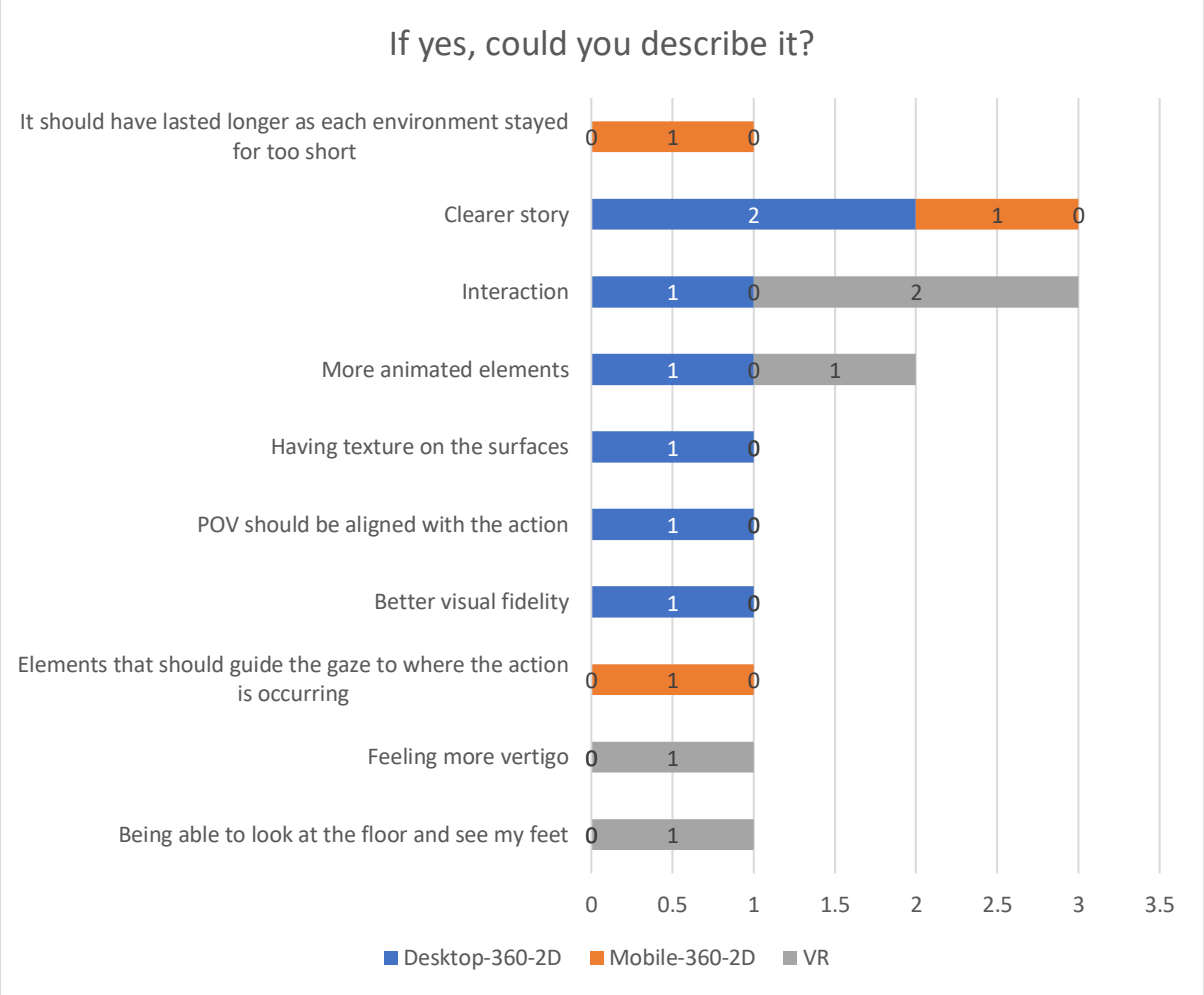
48 and 49 - Did you felt that something was lacking? / If yes, could you describe it?

Seeing Graphic 43, we can tell that 13 people felt that something was lacking from the experience while 9 did not. The reasons as to why will be described in the Graphic 44.



Graphic 43 - Did you felt that something was lacking?

Of the answers, the point that was given for what was lacking was the lack of a clearer story with 3 people, followed by the lack of interaction and animated elements with 2 people, and then, mention by a person each: being able to look at the floor and see his or her own feet, feeling more vertigo elements that would guide the gaze to where the action is happening, better visual fidelity, the POV being aligned with where the action is happening, having textures on the 3D models, and a longer video as each environment stays for too short to be fully perceived.

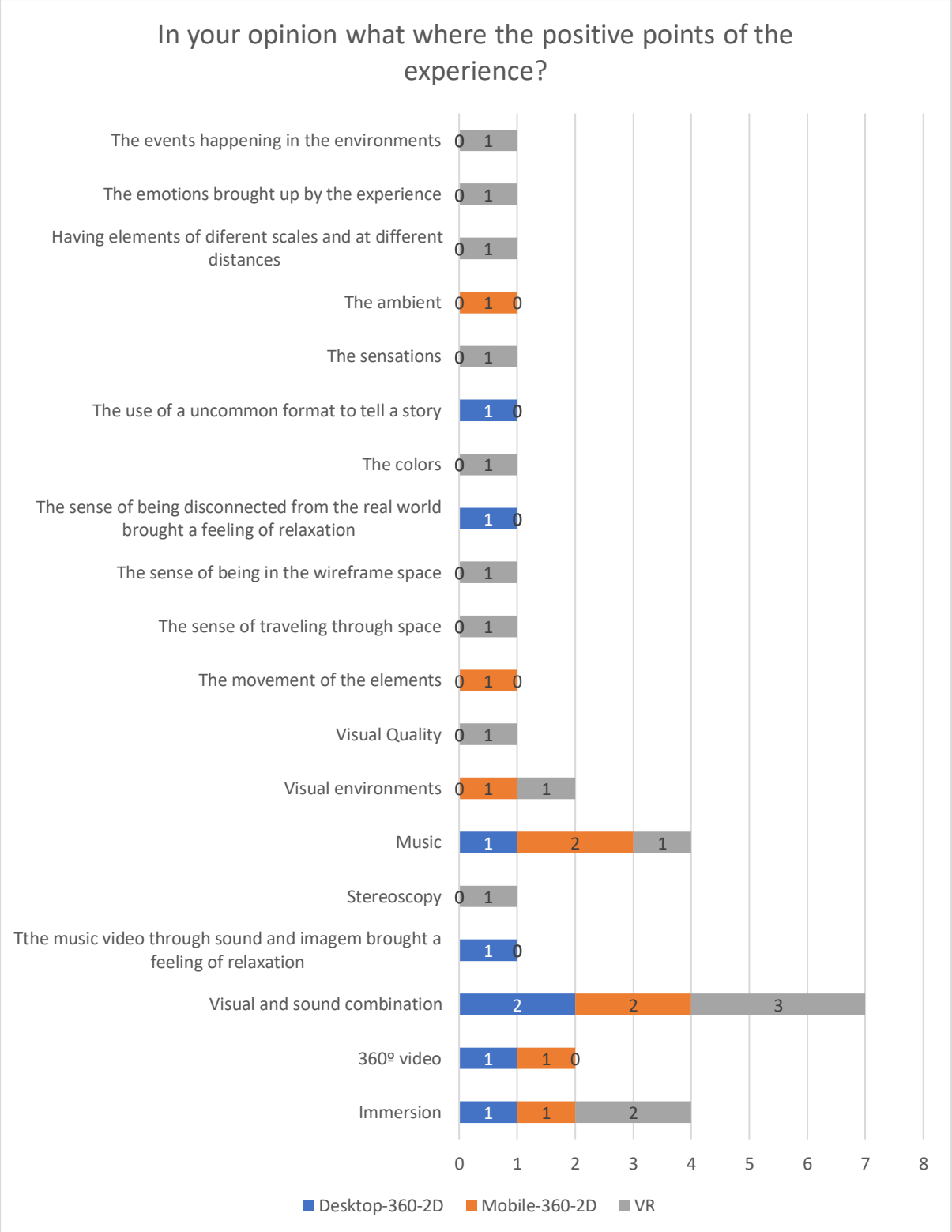


Graphic 44 - If yes, could you describe it?

56 - In your opinion what where the positive points of the experience?

Regarding people's opinion on what were the positive points (see Graphic 45), in first comes immersion and visual and sound combination both with 7 people, next was visual environments with 5 people, then the music with 4, the 360º video with 2 and the other aspects only had one mention, which were, the use of a uncommon format to tell a story, the colors, a sense of relaxation that was brought by being disconnected from the real world., the sense of being in the wireframe space[127], the sense of traveling through space, the movement of the elements, the visual quality, stereoscopy, and the feeling of relaxation that was brought through the use of sound and image.

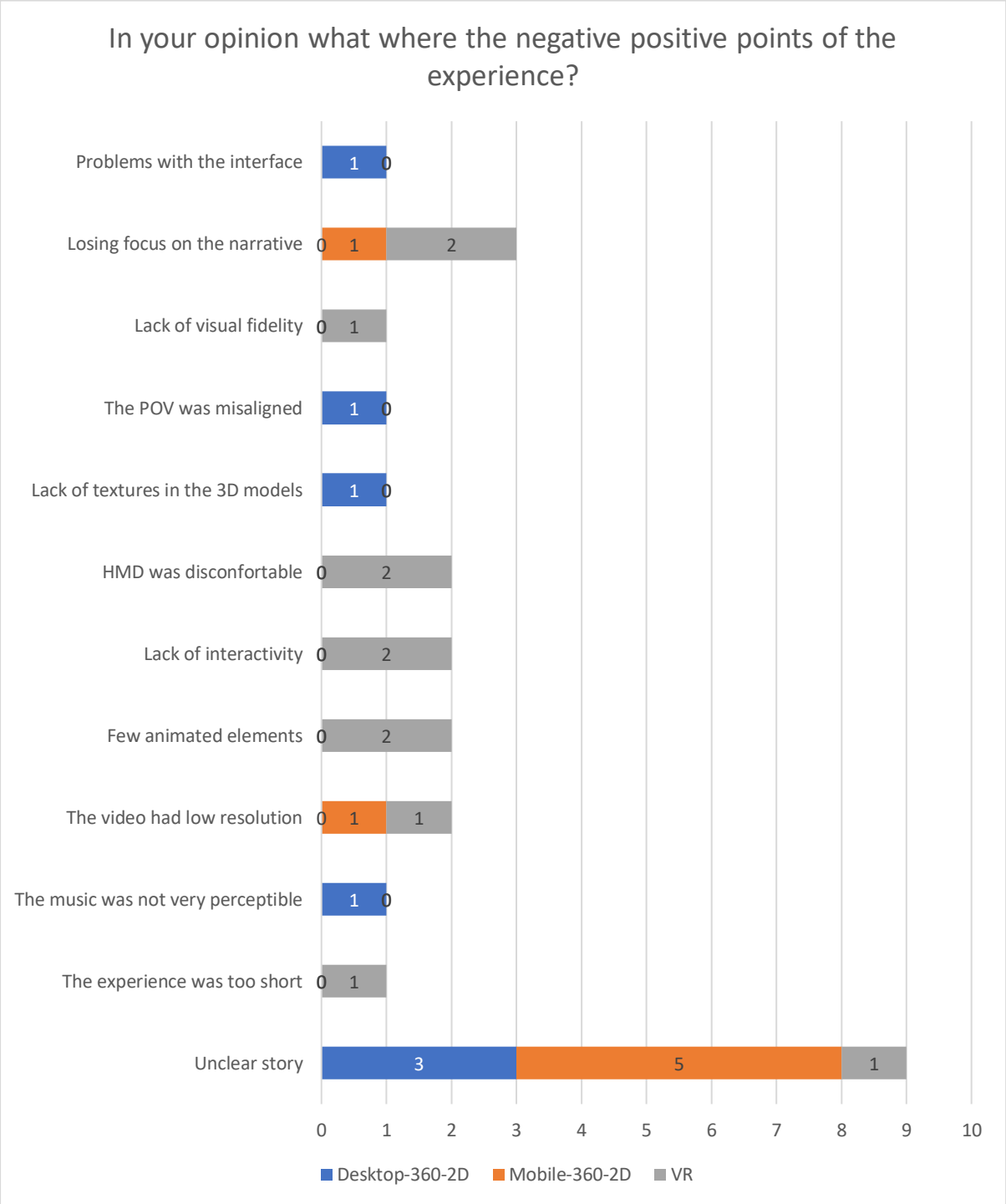
[127] This is a reference to the third and sixth scenes which feature the map portraying Clatterlex 5.



Graphic 45 - In your opinion what where the positive points of the experience?

57 – In your opinion what where the negative positive points of the experience?

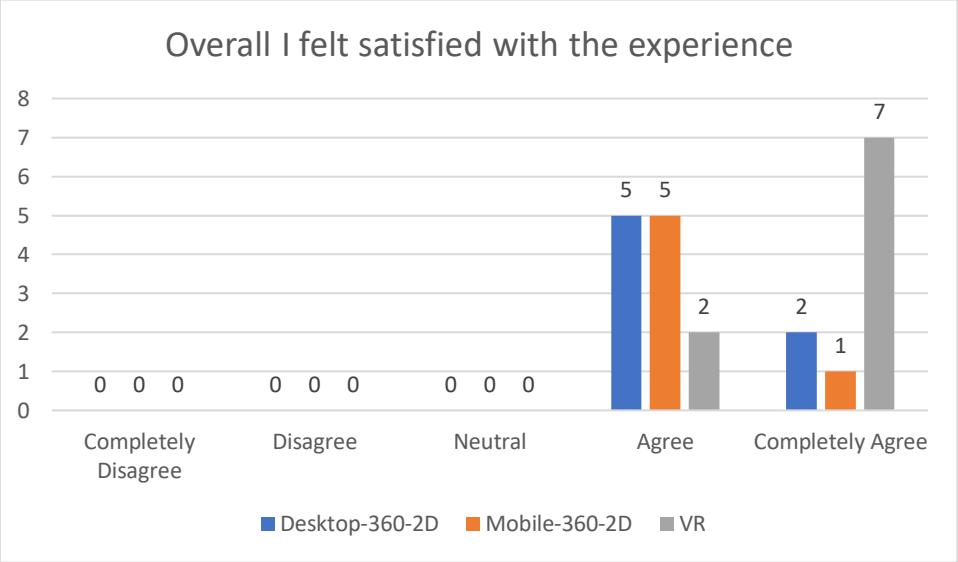
The negative points were primarily having an unclear story, which 11 people pointed out, then the lack of visual fidelity was pointed out by 2 people, as well as the fact that the HMD was discomfortable (most probably due to the fact that the participants could not use the facial interface foam), the lack of interactivity and the lack of animated elements. Then having the POV misaligned with the action taking place, the video having low resolution, the music not being perceptible, and the experience being too short, were all pointed out by one person each (see Graphic 46)



Graphic 46 - In your opinion what where the negative positive points of the experience?

58 – Overall I felt satisfied with the experience

Considering there were practically no side effects, and that the participants liked the music, the visuals, the immersion, and the fact that they thought the experience was intriguing enough to desire wanting to know about it, although many of them felt that the narrative was lacking, might prove why overall the participants felt satisfied with the experience, with 12 agreeing and 10 that completely agreed with the statement (see Graphic 47).



Graphic 47 - Overall I felt satisfied with the experience

4.3.3 Non-observant participation

An analysis grid was made to gather the information through the recordings made in the test sessions. This analysis grid also provided data on other relevant aspects which will be discussed below. Furthermore, the HMD was being recorded internally which gave insight into where the participants were looking in the video. The analysis grid had the following arrangement, which includes an example of how the table was written, will be provided below (see Table 7).

ID	Timecode	Body movements	Head Rotation	Verbal comments	Observations
1	00:08	He adjusted the HMD	He looked down		
…	…	…	…	…	…

Table 7 - Analysis grid

Through the analysis grid we noticed that it was frequent for the participants to adjust the HMD, having had comments after the test about the headset being heavy. 7 people adjusted the headset during the experience, with a frequency ranging from 1 to seven times. There were also some people who adjusted the headphones. The participants also tried to put themselves comfortable in their standing positions by shifting the weight of their legs and their hand positions.

Two participants asked if they needed to use the controller, and two other participants pointed the controller to where they were looking at, in some moments of the experience, suggesting they were curious how the controller might affect the experience, although they did not ask anything related to that.

Regarding vocal comments, some people praised the work, either through interjections or specific comments, one person even mentioned how the experience was “trippy”. Other comments were related with questions or concerns such as the fact that two people found that the lighting of the room was interfering with the headset since they were not using the facial interface foam, or the case with one participant that expressed that the volume was low, and another who asked if there could be movement. Otherwise, the participants only talked when the experience was over.

In the next chapter we will analyze the results of the questionnaires and the non-observant participation.

4.4 Analyzing the results

In this section of the document, we present a reflection on the results obtained through both questionnaires and non-participant observation.

4.4.1 Unclear Narrative

It is clear that the most penalized element of the experience was the narrative. Through graphic 28, it can be seen that most people in all groups being analyzed did not understood the story or were neutral about it with only 3 people disagreeing, being that they thought they could understand it. In the graphic 29, about the reasons why the participants would want to rewatch the music video, the second most voted reason was “there were details of the story I did not understood”. Furthermore, in the graphic 36, regarding weather or not the participants felt disconnected from the story was divisive as 8 people disagreed with the statement while 9 agree and 2 were neutral. In the Graphic 44 regarding the reasons why the participants felt that something was lacking from the experience, a clearer story was one of the most expressed reasons. Additionally, in the graphic 46 regarding the participants opinion on what were the negative points of the experience, the most frequently expressed opinion was the unclear story, with 9 people agreeing with that statement, while the second was losing focus on the narrative with 3 people. Finally, in the 3rd question of the post-questionnaire, in a question asking the volunteers to succinctly describe the story, many could identify some aspects of the story, albeit some were blatant, like space travel, but could truly make a full synopsis of the story, which further reinforces that the delivery of the message was the most lacking part of the whole experience.

Nevertheless, we should take into consideration that having an unclear narrative, or, at least, a narrative that is not understandable right away, is not necessarily a flaw of the work as that might be a desirable trait, and a deliberate choice of the creators as to grab the interest of the users as to explore more.

4.4.2 Immersiveness

Regarding the sonic aspect of immersion, most users could understand that there were different sounds coming from different locations in space (see Graphic 29), albeit 5 people could not perceive that, including two people in VR. Most people also felt tridimensional depth between the objects (see Graphic 31) and, unsurprisingly, the VR group unanimously agreed that the music video was something the participants were experiencing rather than just seeing, compared to the other groups which had more divergent results (see Graphic 33), which is identical to the question regarding if the users felt

immersed in VR space (see Graphic 32). Still, in Graphic 35, on the estimative of the duration of the music video, the desktop-360-2D and mobile-360-2D had most votes for 3 minutes which was the actual duration of the music video. However the VR group had most of the votes to other durations such as 2 minutes (with 3 people), and 4 minutes (3 people), and one vote (much like the other groups), for 5 minutes. This difference might be due to the immersion of the HMD with the headphones, which, by occupying our sight and our earing, creates a discrepancy in the perception of time. Finally, in Graphic 34, regarding how much people felt disconnected from the story after a certain point, the results are somewhat inconclusive since all groups had divergent results, however, we can notice that the groups that felt more disconnected from the story were the mobile and the VR group as compared to desktop, which might be correlated with the quasi-interactive feature of mobile and VR, since in mobile the user had to move the smartphone to explore the 360º space like in VR, which is a more immersive element since it needs movement to happen, so therefore interactivity and immersion might help to take the user away from the story. However, nothing points how that the contrary could not be done, and as such, this should be only a warning to how the creators of a music video are handling story in VR and how it might affect the narrative experience and by extension the whole experience.

4.4.3 Feeling of participation in the ambient and in the story

In the graphics 41, 42 and 43 it can be noticed that in the VR group, the quantity of people who felt excited with the experience was larger than on the other groups, with 3 people agreeing with the statement, as in mobile-360-2D two people agreed and in desktop-360-2D, only one participant agreed. Additionally, through the comments, as shown in the Graphic 45, the most positive point of the experience was the visual and sound combination, followed by immersion and the music itself. So, liking the music might have had an impact on the opinions regarding this aspect. Furthermore, on the Graphic 30, all participants agreed that the music video fits the music. Also, in the Graphic 28 the users expressed liking the sensation of being in the virtual environment.

On the question regarding the overall satisfaction with the experience (see Graphic 47), the participants either agreed or completely agreed with the statement, being the VR group the one with the most votes for Completely Agree, which might be correlated with the immersive experience.

Other factors to have in consideration while analysing the results is that the participants are very technological and cultural literate as everyone not also had experience with computers and laptops, but also had experience with VR at least at some point. Additionally, many participants had experience with videogames (graphic 15), films (16), including science fiction ones (graphics 20 and 21), music

videos (graphics 18 and 19), and some people liked and consumed electronic music, which might have helped with the level of engagement.

4.4.4 Interaction

During the tests, one of the participants commented that he did not wish to have interactive elements has they would interfere with the narrative experience, but otherwise, most of the participants expressed that they would have liked to have interactive elements (see Graphic 36). Furthermore, in Graphic 44, 3 participants expressed that one of the lacking elements of the experience was interaction, being 2 of those from the VR group, likewise, in the Graphic 46, regarding what the participants thought were the negative points of the experience, 2 participants of the VR group mentioned the lack of interactivity.

4.4.5 Presence in VR

One of the challenges of VR was trying to visualize the music video in 360 rather than conventional 2D video, as we are so used to. The difference of VR is that we can no longer think only in terms of camera as in point of view, but rather presence, as VR implies a sense of it. In cinematic VR there is no notion of a directed focused attention to a portion of the action. VR is not a passive activity, it demands a different level of engagement, a different way of thinking about the role of the spectator in the story. We can say that the user is a character now. So much that a participant expressed the need to see his or her own feet in VR as to feel more immersed (see Graphic 44).

4.4.6 Final thoughts

It seems that narrative can be, although not necessarily, an obstacle to the creation of a VR experience. In this case it was problematic has the was the music video was made, did not allow the user time to explore and to become acquainted with each scenery has the visual aspect was made to represent what was being narrated, so it had to be synchronized and timed to that element. Perhaps if the music video were not linear in the way it represented the story it could have had more time for itself, in the sense that it was not so strictly bound to the pre-recorded narration. Another possibility could be that if the video were interactive, the audio could adapt to the user response. So, for example, imagine that the user could explore each scenery freely, and as the user would progress through the scenery, he or she would trigger a transition to a different place and therefore a different part of the narration. Then there would be no restriction on the creative side of the video, and it could give time for each person to explore the video and to allow for interaction and possibly a better understanding of the story as more time would be given to the user to process each bit of information

at a time. The two aspects that did not contribute to this possibility was the restricted knowledge of the researcher on game engines and the limited time that could not allow for the learning of such tools, much less the production of a full interactive music video.

5. Conclusion

5.1 A synthesis of the investigation

We start this conclusion chapter by doing a synthesis of the investigation made.

The music video as decades of history and development, but with the development of VR in recent year, new opportunities for this art form have open, and we hope, through this investigation to provide a clearer path to anyone undertaking the task of creating a music video for VR.

In this investigation, we brought to light some important concepts in the Theoretical Framework (see Chapter 2) about music videos including a proposal of categorization of music videos (see Table 2) and, most importantly, about music videos in VR, including a table with breakdown of different aspects of various VR music videos (see Appendix A - Music video VR table).

Since the goal of this investigation was to understand the potentialities of the music video in VR, to do so, we recurred to creating a music video for this medium. The result was a music video made for the song *L'AIR* of a band named J U P I T E R. The music video is in stereoscopic 360º and with ambisonic sound as to provide full immersion. In Chapter 3 there was provided an in-depth explanation of how the music video was created from choosing the band to adapt a song for VR, to choosing the song, the brainstorming, and then development of the music video through the conventional pre-production, production, and post-production phases.

In Chapter 4 we described the users tests made for the music, which were made as to better evaluate the video and the experience it provided. These tests were made with 3 different samples, each evaluating a different format: desktop-360-2D, mobile-360-2D and VR. This methodology allowed us to compare between the different formats and to formulate conclusions from these comparisons. For the tests, the users answered to a pre-session questionnaire as to gather information for the categorization of everyone, and then a post-session questionnaire regarding their experience. All this information was then analysed and compared with each other as to find how the music video performed in terms of immersion and engagement, and in which aspects each format benefitted the watching experience.

In the chapter 4.4, we did an analysis of the results. First, we found out that it is important to have in consideration that if a music video is going to have a narrative it should be carefully though how it is going to be articulated with the other elements of VR such as the 360º and interactivity. Secondly, VR implies a sense of presence for which to be very mindful of, and as such, one should think of the role of the spectator not only as a spectator, but also as a character and an element of the music video and the experience. Thirdly, VR, due to its novelty, is a very engaging experience, and one should question if the work might be interesting not only because of the immersive experience, but also

because the work itself is interesting. Visual ideas that would work in typical 2D format, might not work in VR due to its immersive aspect. Additionally, ambisonics might be considered for added immersion if possible; however, this poses a new added step to the process. Lastly, it is highly important to consider having interactivity has the experience naturally demands it.

We can finally conclude VR is a new territory worth exploring for its fascinating capabilities of immersion and presence, but that it requires new ways of thinking on how to produce a music video, and new requirements to fully take advantage of the medium.

5.2 Critical analysis

In this section we will elaborate a critical analysis of the investigation.

In the development of this investigation, we aimed to answer what are the potentialities of creation of a music video in Virtual Reality, for which we directed through various goals: Firstly, was the creation of a theoretical basis to analyze music videos in Virtual Reality, for which we proposed a table for categorizing music videos, featuring the newly added categories of immersion and interactivity, which are elements of VR music videos. Secondly, given the lack of research on music videos for VR, we created an analysis table of various music videos produced for Virtual reality has to better understand their characteristics, which we created with an analysis of over 80 VR music videos. This analysis was used as a basis to form considerations on music videos for VR having as basis the theoretical framework created before on music videos and VR.

The third goal of the investigation was the creation of a music video for VR, which was completed successfully, having been made entirely through CG, and featuring elements, such as stereoscopy and ambisonics audio. However, the element that was lacking in the experience of the music video was interactivity, which was evident through the analysis made of the user test's data, and the analysis of the music videos discussed in the theoretical framework (see Chapter 2.5 – Music Video in Virtual Reality).

The fourth goal was the planning and creation of user tests for the music video in different formats created for VR in the course of this investigation. The user tests were made for desktop-360-2D, mobile-360-2D, and VR; and were conducted over the course of a week with 22 participants, being the majority, college students from the masters of Multimedia Communication.

The biggest obstacle to the user tests was the pandemic of the COVID-19 in 2020, which limited the availability of people for the test and the conditions in which the test was conducted. Ultimately, the test could have benefited from a more varied sample and better conditions for testing, which would also benefit the comfort of the participants. The tests could have also benefitted from

integrating the retrospective think-aloud protocol, in which the participants are asked to retrace their steps after the session is complete (Usability.gov, n.d.).

The fifth goal is Understanding the potentialities of VR compared to other formats of visualization of VR, namely desktop-360-2D and mobile-360-2D. The results showed that in fact VR does provide a more immersive experience, both sonically, and visually. However, as expressed previously, the experience is lacking interactive elements, which does not fully take advantage of all the potentialities of VR and, because of that, is not really providing a fully immersive experience.

The sixth and final goal of this investigation was to understand the potentialities of creation of a music video for VR through the process of creating one. From that experience, we understood that VR poses many challenges and different ways of thinking about audio-visual content, which, in this case, implies a sense of presence, demanding a totally different way of thinking about storytelling.

5.3 Future work

Lastly, since this type of content is very recent, and still has a lot of room to expand and improve. As such, it would be interesting to further research upon the untouched potentialities of music videos for VR, visually, sonically, interactively, and from a storytelling viewpoint.

Regarding this project, since the song *L'AIR* for the music video is part of an EP, it would be very interesting to adapt the rest of the EP, as a whole, to an entire VR music video. Furthermore, it could be interesting to understand how the music video could work with interactive elements, and make them an integrant part of the experience, rather than a feature that would be added to the experience just for the sake of adding interactivity.

Finally, the music video created for this project might be published and distributed online such as on the band's YouTube channel and in their Facebook page, being that both platforms feature 360 video.

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7. Appendixes

Appendix A - Music video VR table

Artist and Song Title	Release Date	Marketed as VR	Marketed as 360 video	180	Stereoscopic	3D Audio	Interactive	Concert	Dance	Lyric video	3D elements	Point of View	Analysis/Observations	Similar videos	Transmedia	Fan made
Björk - Stonemilker	2015	Yes	Yes	-	-	-	-	-	-	-	-	-		-	-	-
FOALS - Mountain At My Gates	2015	-	Yes	-	-	-	-	-	-	-	-	-		Yes	-	-
Avicii - Waiting For Love	2015	-	Yes	-	Yes	-	-	-	Yes	-	Yes	-	There's a lyric video and a standar music video for this music	-	Yes	-
Duran Duran - Pressure Off	2015	-	Yes	-	-	-	-	-	-	Yes	Yes	-		-	Yes	-
Buffalo Huddleston - Sky High	2015	-	Yes	-	-	-	-	Partially	-	-	-		The camera only has movement in a moment where it is attached to a bicicle, otherwise it's all static shots	-	Yes	-
Soulfly - Archangel	2015	-	Yes	-	-	-	-	Yes	-	-	-	Person in crowd		-	Yes	-
Noa Neal - Graffiti	2015	-	Yes	-	-	-	-	Partially	Yes	-	-	We're in the middle of the action. There are musicians behind us. The lead singer, sings, dances and walks in front of us	It's an energetic video. Sometimes stitching is evident	-	Yes	-
Kamera - Cold Land	2015	-	Yes	-	-	-	-	-	-	-	Yes	-	It's a completely abstract video, where what at the beginning seems like a landscape with mountains rapidly reconfigures itself into a dinamic and abstract landscape of moving images	-	-	-
Galvanized Souls - New Generation	2015	Yes	Yes	-	-	-	-	Partially	Yes	-	-	We're in the middle of the action	The video, although funny, can get really desorientating due to the amount of cuts and camera angles. I can see through the acting very easily, although this is not a video to be taken seriously	-	-	-
Ethiocolor - Mali Malonayie	2015	Yes	Yes	-	-	-	-	Yes	Yes	-	-	We're on the rooftop of the National Theater in Ethiopia, in the center of the performance	The video is well built. There's no noticeable stitchs, which is helped by the static camera. Each part of the performance happening around us as time to be observed. In the description it is claimed that this is Africa's first 360 degree video	-	-	-
Yurp - Dirty Secrets	2015	Yes	Yes	-	-	-	-	Yes	-	-	-	In the center of the performance with the musicians all around. At a certain point we're on the top of a a car doing drifts in a circle	The POV of the car doing a drift in circles could be desorientating. The video felt underwelming compared to the intensity of the music	-	-	-
Scooter - Riot	2015	-	Yes	-	-	-	-	Yes	Yes	-	-	Vêmos o concerto de várias perspetivas. Principalmente de cima do palco. Mas também de um drone aéreo, no meio da plateia e numa plataforma	The performance recorded, and the use of drone footage help to dynamize the video content in order to catch the pace of the music. Given that the images are all of the same space, and that they are cutted interchengably, they never feel desorienting	-	-	-
Luke Brian ft. Karen Fairchild - Home Alone Tonight	2015	-	Yes	-	-	-	-	-	-	Yes	Yes	In the beginning we're in a parking lot, and then we're inside a bar	The camera as sharp movements and rotation which are unnecessary. Also the lettering is not very readible	-	-	-
From the Ashes - 360 VR live video	2015	Yes	Yes	-	-	-	-	Yes	-	-	-	We're in the middle of the band	It is a little strange when the bassist and the lead singer sing next to my face. The sound leaves a lot to be desired. Also the video has a basic composition of a division in 4 areas. One for each of the band members	-	-	-
Roomie - This Summer (Maroon 5 cover)	2015	-	Yes	-	-	-	-	-	Yes	Partially	Yes	We find ourselves in various urban places	The video keeps a good pace with the song, given the elements going on in each shot. Being a bicicle ride, people dancing, the performer singing and playing	-	Yes	Yes
Infinite - Bad	2015	Yes	Yes	-	-	-	-	-	Yes	-	-	We find ourselves in various indoor places.	The video as only static shots. The sets have very delimited 4 and 2 divisions. Like a mirrored bathroom or a hall with 2 crossed corridors. The video also shares elements from its 2D equivalent	-	-	-
Jun Aiba - X and Y (蟹座純「xとy」)	2015	Yes	Yes	-	-	-	-	-	Yes	-	-	We're in the middle of the performance	It's interesting to see the overlaying images of the performer	-	-	-
The Main Squeeze - Sun is Shining (Bob Marley cover)	2015	-	Yes	-	-	-	-	Yes	-	-	-	We're in the middle of the performance	The only thing lacking is spatialized audio	-	-	-
U2 - Song for Someone	2015	Yes	-	-	-	Yes	-	Yes	-	-	-	We're in the middle of the performance in various places of the world	There's a synergy between the different performers being played next to each other	-	Yes	-
Volbeat - Dead But Rising	2015	-	Yes	-	-	-	-	Yes	-	-	-	We see various points of the stage	The video is a little repetitive	Yes	-	-
Feed the Rhino - Featherweight	2015	-	Yes	-	-	-	-	-	-	-	-	We're in the middle of the performers	The video is only a static shot, but it flows really well with the performance of the band. Also there is no visual artifact like stitching or the point of convergence below and above the viewer	-	-	-
Orchestra VR	2015	Yes	-	-	Yes	-	-	Yes	-	-	Yes	We see various points of the stage	It is a very interesting video in that it is a 360 recording of an orchestra from various points of view, however it is interesting that there are 3D particles representing visually the music	-	-	-
The Halle Beethoven Symphony No.5	2015	Yes	Yes	-	-	-	-	Yes	-	-	-	We see the concert from the middle of the orchestra in front of the maestro	I believe the perspective of the concert is very low as it does not allow to properly see the whole orchestra	-	-	-
Muse - Revolt	2016	-	Yes	-	Yes		-	-	-	-	Yes	Drone		-	-	-
EDEN - drugs	2016	Yes	-	-	Yes	Yes	-	-	-	-	Yes	The void, a city and a desert	The video creates a landscape of human figures and ethereal landscapes through abstract elements dictated by an highly emotional and envolving score	-	Yes	-
OneRepublic - Kids	2016	-	Yes	-	-	-	-	-	-	-	-	-	-	-	Yes	-
Trevor Wesley - Chivalry is Dead	2016	-	Yes	-	-	-	-	-	Yes	-		-	-	-	Yes	-
Run The Jewels - Crown	2016	Yes	Yes	-	-	-	-	-	-		-	We're in a dark environment with dark clouds above us. All around us there are people which maybe communicating in our direction or just behaving in a characteristic way	-	-	Yes	-
Imagine Dragons - Shots	2016	-	-	-	-	-	-	-	-	-	Yes	-	It is very evident the division of the scene in 4. Also the video uses many visual elements from its 2D counterpart	Yes	Yes	-
Megadeth - Poisonous Shadows	2016	-	Yes	-	-	-	-	Yes	-	-	-	-	The camera circles around the vocalist while passing between all the band members	-	-	-
Refoo - Booty Man	2016	-	Yes	-	-	-	-	-	Yes	-	Yes	-	At some points the camera rotates and it is very noticeable the studio ceiling	-	Yes	-

Cut Throat Finches - Boundaries	2016	Yes	-	-	-	-	-	-	-	-	Yes	-	This video has various problems. Firstly, there are moments in which the camera rotates to follow a character's movement which is unnecessary considering it is a 360 video. Furthermore, there's a noticeable oscillation of the movement of the camera when it moves. It is also common in this video the use of a slow movement of the camera towards the actors, which feels like a compensation for the lack of zoom as would happen in a standard video. | Another detail is that the camera sometimes is too close to the actors to a point in which it feels like we're invading the actor's personal space. But, perhaps stranger is when a person is between the couple while they are looking romantically towards each other, and we feel like we're in the middle of them in a intimate scene. The worst of these cases is when the couple is beneath a bad sheet and we're still in the middle of them. | This could be interesting, however, considering that the song is called "Boundaries", but nothing in the song suggests an exploration of the physical space, that would justify the proximity of the camera towards the actors, other than being a point of view with the unforeseen consequence of causing awkwardness and discomfort towards the viewer. |The stitching is very noticeable in some moments, specially when the camera is moving. There was also a moment where the environment was divided in two: in one half of the scenario we see the band playing, and in the other part we see the actors. This scene came out as a little rough because the video mixture wasn't very smooth, while also feeling a little busy in the sense that there is a lot going on in such as short space of time to be perceived properly.	-	-	-
W.E.R.D. ft. Ysatiz Hernandez - Paper Dreams	2016	-	Yes	-	-	-	-	-	-	-	Yes	-	The video is interesting. It could have been better with stereoscopy. The camera rotation was unnecessary	-	-	Yes
Skrillex live at Carnival Brazil	2016	Yes	Yes	-	-	-	-	Yes	-	-	-	We're between the stage and the audience		-	-	-
Redfoo - Lights Out	2016	-	Yes	-	-	-	-	-	Yes	-	Yes	-	The audio could have been spatialised, specially given the fact that there were speeches made, and that there were musicians playing	-	-	-
Jean-Michael Jarre - Oxygene Pt. 17	2016	-	Yes	-	Yes	-	-	Yes	-	-	-	We see various points of the stage	The pacing of the music is followed by the movement of the performers	-	Yes	-
Kevin LaSean - Topless	2016	.	Yes	-	Yes	.	-	-	-	-	-	We see various places of a tropical place, which I suppose its Brazil. Most of those places are crowded, and are near the sea.	It's interesting to see the rapper in those different contexts, and some times interacting with the people passing by. My only complaint is that perhaps the cuts between shots should have matched the place where the rapper is, which happens sometimes. However, the way the video is edited might also be good for exploring the liberty of the 360 video	-	Yes	-
Gorillaz - Saturnz Barz	2017	-	Yes	-	-	-	-	-	-	-	Yes	-		Yes	-	-
NoMBe - Freak Like Me	2017	-	Yes	-	Yes	-	-	-	Yes	-	-	-		-	-	-
Night Club - "Show It 2 Me"	2017	-	Yes	-	-	-	-	-	-	-	Yes	-		-	-	-
Imagine Dragons - Whatever It Takes	2017	-	Yes	-	-	-	-	-	-	Yes	Yes	-		-	Yes	-
Sampha - (No One Knows Me) Like The Piano	2017	Yes	Yes	-	-	-	-	-	-	-	Yes	Pianist		Yes	-	-
Sam Tsui - Built to Love	2017	-	Yes	-	Yes	-	-	-	Yes	-			A câmera está constantemente a girar para acompanhar o cantor. Para além disso um outro factor que mostra que não aproveitaram totalmente as capacidades do 360 é que a certa altura (e estou foi evidênciado nos comentários) uma pessoa no lado oposto de onde está o cantor começa a seguir a câmera	-	Yes	-
Saint Motel - Sweet Talk	2017	-	Yes	-	-	-	-	-	-	Yes	Yes			-	Yes	-
Saint Motel - Gateway	2017	-	Yes		-	-	-	-	-	Yes	Yes	We're a car driver		-	Yes	-
Kid Ink - Mochi	2017	-	-	-	-	-	-	-	-	-	-	We're at the top of the table in a chinese restaurant	It is interesting the original point of view. Also, the video as realistic quality given by its camera low fidelity which feels like a Skype call but in VR. The fact that the video is in 360 reveals a little of the acting	-	Yes	-
Software - Island Sunrise	2017	Yes	Yes	-	Yes	-	-	-	-	-	Yes	-	The video by itself is very still, reflecting the calmness of the music. Also it's interest goes behind itself in that the scenario is actually based on a 1981 animation calleld Carla's Island, from which the album cover was based, and which is considered the first video of fluid simulation in 3D	Yes	Yes	Yes
David Rosen - Constellations (ft. Tyson Bolkcom)	2017	Yes	Yes	-	-	-	-	-	-	-	Yes	We're in the middle of an open field looking at the dancing stars	The video is fun. It would have been nice if we could have travelled through the constellations	-	-	-
The Chemical Brother - Under Neon Lights	2017	Yes	-	-	Yes	-	Yes	-	-	-	Yes	We're following a girl through various environments	We can control the point of view. And if clicked the colors change and a pattern appears over all the objects in the scene	-	Yes	-
Shigeto - Hovering	2017	Yes	-	-	Yes	Yes	-	-	-	-	Yes	We're offered various viewes of a planet	The video works really well with the audio	-	-	-
Nan Madol - Children of the Earth	2017	-	-	-	Yes	-	-	Partially	-	-	-	We experience two scenarios: one in the wood with the band and the other in a room. Within that room we see some different points of view, but with a dominant one in from of the drum set, since the drummer is also the singer	The video is a little repetitive since it uses almost always the same points of view and the same camera movement	-	-	-
Stone Sour - Somebody Stole My Eyes	2017	-	Yes	-	Yes	-	-	Yes	-	-	-	It's a single shot video of the band performing all around us	Although a single steady shot, the charisma of the band makes up for that	-	Yes	-
Suburban Living - Lovely Times	2017	-	Yes	-	Yes	-	-	Yes	-	-	-	We start the video on top of a van and then we enter a large room with few forniture and undone painting. The camera moves towards the band and stays there until the end of the song when it backs away	It's an interesting video. I also found interesting the fact the they decided to show the equipment for the lighting and to move the camera. Also I also felt that this was also a 180 video since the majority of the time I was looking almost exclusively to the band members. However, I might admit that perhaps that was a creative choice as to show the emptiness of the space. But I'm not sure if that would be an interesting idea since we're focused on the musicians	-	Yes	-

Fred V & Grafix - Nearly There	2017	Yes	-	-	Yes	-	-	-	-	-	Yes	We are in a abstract space with objects glowing in different patterns. Then those objects start moving and we enter to a different environment with what seems like mountains framed by huge rings rotating around the landscape	It's a simple but interesting video. I feel that it fits with the mood of the song	-	-	Yes
SaSaSaS - Noctural Insomniacs	2017	-	Yes	-	Yes	-	-	-	-	-	-	We're in the middle of a staged scene we're we have the performers in 4 different environments around us	The videos is engaging given the amount of things happening at once. The scene is divided into 4 sections.	-	-	-
Villette - Money	2018	-	Yes	-	-	Yes	-	-	-	-	Yes	Homem		-	Yes	-
Life Support - Al and Taryn Southern	2018	Yes	Yes	-	Yes	-		-	-	-	Yes	-		Yes	-	-
YAO - Unraveled	2018	-	Yes	-	-	Yes	-	-	-	-	Yes	-	-	-	-	-
The Beast of Nod - Vampira Infernalis	2018	Yes	Yes	-	Yes	-	-	-	-	-	-	-		-	-	-
Koven - Do You	2018	-	Yes	-	-	-	-	-	-	-	Yes	We're ascending from the earth to space	This video, similarly to "Journey to the edge of space", is filmed on a ballon that goes up in the air to the limit of the earth's atmosphere. However this video was not stabilised, which might create motion sickness	-	-	-
Mamma Mia! Ci risiamo - Waterloo	2018	-	Yes	-	Yes	Yes	-	-	Yes	-	Yes	We're in the middle of the performance		Yes	-	-
David Rosen - PalinDRONE	2018	Yes	Yes	-	-	-	-	-	-	-	Yes	We're inside a tall room floating up	The concept was interesting and well executed			
PLYA - Adrenaline	2018	-	Yes	-	Yes	-	-	-	Yes	-	-	We're in the middle of the performance	The video is engaging because of the performance of the artists. Like many others, the experience could have been enhanced with spatialized sound	-	Yes	-
Satin Sheets - Fashion (ESPRIT 空想 Remix)	2018	Yes	-	-	Yes	-	-	-	-	-	Yes	Firstly, we're inside a car, then we follow it until while it drives form the outside. At a certain point we're an angel	It's a very interesting video. It reflects the vapowave style and the final were we're an angel watching the carshed car is very interesting and expectation defying	-	-	Yes
Alex Aiono - One At A Time ft. T-Pain	2018	Yes	-	-	Yes	-	-	-	Yes	-	-	We're present in various staged places with urban themes such as graffities and other simbolic elements such clouds. Also there's a shot were we're in the front of a moving car	The video, like the music is very calm, it is interesting that the position of the singers are matched between shots. Also there's an interesting shot were we're in the front of a car driving slowly in the scenery	-	Yes	-
ORII - Vicious	2018	-	Yes	-	Yes	-	-	-	Yes	-	-	The whole video takes place in the Topanga Lookout in Los Angeles, and we see Ivan Velez dancing from various points of view	I belive that the video had potential to folllow more closely the intensity of the music, however I found interesting the use of editing to create glitch like effects in the dancer	-	-	Yes
Phantom - Lost	2018	Yes	Yes	-	Yes	-	Yes	-	-	Partially	Yes	We orbit around a abstract sphere from were come particles and all other elements that float and move in front of and around us. This is all set in space	Since our point of view is rotating around an object in the center of the experience the video almost feels like a 180 video since it is our main focus of attention. Everything else is just scenario, with a reference to the Death Star of Star Wars	-	-	-
Pete Simcoe - One More Chance ft. Alex Edy	2018	-	Yes	-	Yes	Yes	-	-	-	-	Yes	It's a single steady shot video of a performance happening all around us in a strange place with the star above us and violet stage were we're standing	The video is completely 3D and it features neon 3D figures made of glowing lines of the musicians. I believe the video is a little too still, and the performance of the musicians isn't has captivating as some of other similar videos. However the video is interesting in it's presentation and its use of ambisonics	-	-	-
Pete Simcoe - The Journey ft. Birgir Guðmundsson	2018	-	Yes	-	Yes	Yes	-	Yes	-	-	Yes	We're in some desert landscapes with the two musicians performing in front of us.	It is a very calming and powerful experience. The meditative music drives the observation of the space	-	-	-
Evanescence - Hi-Lo (live)	2018	-	Yes	-	Yes	-	-	-	-	-	-	It's a single shot of the musical group performing. We're on top of the stage next to the piano	The performance of the group is very captivating	-	Yes	-
Erika Costell - Conscience	2019	Yes	-	Yes	Yes	-	-	-	-	-	-	We see various scenarious of a house, and at some certain points we incorporate the lead singer's perspective		-	Yes	-
Dying Gorgeous Lies - From the Ashes/Hellfire	2019	Yes	Yes	-	-	-	-	-	-	-	-	-	The video has some interesting visual solutionos like having the camera attached to the neck of a guitar, which, however, might cause disconfort. Furthermore, the video has lot of cuts between shots which makes it difficult to perceive what's happening around. This also renders the use of 360 useless. Because of this this video could have functioned better as a 180 video rather than a 360 one. An example of this fact is that the camera rotates to follow a character's movement.	-	-	-
Savlonic - Action Causes Reaction	2019	Yes	Yes	-	Yes	-	-	-	-	-	Yes	We're inside an arcade game		-	Yes	-
Odd Mob - All of Your Heart	2019	-	Yes	-	-	-	-	-	-	-	Yes	We're between two different worlds: the world of the boy and the world of the girl	It's interesting the use of two halves in each side of the environment	Yes	-	-
Twenty One Pilots - Pet Cheetah	2019	Yes	-	Yes	Yes	-	-	Yes	-	-	Yes	We see the concert from various perspectives, including that of the audience	The video in 180 is captivating, the only thing that I would like to have is the possibility to turn back and to watch the audience's response to the concert	-	Yes	-
Malaa ft. Jacknife - Revolt	2019	-	-	-	Yes	-	-	-	-	-	Yes	-	This video is very different from everything else in the sense that each eye as a very different image from the other	-	Yes	-
Mathew Dear - What You Don't Know	2019	Yes	-	-	Yes	Yes	Yes	-	-	-	Yes	We're in the middle of a abstract place filled with controls	The interactions influence the music and the accompanying visuals	-	-	-
Mozart - Gloria	2019	Yes	-	-	Yes	Yes	-	Yes	-	Partially	Yes	We're in the middle of the orchestra and the other next to the timpani. The orchestra is playing in the Cathédrale de Saint-Omer	It's interesting to being in the middle of a full orchestra. I whish it was only in 3D. The video has accompained lyrics and notes about the music	-	-	-
Mozart - Agnus Dei	2019	Yes	-	-	Yes	Yes	-	Yes	-	Partially	Yes	We're in the middle of the orchestra and the other to the right of the conductor. The orchestra is playing in the Cathédrale de Saint-Omer	It's interesting to being in the middle of a full orchestra. I whish it was only in 3D. The video has accompained lyrics and notes about the music	-	-	-
Mozart - Benedictus	2019	Yes	-	-	Yes	Yes	-	Yes	-	Partially	Yes	We're in the middle of the orchestra and the other next to the choir in the left side. The orchestra is playing in the Cathédrale de Saint-Omer	It's interesting to being in the middle of a full orchestra. I whish it was only in 3D. The video has accompained lyrics and notes about the music	-	-	-
Christopher - Irony	2019	Yes	-	Yes	Yes	-	-	Partially	-	-	-	It's a single steady shot video inside a room	The video, although technically is 360, the content is only in 180 space, the other half of the space is filled with a black background and the song title and artist name	-	Yes	-
Harry Shotta - Virtual Insanity	2019	Yes	Yes	-	Yes	-	-	-	-	-	Yes	We see different spaces. Firstly we're inside a train. Then a vista of the outside of the train, above water, from this point on, it starts to appear visual glitches and static. At a certain point we see a virtual world and the song starts	The video is interesting of its use of the glitch elements and the way it expresses the passage to the virtual world. The constant moving backward and forwards of the camera might be disconfortable for some users.	-	-	-
Saul Williams - Experiment	2019	-	Yes	-	Yes	-	-	-	-	-	Yes	We're in the middle of a empty large room. In front of us is the artist who then starts rapping to us.	This video is interesting in many aspects. Firstly, the musician uses proximity to create an intimidating feeling. Also there's an abundant use of visual effects like overlaying of various performances of the artist and glitch effects.	-	-	-

Appendix B – Script for the user tests

The VR group

1. The test will be made in a room of the Department of Communication and Art of the University of Aveiro. In this local there will be the material needed for the visualization of the music video such as the HMD and the headphones, the camera and tripod to record the user test, finally, the tools to disinfect the space and the objects being used by the users.
2. During the experience there should be only two people in the room: the participant and the researcher.
3. The researcher will explain to the volunteer all the procedures of the test.
4. Before the experience, there should be explained the risks of using the HMD.
5. Before visualizing the music video, the participant will answer a pre-questionnaire as to gather information characterizing him or herself. Further, in the pre-questionnaire there will be a consent form to authorize the recording of the session.
6. Having done this, the researcher will explain to the participant how the equipment works and will help that person putting the HMD and the headphones.
7. Then the researcher will start recording the session on the camera, and the participant will start playing the music video.
8. After watching the music video, the researcher will help taking out the headphones and the HMD.
9. Then, the volunteer will answer the post-test questionnaire with questions regarding the watching experience.
10. Having done the test, the participant will leave the room and the researcher will disinfect every object and the space for the next volunteer.

The desktop-360-2D group

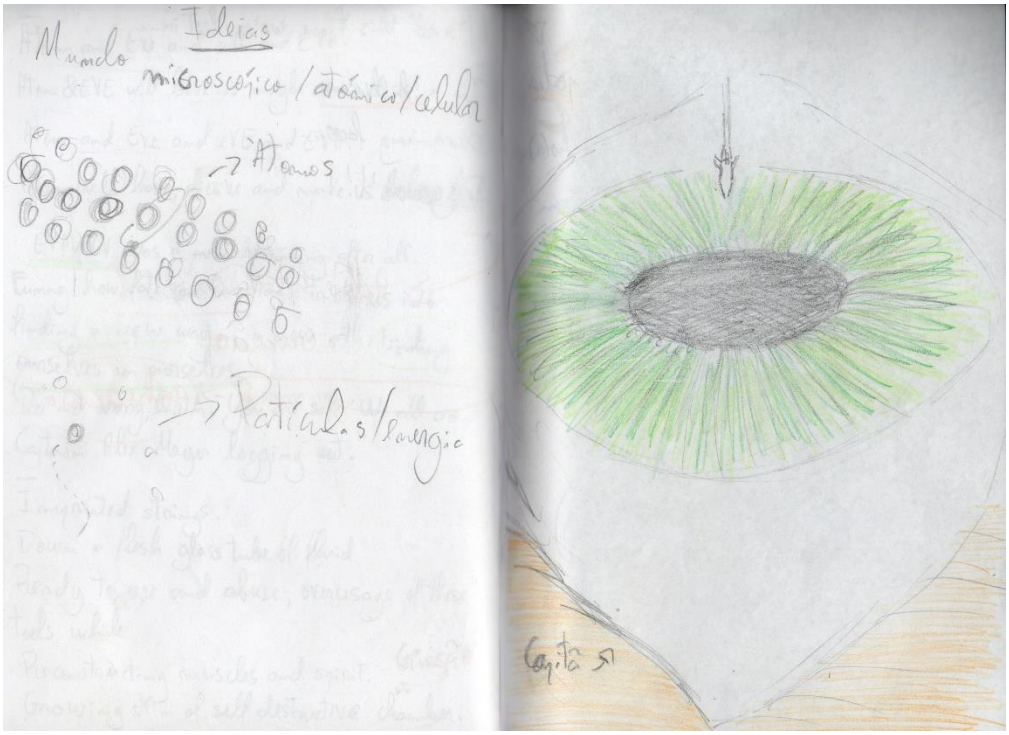
1. The test will be made in a room of the Department of Communication and Art of the University of Aveiro. In this local there will be the material needed for the visualization of the music video the laptop and the headphones, and the tools to disinfect the space and the objects being used by the users.
2. During the experience there should be only two people in the room: the participant and the researcher.
3. The researcher will explain to the volunteer all the procedures of the test.
4. Before visualizing the music video, the participant will answer a pre-questionnaire as to gather information characterizing him or herself. Further, in the pre-questionnaire there will be a consent form to authorize the recording of the session.
5. Having done this, the researcher will explain to the participant how to play the music video on the computer.
6. The participant will watch the music video.
7. Then, the volunteer will answer the post-test questionnaire with questions regarding the watching experience.
8. Having done the test, the participant will leave the room and the researcher will disinfect every object and the space for the next volunteer.

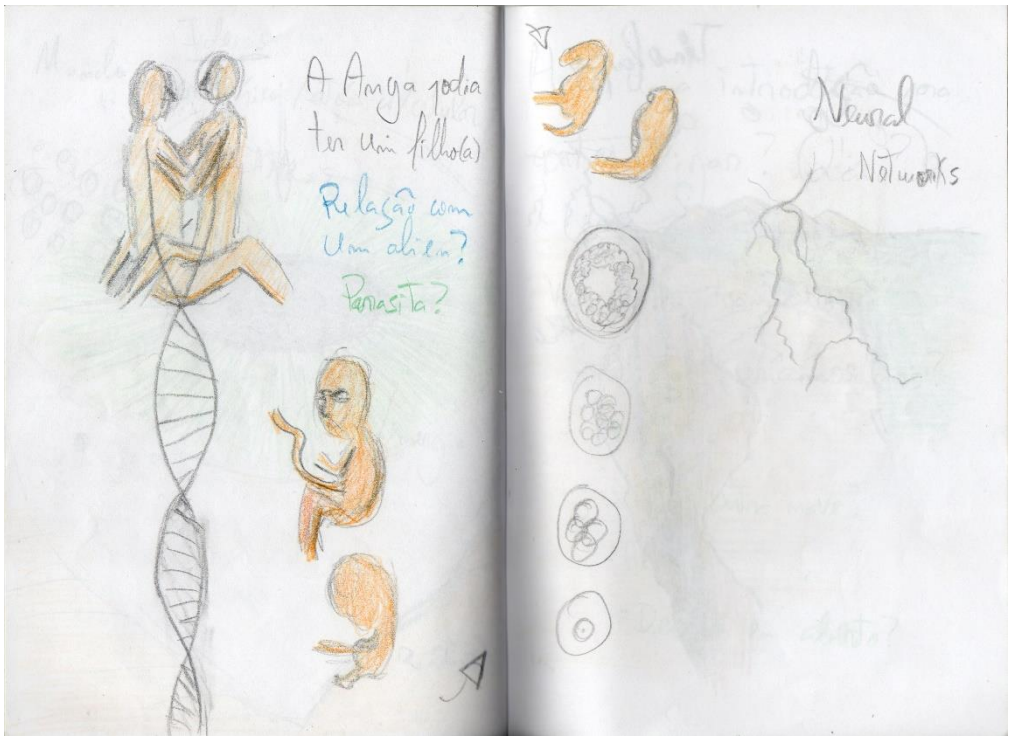
The mobile-360-2D group

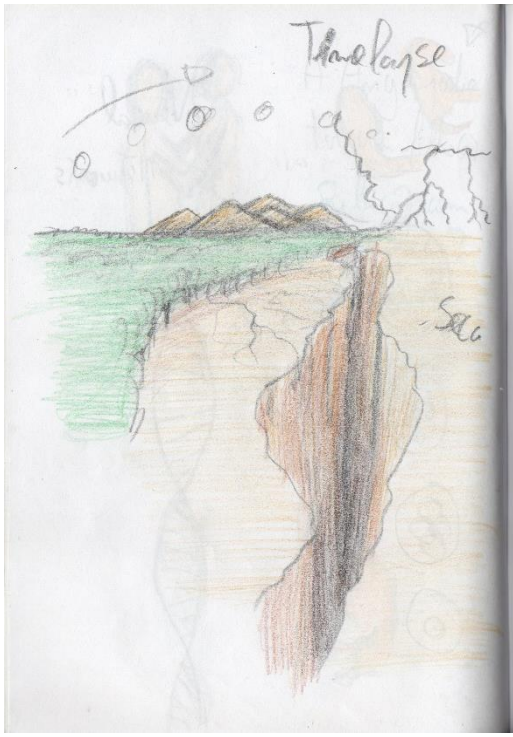
1. The test will be made in a room of the Department of Communication and Art of the University of Aveiro. In this local there will be the material needed for the visualization of the music video, the smartphone and the headphones, and the tools to disinfect the space and the objects being used by the users.
2. During the experience there should be only two people in the room: the participant and the researcher.
3. The researcher will explain to the volunteer all the procedures of the test.
4. Before visualizing the music video, the participant will answer a pre-questionnaire as to gather information characterizing him or herself. Further, in the pre-questionnaire there will be a consent form to authorize the recording of the session.
5. Having done this, the researcher will explain to the participant how to play the music video on the smartphone.
6. The participant will watch the music video.
7. Then, the volunteer will answer the post-test questionnaire with questions regarding the watching experience.
8. Having done the test, the participant will leave the room and the researcher will disinfect every object and the space for the next volunteer.

Appendix C – Concept art

In this appendix it is exposed the concept art for the music. This includes many ideas that did not went into the final project as they were though for the song *ATOM & EVE*, and some notes that were written in Portuguese.







Haver uma introdução para contextualizar? (d'ain?)

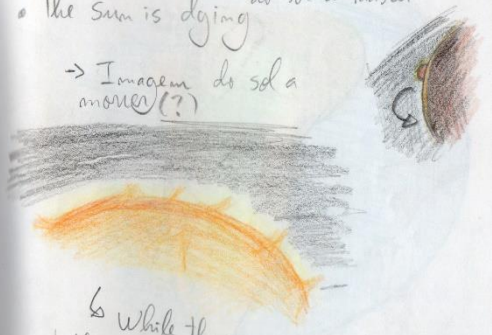
↳ Como se tivéssemos a ver uma transmissão

- Quem seríamos nós?
  - Atena?
  - Uma outra nave?
  - Alien?
  - Deixam em aberto?

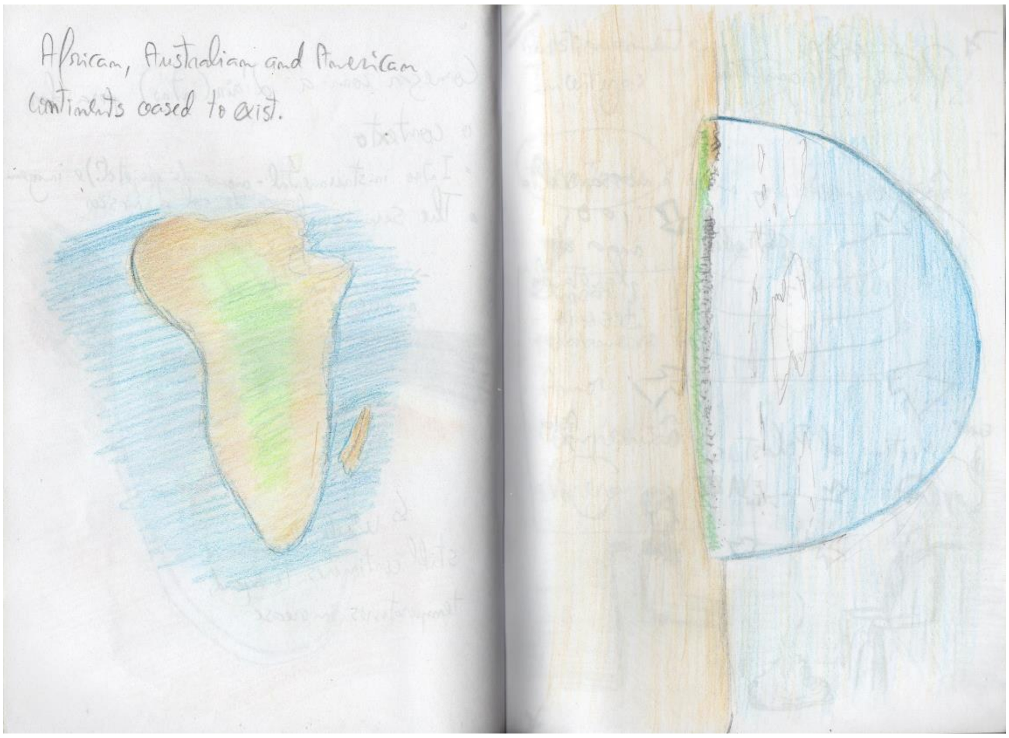
Começar com a d'ain (intro) para dar o contexto

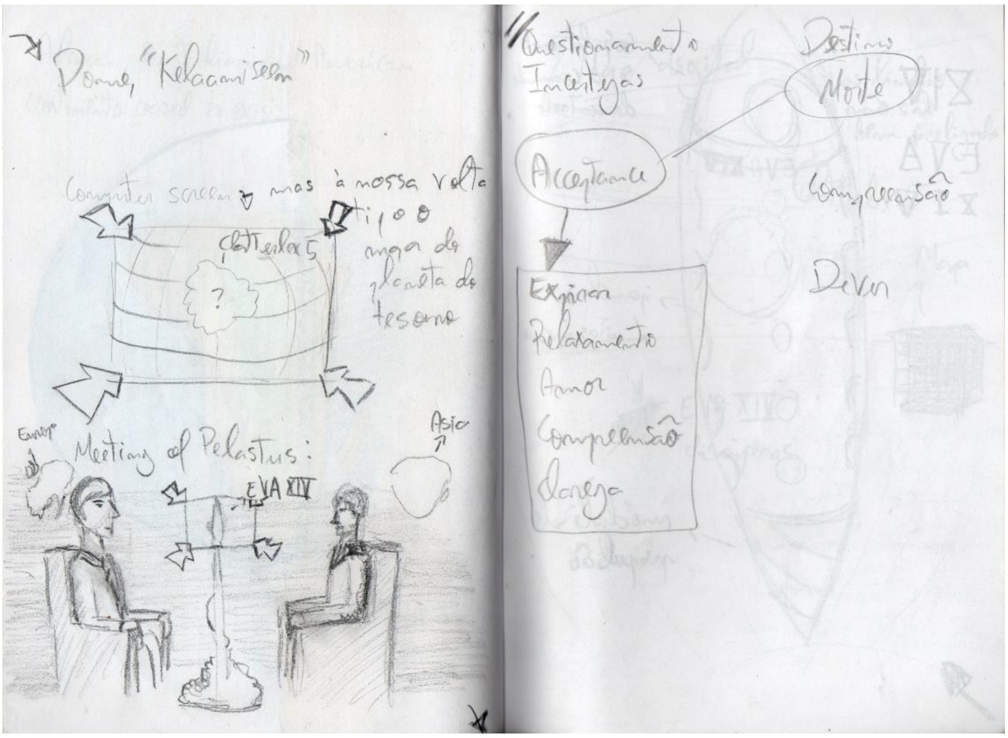
- Intro instrumental - ampliar do projeto(?) e imagem do sol a nascer
- The sun is dying

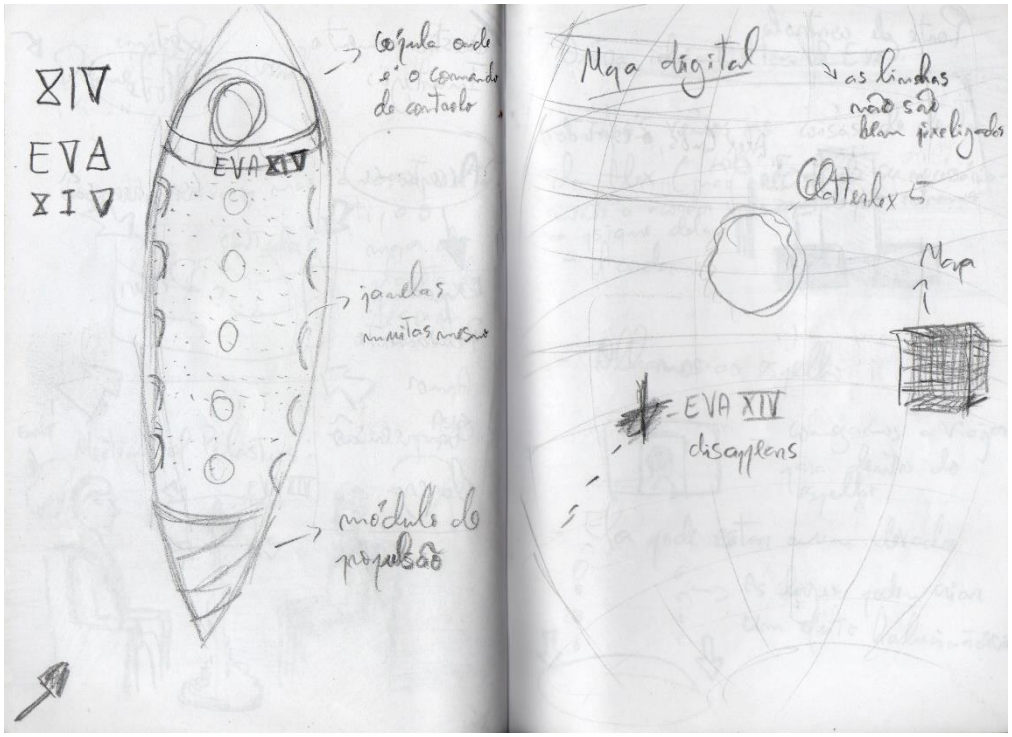
-> Imagem do sol a morrer(?)

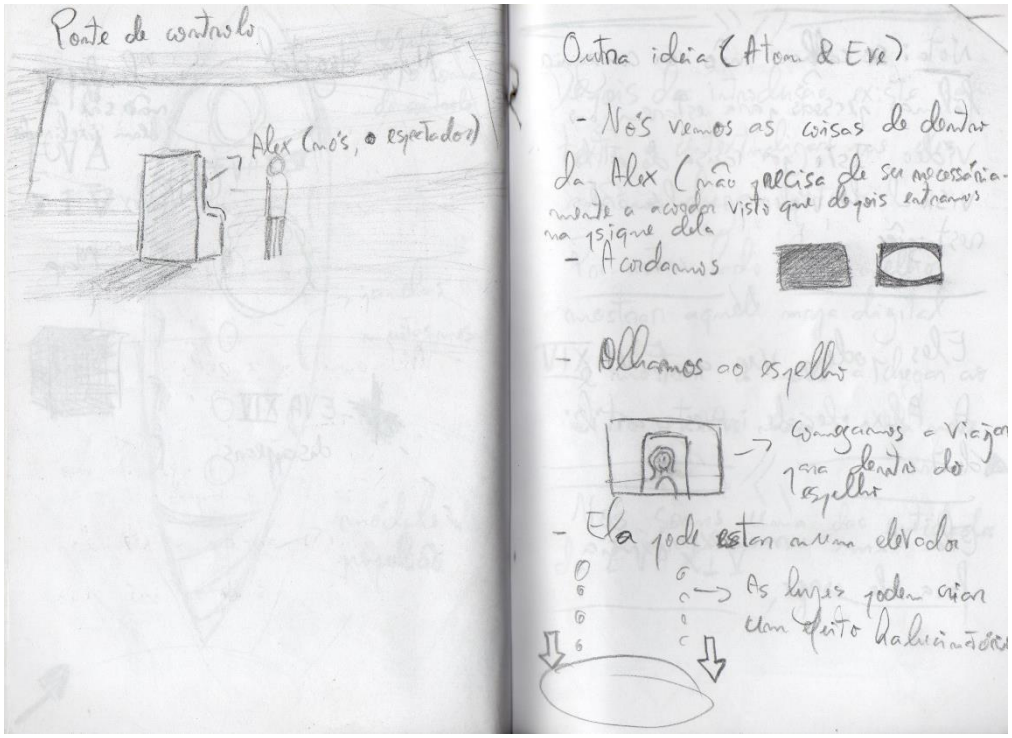


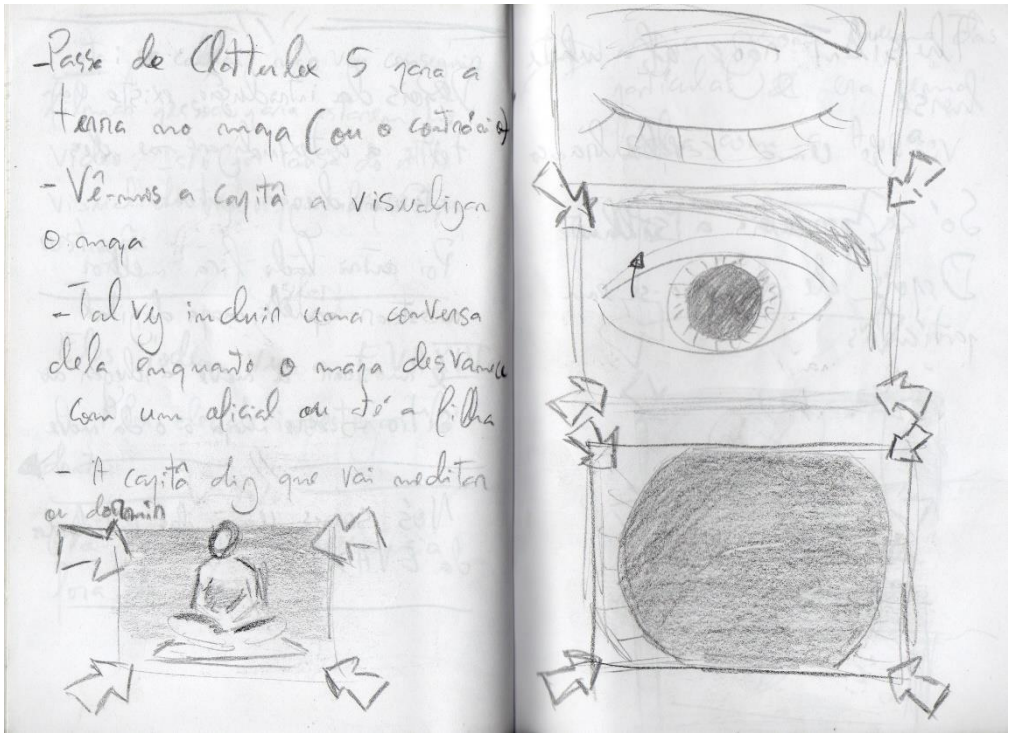
↳ While the sun still continues to expand, temperatures increase

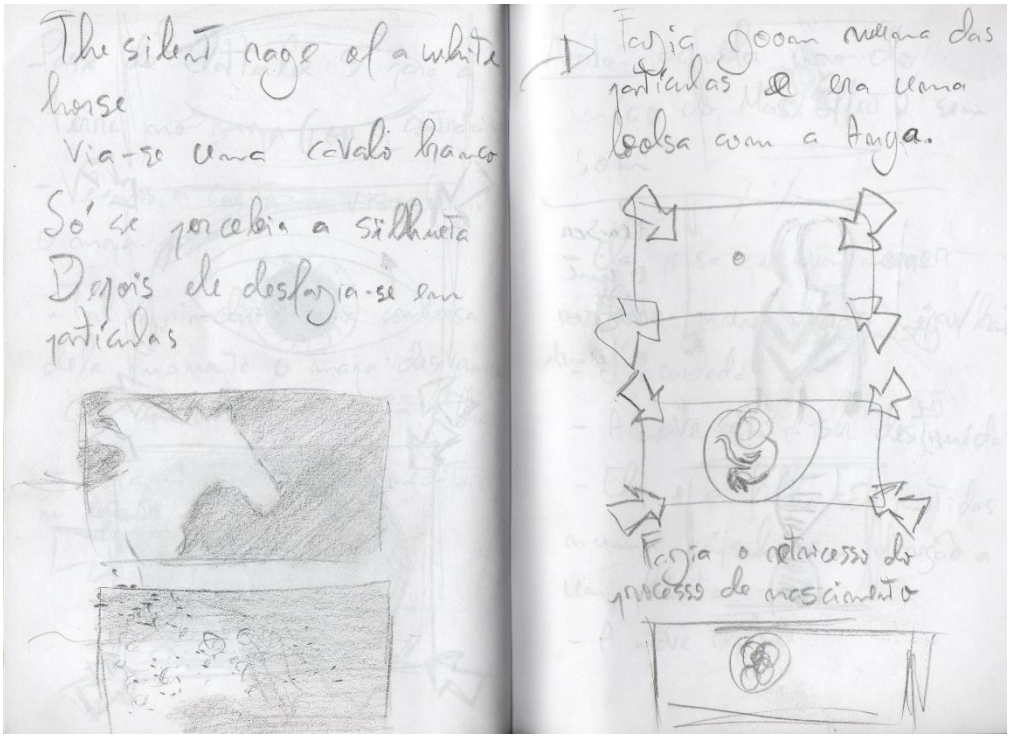

African, Australian and American continents ceased to exist.

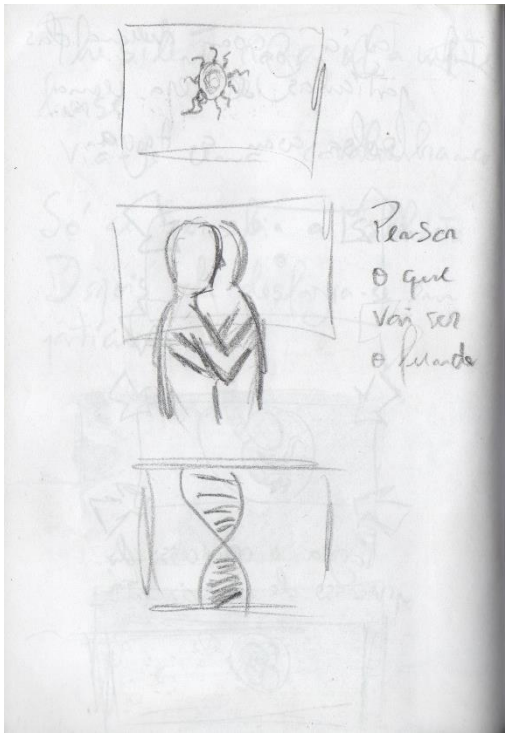

Computer screen
mas à nossa volta
Meeting of Pelastus:
EVA XIV
Asia
Questionamento
Incertezas
Destino
Morte
Acceptance
Compreensão
Relaxamento
Amor
Compreensão


EVA XIV
cápsula onde é o comando de contacto
janelas muitas mesmo
módulo de propulsão
Mapa digital
as linhas não são bem pixelizadas
Mapa
EVA XIV
desaparece


Ponte de comando
Alex (nós, o espetador)
Outra ideia (Atom & Eve)
- Nós vemos as coisas de dentro da Alex (não precisa de ser necessariamente a acordar visto que depois entramos na psique dela
- Acordamos
- Olhamos ao espelho
começamos a viagem para dentro do espelho
- Ela pode estar numa elevador
As luzes podem criar um efeito alucinatório

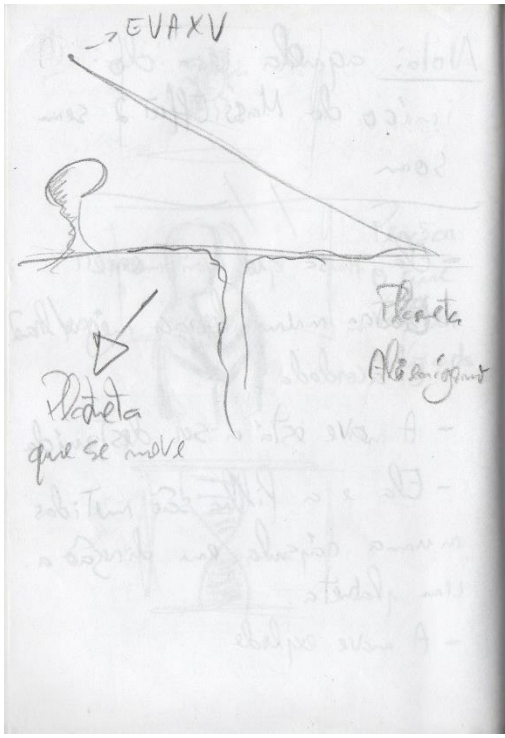

- Passe de Clotilde 5 para a
tarefa ao maya (ou o contrário)
- Vê-mos a capita a visualizar
o maya
- Talvez incluir uma conversa
dela enquanto o maya desvanece
com um aliado ou até a filha
- A capita diz que vai meditar
ou dormir


The silent rage of a white horse
Via-se uma cavalo branco
Só se percebia a silhueta
Depois de desfazia-se em partículas
Fazia jogar milhares das partículas e era uma bolsa com a fauna.
Fazia o retrocesso do processo de nascimento

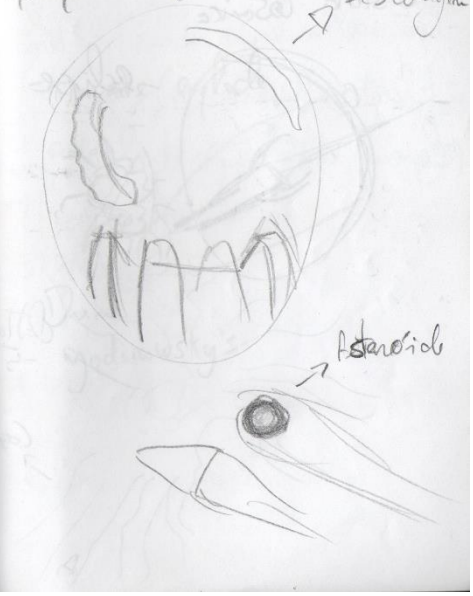


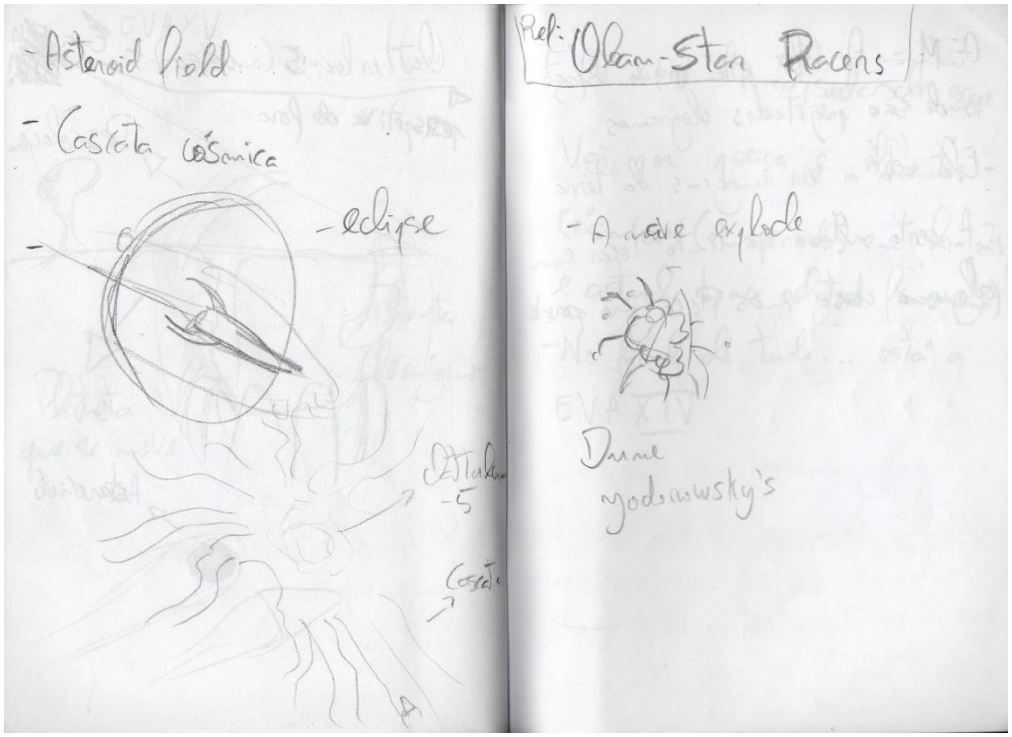
Nota: aquela cena do início do Mass Effect 2 sem som

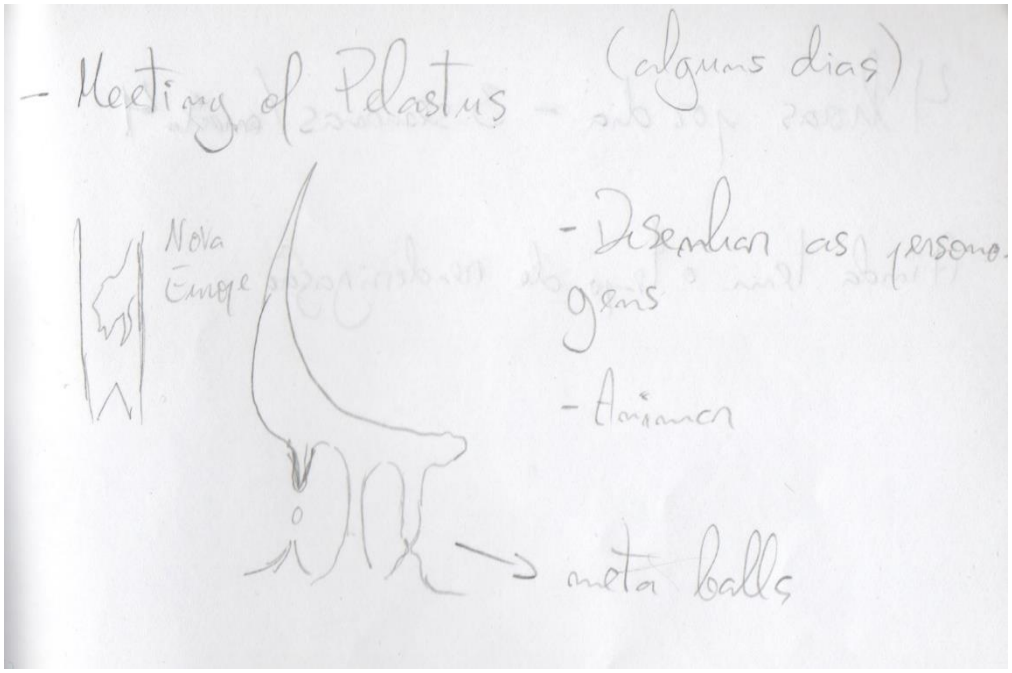
- Ela pensa que vai morrer
- Leva uma bala na cabeça
- É acordada
- A nave está a ser destruída
- Ela e a filha são metidas numa cápsula em direção a um planeta.
- A nave explode



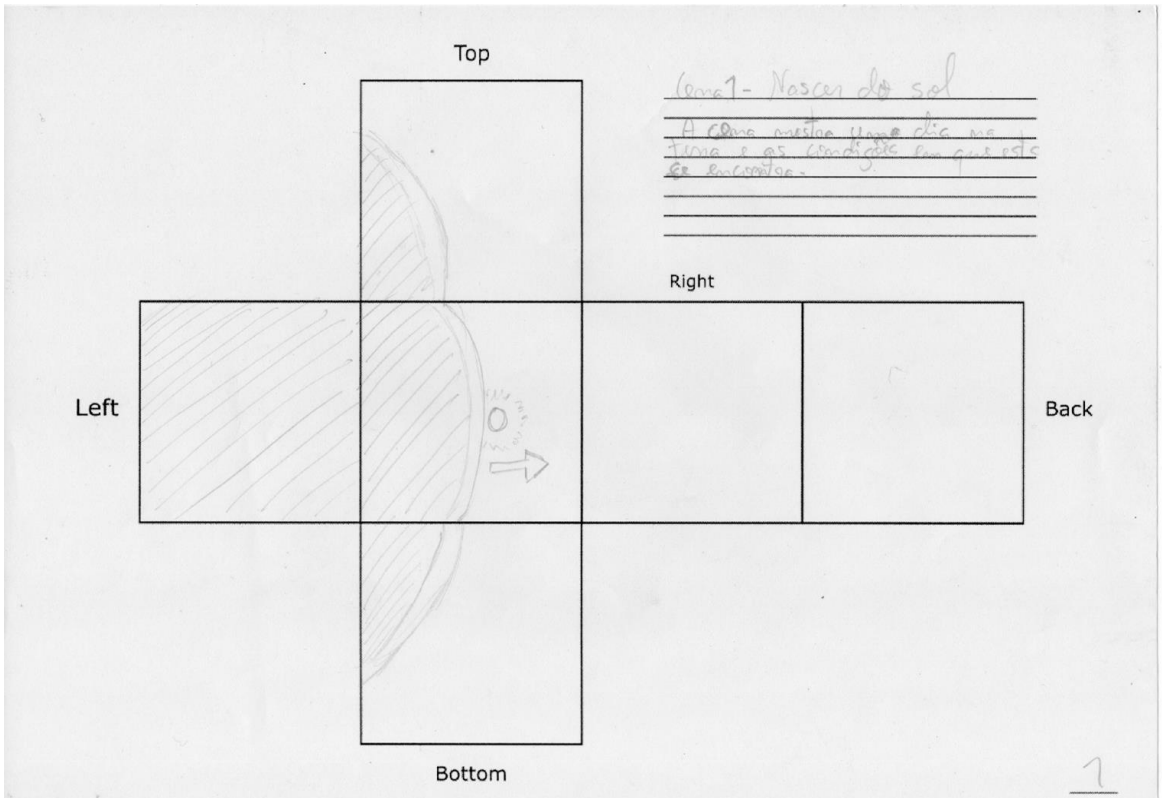
Detention-5 (música) - É a perspetiva do Poe

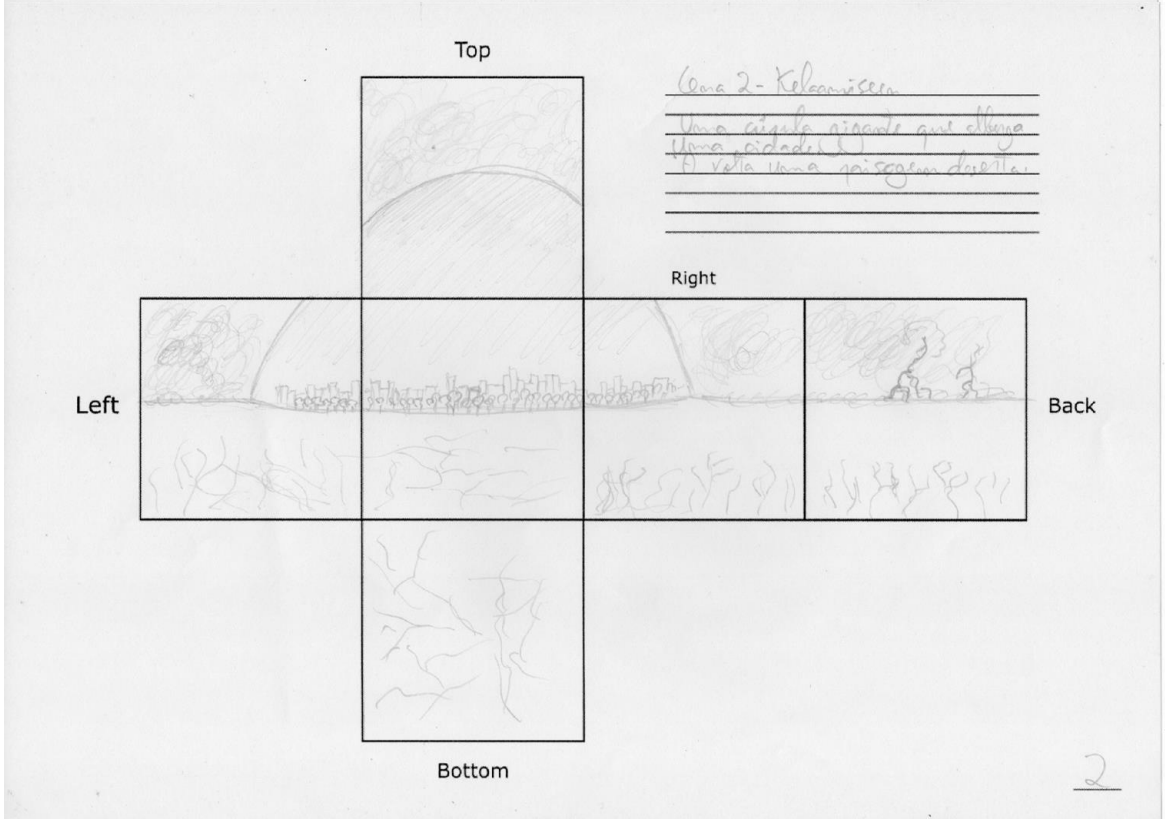


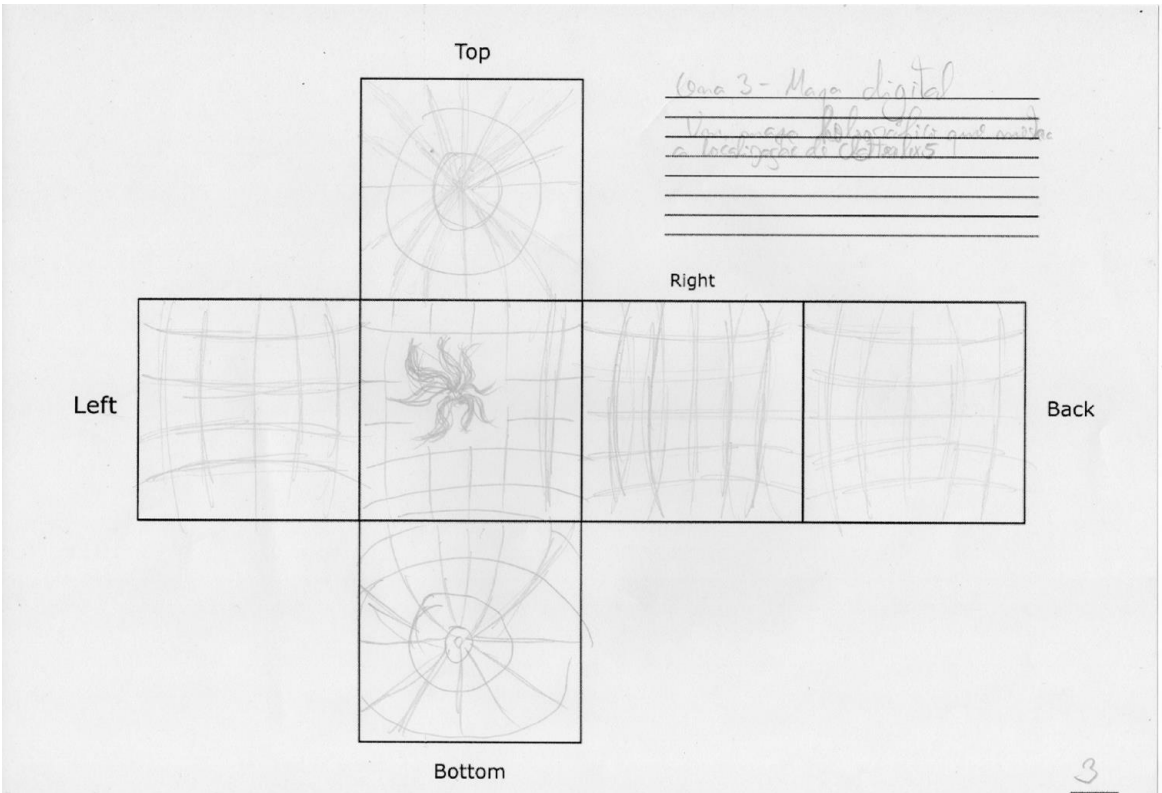

- Asteroid field
- Castela cósmica
- eclipse
-
-5
Ref: Ocean-Star Racers
- A nave explode
Dunne
godsnowsky's


- Meeting of Pdastus
(alguns dias)
Nova
Europe
- Desenhar as personagens
- Aniamar
meta balls

Appendix D – Music Video Storyboard



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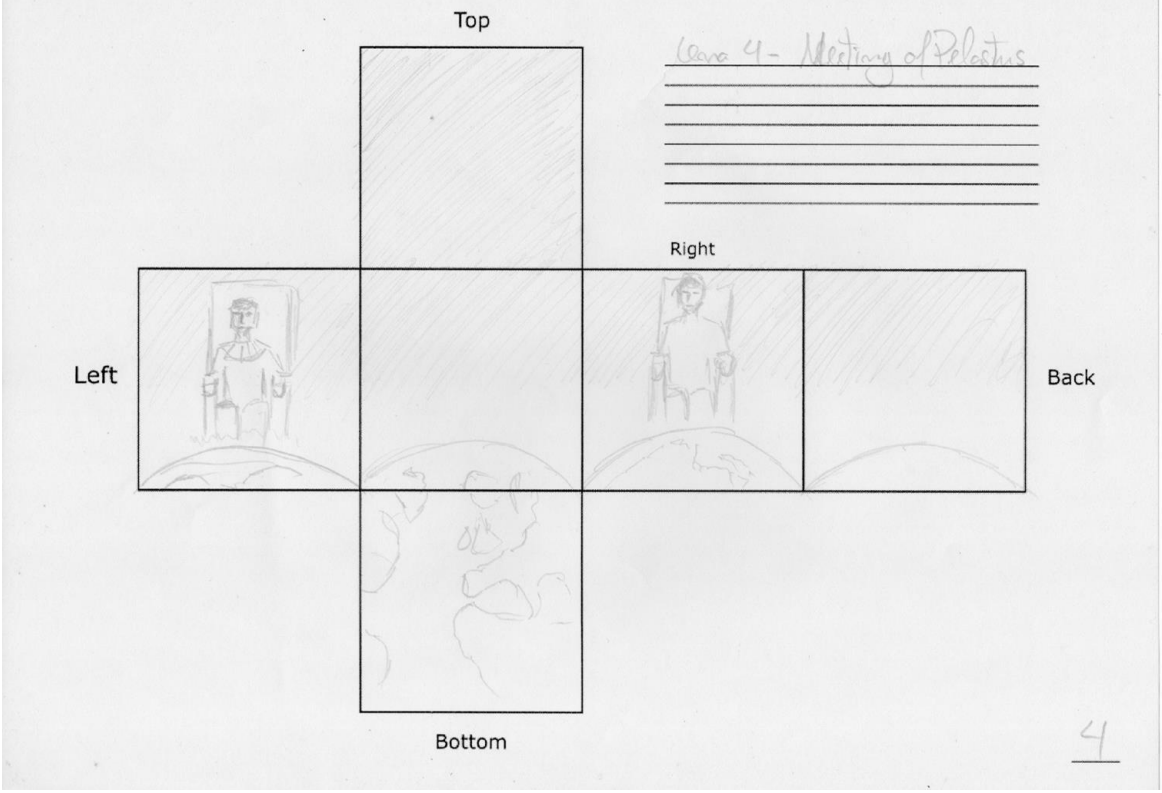
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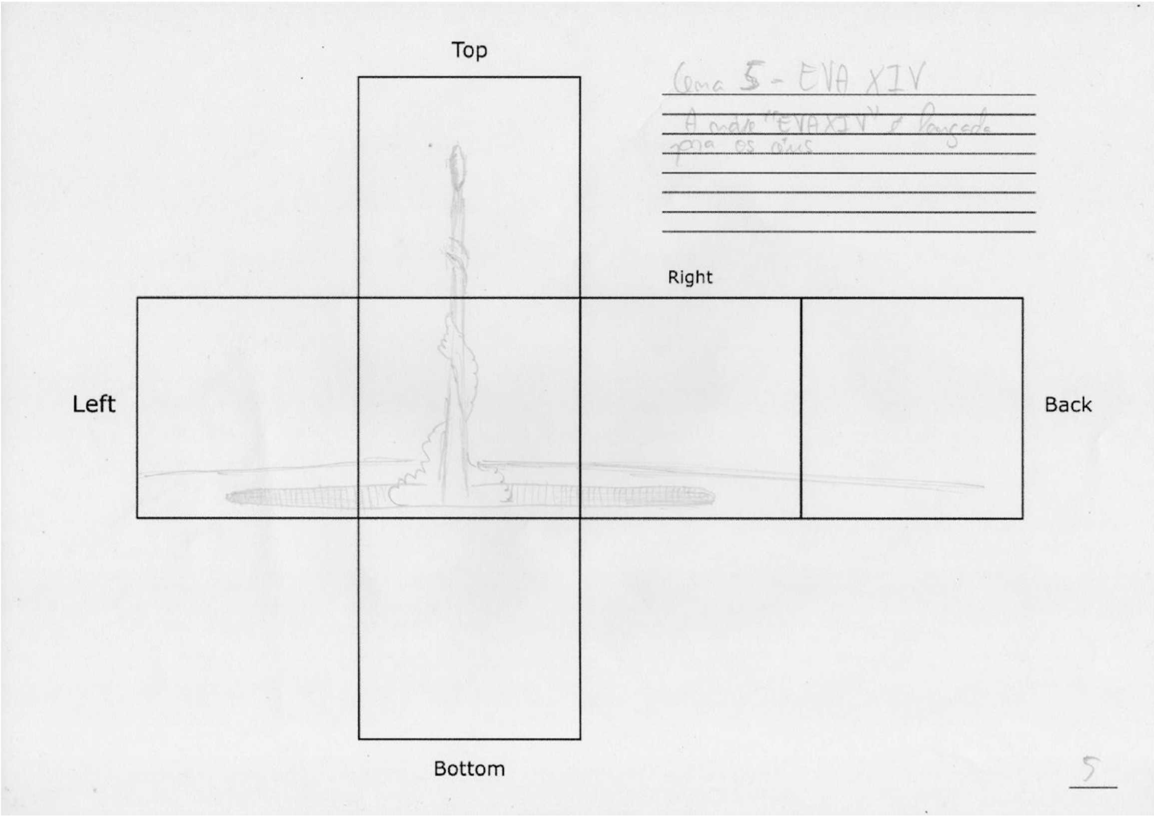
Top
Cena 5 - EVA XIV
A nave "EVA XIV" é lançada para os céus
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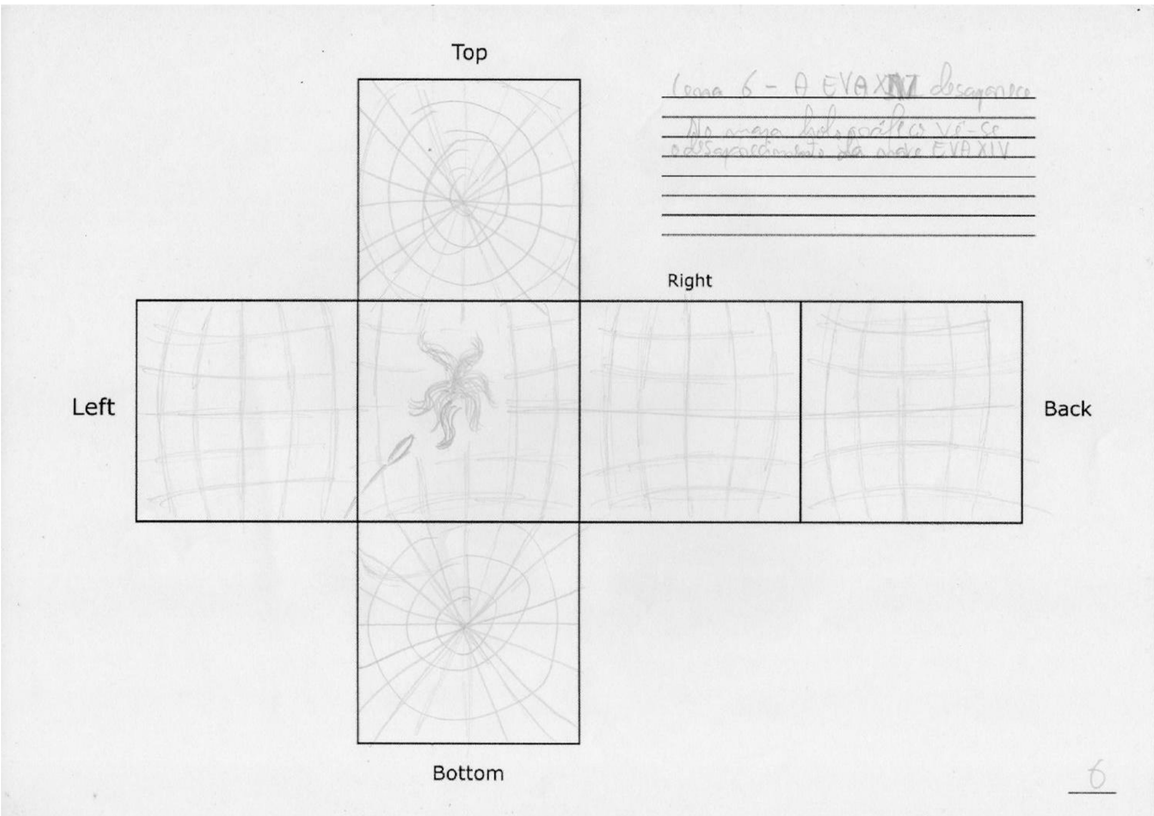
Top
Cena 6 - A EVA XIV desaparece
No mapa holográfico vê-se o desaparecimento da nave EVA XIV
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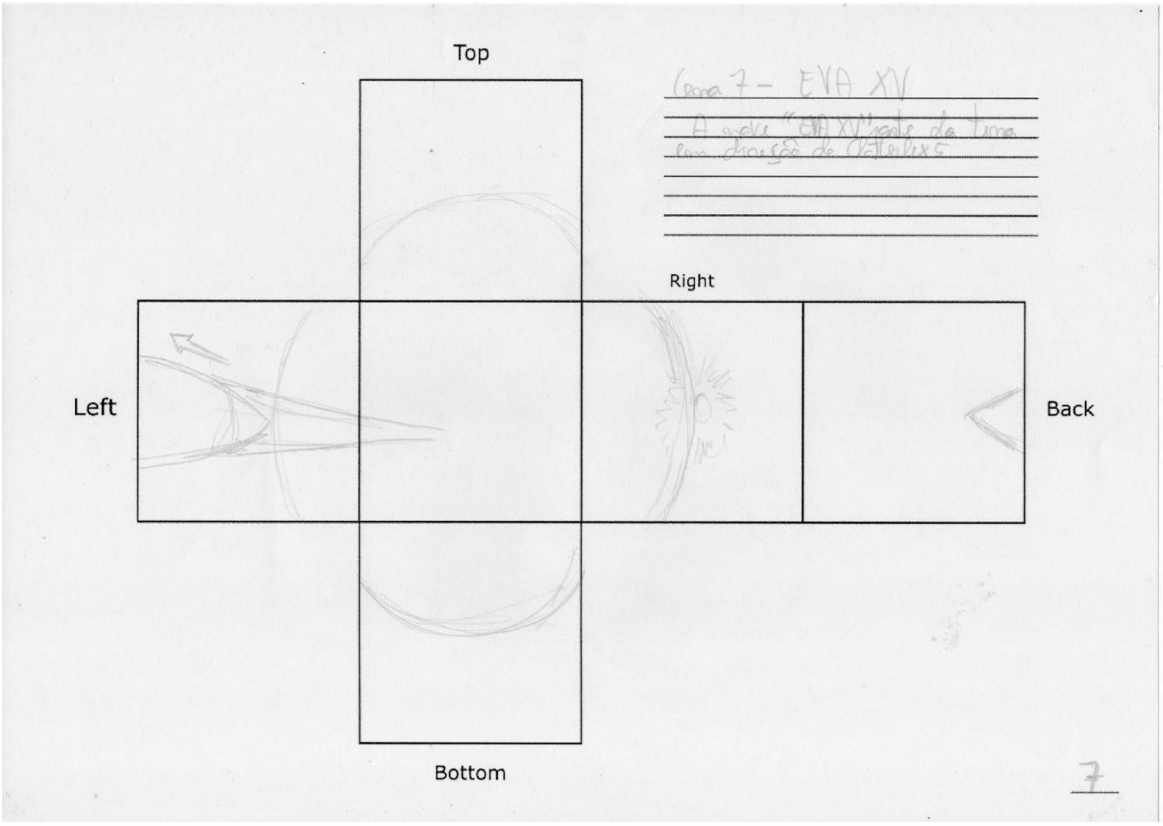
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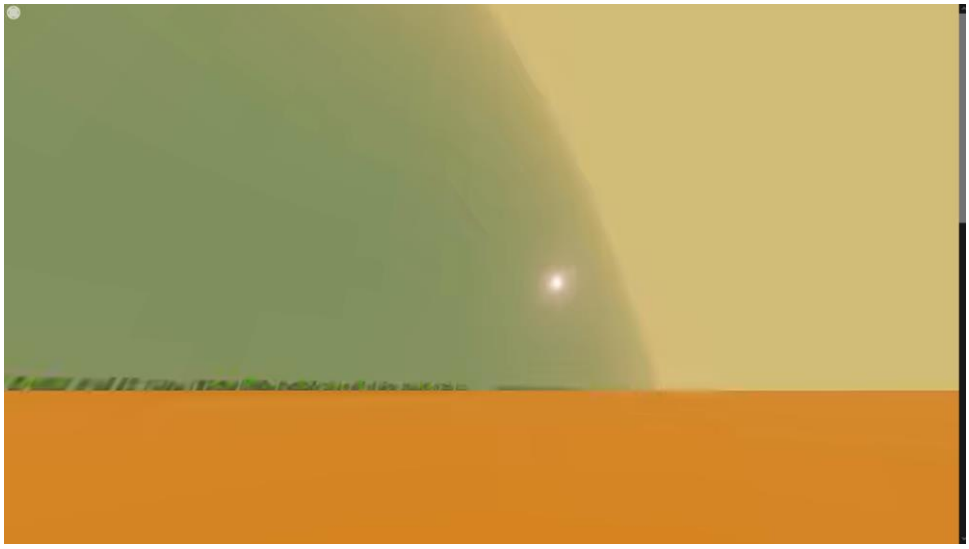
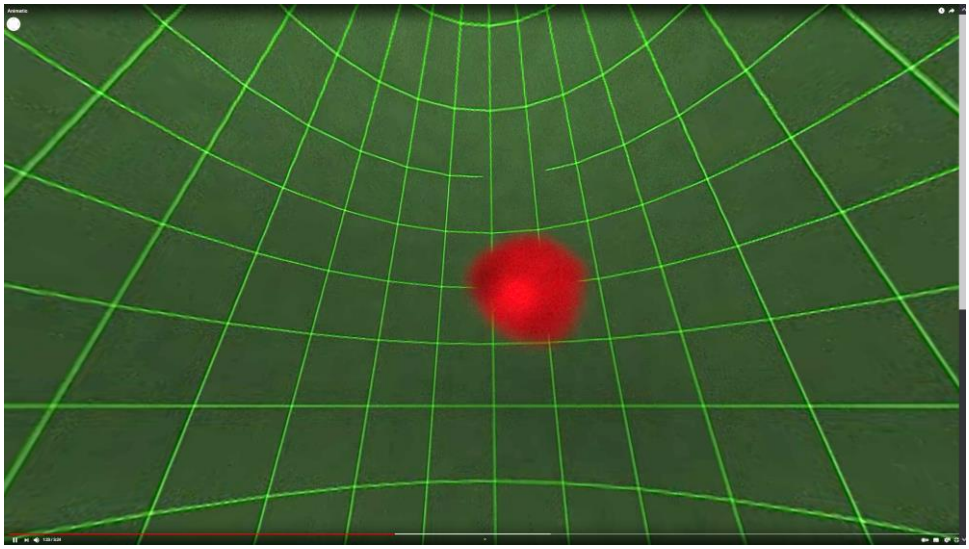
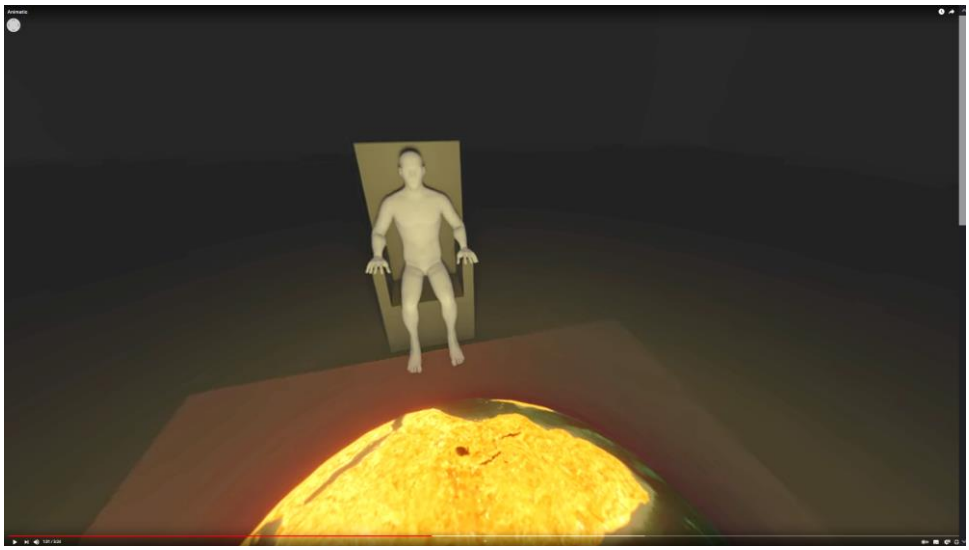
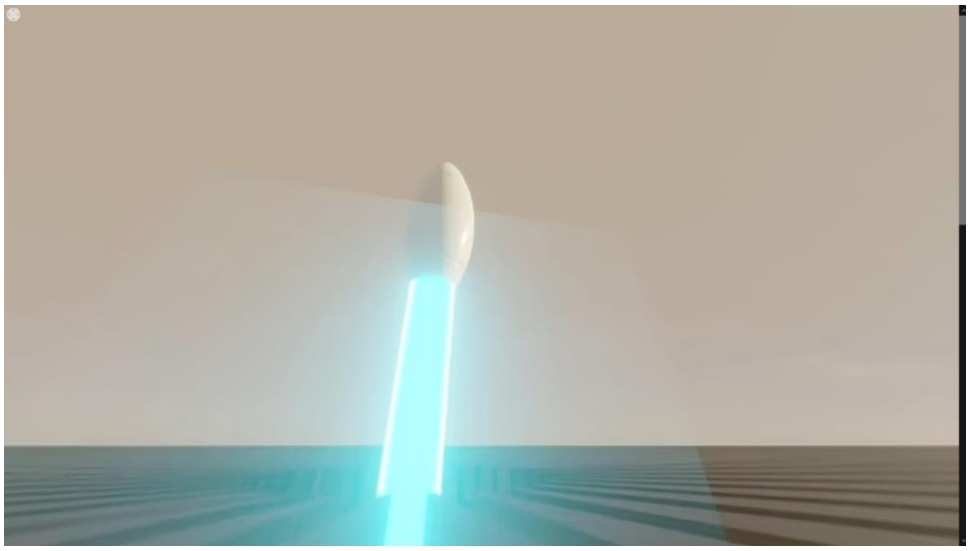
Appendix E – The animatic

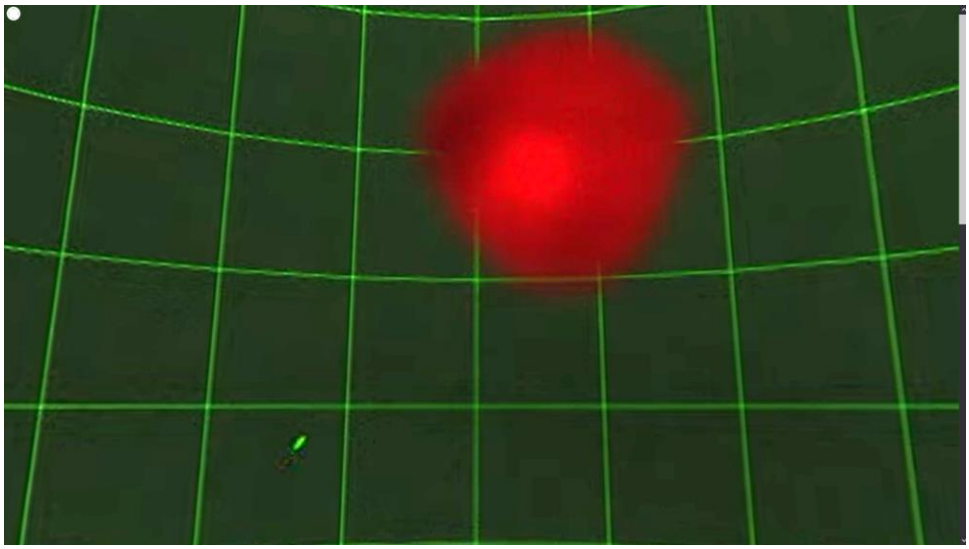
In this appendix there will be presented screenshots of the animatic

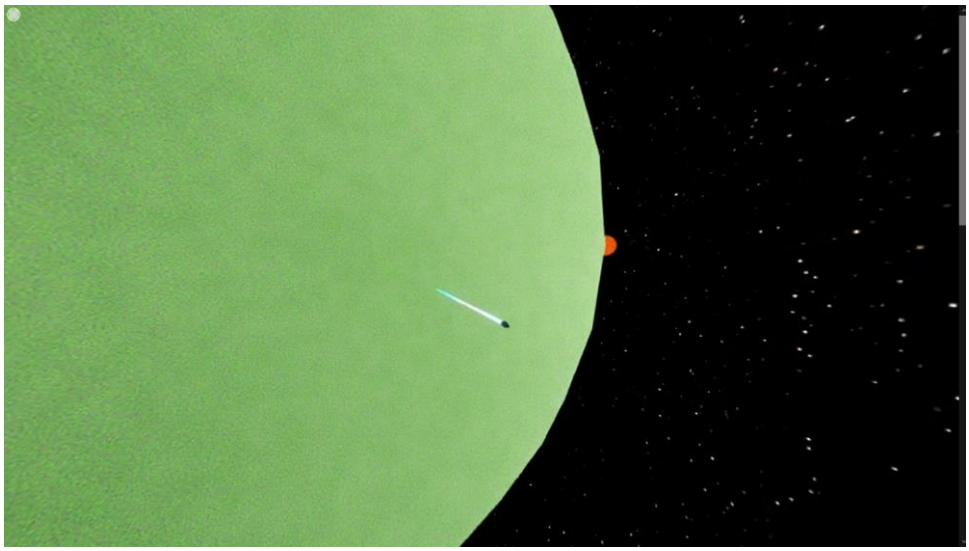












Appendix F – Pre-test questionnaire in English

Pre-test questionnaire (English)

The present questionnaire was developed in the context of a dissertation project in Multimedia Communication in the Department of Communication and Arts of the University of Aveiro, with the advisership of Professor Doctor Mário Vairinhos.

Secção 1 ...

Consent Form

Do you consent with the recording of image and sound, which has the only purpose of helping with the process of information gathering for the current investigation? The recordings will not be shared or published, as they will only be used for academic means. Furthermore, the only people with access to them are the investigator and his advisor.

1. *

- ○ Yes
- ○ No

II - Characterization of the inquired

2. Age *

The value must be a number

3. Genre *

- ○ Feminine
- ○ Masculine
- ○ Other
- ○ I prefer not to say

III - Virtual Reality

4. Have you experimented Virtual Reality? *

- ( ) Yes
- ( ) No

III - Virtual Reality

This section refers to the people who have had experience with Virtual Reality

5. If yes, what type of content have you experimented in Virtual Reality? *

- [ ] Videogames (e.g. Beat Saber)
- [ ] Music Videos
- [ ] Films/tvshows (e.g. Netflix)
- [ ] Creativity apps (e.g. Tilt Brush)
- [ ] Educational apps (e.g. Anne Frank House VR)
- [ ] Virtual tours (e.g. Google Earth VR)
- [ ] Other

6. Did you experiment in your equipment? *

- ( ) Yes
- ( ) No

7. If yes, what is your equipment? *

- [ ] Oculus Go
- [ ] Playstation
- [ ] Google Cardboard
- [ ] Oculus Quest
- [ ] Vive
- [ ] Oculus Rift
- [ ] Samsung VR
- [ ] Nintendo Labo VR Kit
- [ ] Outro

8. Which aspects of Virtual Reality do you like more? *

- [ ] Visual immersion
- [ ] Sonic immersion
- [ ] Stereoscopy (images with 3D depth)
- [ ] Interaction
- [ ] Story
- [ ] Other

9. How frequently do you experience Virtual Reality? *

	Never	Annualy	Montly	Weekly	Daily
	○	○	○	○	○

III - Virtual Reality

This section refers to those who haven't had experience with Virtual Reality

10. What are the reasons why you haven't experimented Virtual Reality? *

- [ ] I don't have the equipment
- [ ] The equipment is expensive
- [ ] There was never the opportunity
- [ ] I never had the curiosity
- [ ] There isn't much content
- [ ] I'm prone to motion sickness, vertigo and tiredness
- [ ] Other

IV - Electronic Competencies

11. Do you have a personal computer? *

- ( ) Yes
- ( ) No

12. If yes, how frequently do you use it? *

	Never	Annualy	Montly	Weekly	Daily
	( )	( )	( )	( )	( )

13. Do you have a smartphone? *

- ( ) Yes
- ( ) No

14. If yes, how frequently do you use it? *

	Never	Annualy	Monthly	Weekly	Daily
	○	○	○	○	○

15. How frequently do you play videogames? *

	Never	Annualy	Monthly	Weekly	Daily
	○	○	○	○	○

16. How frequently do you watch films? *

	Never	Annualy	Monthly	Weekly	Daily
	○	○	○	○	○

V - Music Videos

17. Do you like to watch music videos? *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

18. How frequently do you watch music videos? *

	Never	Annualy	Monthly	Weekly	Daily
	○	○	○	○	○

19. The music videos that I watch by my own initiative *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

VI - Science Fiction

20. Do you like to watch science fiction films? *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

21. How frequently do you watch science fiction films?

	Never	Annualy	Monthly	Weekly	Daily
	○	○	○	○	○

VII - Electronic Music

22. Do you like to listen to electronic music? *

	Completely Disagree	Disagree	Neutro	Agree	Completely Agree
	○	○	○	○	○

23. If yes, how frequently?

	Never	Annualy	Monthly	Weekly	Daily
	○	○	○	○	○

24. Do you play or have played a musical instrument? *

- ○ Yes
- ○ No

25. Are you in, or have you been in a musical band? *

- ( ) Yes
- ( ) No

26. If yes, did the band have a music video?

- ( ) Yes
- ( ) No

27. Of the following musical genres do you like any? *

- [ ] Electronic
- [ ] Rock
- [ ] Experimental
- [ ] Classical
- [ ] Indie
- [ ] Ambient
- [ ] Fado
- [ ] Other

Appendix G – Pre-test questionnaire in Portuguese

This is the original Portuguese version of the pre-test questionnaire

I - Formulário de Consentimento

Consente na recolha de imagens e som em vídeo com o único propósito de auxiliar no processo de recolha de informação para a investigação em curso? As captações não serão partilhadas ou publicadas, e serão somente ser usadas para fins académicos, bem como só terão acesso às mesmas o responsável pela investigação e o seu orientador.

1. *

- ○ Sim
- ○ Não

II - Caracterização do Inquirido

2. Idade *

The value must be a number

3. Género *

- ○ Feminino
- ○ Masculino
- ○ Outro
- ○ Prefiro não dizer

III - Realidade Virtual

Esta secção é referente para as pessoas que têm experiência com Realidade Virtual

5. Se sim, que tipo de conteúdo já experimentou em Realidade Virtual? *

- [ ] Jogos (ex. Beat Saber)
- [ ] Videoclips
- [ ] Filmes/séries (Netflix)
- [ ] Aplicações de creatividade (Tilt Brush)
- [ ] Aplicações educacionais (Anne Frank House VR)
- [ ] Visitas virtuais (Google Earth VR)
- [ ] Other

6. Experimentou em equipamento seu? *

- ( ) Sim
- ( ) Não

7. Se sim, qual é o equipamento que tem? *

- [ ] Oculus Go
- [ ] Playstation
- [ ] Google Cardboard
- [ ] Oculus Quest
- [ ] Vive
- [ ] Oculus Rift
- [ ] Samsung VR
- [ ] Nintendo Labo VR Kit
- [ ] Other

8. Que aspetos da experiência de Realidade Virtual gosta mais? *

- [ ] Imersão visual
- [ ] Imersão sonora
- [ ] Estereoscopia (imagem com profundidade 3D)
- [ ] Interação
- [ ] Narrativa
- [ ] Other

9. Costuma experiênciar a Realidade Virtual, com que frequência? *

	Nunca	Anualmente	Mensalmente	Semanalmente	Diariamente
	○	○	○	○	○

III - Realidade Virtual

Esta secção é referente para quem não tem experiência com Realidade Virtual

10. Quais as razões porque não experimentou Realidade Virtual? *

- [ ] Não possuo equipamento
- [ ] O equipamento é caro
- [ ] Nunca surgiu uma oportunidade
- [ ] Nunca tive curiosidade
- [ ] Não existem muitos conteúdos
- [ ] Sou propenso/a enjoo, vertigens, cansaço
- [ ] Other

IV - Competências eletrónicas

11. Tem computador pessoal? *

- ○ Sim
- ○ Não

12. Se sim, quão frequentemente o usa? *

	Nunca	Anualmente	Mensalmente	Semanalmente	Diariamente
	○	○	○	○	○

13. Tem um smartphone? *

- ○ Sim
- ○ Não

14. Se sim, com que frequência o usa? *

	Nunca	Anualmente	Mensalmente	Semanalmente	Diariamente
	○	○	○	○	○

15. Com que frequência joga videojogos? *

	Nunca	Anulamente	Mensalmente	Semanalmente	Diariamente
	○	○	○	○	○

16. Com que frequência assiste a filmes? *

	Nunca	Anualmente	Mensalmente	Semanalmente	Diariamente
	○	○	○	○	○

V - Videoclips

17. Gosta de ver videoclips? *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

18. Costuma visualizar videoclips com que frequência? *

	Nunca	Anualmente	Mensalmente	Semanalmente	Diariamente
	○	○	○	○	○

19. Dos que assisto procuro visualizar por iniciativa própria *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamene
	○	○	○	○	○

VI - Ficção científica

20. Gosta de assistir a filmes de ficção científica? *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

21. Costuma assistir filmes de ficção científica com que frequência?

	Nunca	Anualmente	Mensalmente	Semanalmente	Diariamente
	○	○	○	○	○

VII - Música eletrónica

22. Gosta de ouvir música eletrónica? *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

23. Se sim, com que frequência?

	Nunca	Anualmente	Mensalmente	Semanalmente	Diariamente
	○	○	○	○	○

24. Toca ou já tocou algum instrumento musical? *

- ○ Sim
- ○ Não

25. Já esteve ou está em algum grupo musical? *

- ( ) Sim
- ( ) Não

26. Se sim, o grupo musical possui algum videoclip? *

- ( ) Sim
- ( ) Não

27. Dos seguintes géneros musicais gosta de algum? *

- [ ] Eletrónica
- [ ] Rock
- [ ] Experimental
- [ ] Erudita
- [ ] Indie
- [ ] Ambiente
- [ ] Fado
- [ ] Other

Appendix H – Post-test questionnaire in English

In this appendix it

I - Story and themes

This part of the questionnaire is focused on the aspect of the story and the themes of the music video

1. I was curious about the story *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

2. I did not understand the story *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

3. Briefly describe the story (maximum of 5 lines) *

Enter your answer

4. Would you like to rewatch the music video? *

- ( ) Yes
- ( ) No

5. If yes, why?

- [ ] I felt pleased with the story
- [ ] I liked the music
- [ ] I liked the sensation of being in the virtual environment
- [ ] I liked the environments
- [ ] I liked the story
- [ ] There were details of the story that I didn't understood
- [ ] Other

6. If not, why?

- [ ] I felt nauseous
- [ ] I felt dizzy
- [ ] I felt anxious
- [ ] I felt fear
- [ ] I did not like the music
- [ ] I found it borring
- [ ] I did not like the virtual environment
- [ ] I did not like the music
- [ ] I felt tired
- [ ] Other

7. In case you have marked "There were details of the story that I didn't understood" in the last question, which were the details that you felt were lacking in the music video?

Enter your answer

8. I did not feel emotionally involved in the story *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

9. I would like to know more about the virtual world presented in the music video *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

10. I identified myself with the themes and the story of the music video *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

II - Music

This part of the questionnaire focuses on the sonic aspect of the music video

11. I liked the music *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

12. I could understand that the sounds were coming from different locations in space *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

13. Do you think that the music video fits the music? *

- ○ Yes
- ○ No

14. If not, why? *

Introduza a sua resposta

15. Chose the options that you think are most adequate
The music left you feeling: *

- [ ] Nervous
- [ ] Happy
- [ ] Sad
- [ ] Scared
- [ ] Anxious
- [ ] Bored
- [ ] Excited
- [ ] Confused
- [ ] Tired
- [ ] Outro

III - Visual

This part of the questionnaire focuses on the visual aspect of the music video

16. I felt that the visual elements were consistent *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

17. I did not like the virtual environment *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

18. I felt that the scale of some objects was not adequate *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

19. I felt three-dimensional depth between the objects *

	Completely Disagree	Discordo	Neutral	Concordo	Completely Agree
	○	○	○	○	○

20. I felt that the scenery was realistic *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

21. Choose the options that you think are most adequate
How would you classify the visual environment? *

- [ ] Boring
- [ ] Fun
- [ ] Sad
- [ ] Frightening
- [ ] Relaxing
- [ ] Strange
- [ ] Disgusting
- [ ] Confusing
- [ ] Mysterious
- [ ] Melancholic
- [ ] Outro

IV - Immersion

This part of the questionnaire focuses on the immersive aspect of the experience

22. I felt immersed in the VR space *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

23. I felt that the music video was something I was experiencing instead of something that I was visualizing *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

24. At a certain point I felt disconnected from the narrative *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

25. The music video held my attention *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

26. How long do you think the music video lasted? *

O valor tem de ser um número

V - Interaction

This part of the questionnaire focuses on the aspects related with interaction, which is one of the fundamental aspects of Virtual Rerality.

27. I woud like to have physical elements on the virtual environment with which I could interact *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

28. I would have liked to have the ability to travel through the virtual environments seen *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

29. I would have liked to have the ability to alternate between the environments seen *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

30. I would have liked to have some influence on the direction of the narrative *

	Completely Disagree	Disagree	Neutro	Agree	Completely Agree
	○	○	○	○	○

31. I would have liked to choose which scenery to see *

	Completely Disagree	Disagree	Neutro	Agree	Completely Agree
	○	○	○	○	○

VI - Emotional and physiological

This part of the questionnaire focuses on what you have felt physical and emotionally during the experience, while also having in account common side effects on Virtual Reality
Esta parte do questionário foca-se no que sentiu fisicamente e emocionalmente durante a experiência, tendo também em conta efeitos secundários que são comuns com experiências em Realidade Virtual

32. Senti-me desconfortável por estar desligado do mundo físico *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

33. In case you have answered afirmatively mark the respective reasons why:

- [ ] I felt exposed
- [ ] I felt judged
- [ ] I felt observed
- [ ] I felt unprotected
- [ ] Other

34. I felt nervous with the experience *

	Completely Disagree	Disagree	Neutral	Concordo	Completely Agree
	○	○	○	○	○

35. I felt sad during the experience *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

36. I felt scared with the experience *

	Completely Disagree	Discordo	Neutral	Concordo	Completely Agree
	○	○	○	○	○

37. I felt anxious with the experience *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

38. I felt bored with the experience *

	Completely Disagree	Disagree	Neutral	Concordo	Concordo completamente
	○	○	○	○	○

39. I felt excited with the experience *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

40. I felt confused with the experience *

	Discordo completamente	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

41. I felt tired during the experience *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

42. I feared having done something wrong *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

43. I felt headaches during the experiences *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

44. I felt tired during the experience *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

45. I felt nauseous during the experience *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

46. I felt dizzy during the experience *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

47. I felt vertigo during the experience *

	Completely Disagree	Disagree	Neutral	Agree	Compeltely Agree
	○	○	○	○	○

VII - The Experience

This part of the questionnaire focuses on the experience of seeing the music video as an whole

48. Did you felt that something was missing? *

- Yes
- No

49. If yes, could you describe it? *

Enter your answer

50. I felt that I had to make an effort to pay attention to everything *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree

51. Did you felt the need to stop the reproduction of the music video at any point? *

- ○ Yes
- ○ No

52. If yes, why? *

- ☐ I felt nervous
- ☐ I felt sad
- ☐ I felt scared
- ☐ I felt anxious
- ☐ I felt bored
- ☐ I felt confused
- ☐ I felt tired
- ☐ I felt headaches
- ☐ I felt tired from my eyesight
- ☐ I felt nauseated
- ☐ I felt dizzy
- ☐ I felt vertigo

53. I would like if the music video had a sequence in the future *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

54. I would like to see similar music videos by other bands *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

55. Did you have a preference for the visual or sonic aspect of the music video? *

- ○ Sound
- ○ Visual

56. In your opinion which were the strong points of your experience? *

Enter your answer

57. In your opinion which were the weak points of your experience? *

Enter your answer

58. Overall I felt satisfied with the experience *

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
	○	○	○	○	○

Appendix I – Post-test questionnaire in Portuguese

This is the original Portuguese version of the pre-test questionnaire

I - História e Temas

Esta parte do questionário foca-se no aspeto da história e dos temas do videoclip

1. Senti curiosidade pela história *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

2. Não compreendi a história *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

3. Descreva sucintamente a história (máx 5 linhas) *

Enter your answer

4. Gostaria de visualizar novamente o videoclip? *

- ( ) Sim
- ( ) Não

5. Se sim, quais as razões? *

- [ ] Senti prazer com a experiência
- [ ] Gostei da música
- [ ] Gostei da sensação de estar no ambiente virtual
- [ ] Gostei dos espaços representados
- [ ] Gostei da história
- [ ] Houve detalhes da história que não compreendi
- [ ] Other

6. Se não, quais as razões? *

- [ ] Senti-me enjoado/a
- [ ] Senti tonturas
- [ ] Senti ansiedade
- [ ] Senti medo
- [ ] Não gostei da história
- [ ] Achei aborrecido
- [ ] Não gostei do ambiente visual
- [ ] Não gostei da música
- [ ] Senti cansaço
- [ ] Other

7. Caso tenha respondido "Houve detalhes da história que não compreendi" na última pergunta, quais os detalhes que acha que falta no videoclip?

Enter your answer

8. Não me senti emocionalmente envolvido/a na história *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

9. Gostaria de conhecer mais sobre o mundo virtual apresentado no videoclip *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

10. Identifiquei-me com a história/temas retratados *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

II - Música

Esta parte do questionário foca-se no aspeto sonoro do videoclip

11. Gostei da música *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

12. Consegui perceber que os sons vinham de diferentes localizações no espaço *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

13. Acha que o videoclip se enquadrou na música? *

- ○ Sim
- ○ Não

14. Se não, porquê? *

Enter your answer

15. Escolha as opções que ache mais adequadas
A música deixou-o/a: *

- [ ] nervoso/a
- [ ] feliz
- [ ] triste
- [ ] assustado/a
- [ ] ansioso/a
- [ ] aborrecido/a
- [ ] eufórico/a
- [ ] confuso/a
- [ ] cansado/a
- [ ] Other

III - Visual

Esta parte do questionário foca-se no aspeto visual do videoclip

16. Achei que os elementos visuais estavam consistentes *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

17. Não gostei do ambiente visual *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

18. Achei que a escala de alguns objetos não era adequada *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

19. Senti profundidade tridimensional entre os objetos *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

20. Achei o cenário realista *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

21. Escolha as opções que ache mais adequadas.
Como classificaria o ambiente visual? *

- [ ] aborrecido
- [ ] divertido
- [ ] triste
- [ ] aterrador
- [ ] relaxante
- [ ] estranho
- [ ] repugnante
- [ ] confuso
- [ ] misterioso
- [ ] melancólico
- [ ] Other

IV - Imersão

Esta parte do questionário foca-se no aspeto imersivo da Realidade Virtual

22. Senti-me imerso no espaço VR *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

23. Senti que o videoclip era algo que estava a experiênciar em vez de algo que só estava a visualizar *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

24. A certa altura desliguei-me da narrativa *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

25. O videoclip prendeu a minha atenção *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

26. Quanto tempo em minutos julga ter durado o videoclip? *

The value must be a number

V - Interação

Esta parte do questionário foca-se em aspetos relacionados com interação, que é um dos elementos principais da Realidade Virtual

27. Gostaria de ter elementos físicos no ambiente virtual com os quais conseguisse interagir *

	Discordo completamente	Discordo	Neutro	Concordo	Completamente
	○	○	○	○	○

28. Gostaria de poder deslocar-me pelos espaços virtuais visualizados *

	Discordo completamente	Discordo	Neutro	Concordo	Completamente
	○	○	○	○	○

29. Gostaria de poder alternar entre os cenários visualizados *

	Discordo completamente	Discordo	Neutro	Concordo	Completamente
	○	○	○	○	○

30. Gostaria de ter alguma influência no seguimento da narrativa *

	Discordo completamente	Discordo	Neutro	Concordo	Completamente
	○	○	○	○	○

31. Gostaria de poder escolher que cenários visualizar *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

VI - Emocional e fisiológico

Esta parte do questionário foca-se no que sentiu fisicamente e emocionalmente durante a experiência, tendo também em conta efeitos secundários que são comuns com experiências em Realidade Virtual

32. Senti-me desconfortável por estar desligado do mundo físico *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

33. Caso tenha respondido afirmativamente assinale as razões:

- [ ] Senti-me exposto/a
- [ ] Senti-me julgado/a
- [ ] Senti-me observado/a
- [ ] Senti-me desprotegido/a
- [ ] Other

34. Senti-me nervoso/a com a experiência *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

35. Senti-me triste com a experiência *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

36. Senti-me assustado/a com a experiência *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

37. Senti-me ansioso/a com a experiência *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

38. Senti-me aborrecido/a com a experiência *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

39. Senti-me eufórico/a com a experiência *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

40. Senti-me confuso/a com a experiência *

Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
○	○	○	○	○

41. Senti-me cansado/a durante a experiência *

Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
○	○	○	○	○

42. Senti receio de fazer alguma coisa de errado *

Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
○	○	○	○	○

43. Senti dor de cabeça durante a experiência *

Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
○	○	○	○	○

44. Senti-me cansado da vista durante a experiência *

Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
○	○	○	○	○

45. Senti náuseas durante a experiência *

Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
○	○	○	○	○

46. Senti tonturas durante a experiência *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

47. Senti vertigens durante a experiência *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

VII - Experiência

Esta parte do questionário foca-se na experiência de visualização do videoclip como um todo

48. Sentiu que faltava alguma coisa? *

- ○ Sim
- ○ Não

49. Se sim, conseguiria descrevê-lo? *

Enter your answer

50. Senti que tive que me esforçar para estar atento/a a tudo *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

51. Em algum momento sentiu vontade de parar a reprodução do videoclip? *

- ○ Sim
- ○ Não

52. Se sim, porquê? *

- ☐ Senti-me nervoso/a
- ☐ Senti-me triste
- ☐ Senti-me assustadoo/a
- ☐ Senti-me ansioso/a
- ☐ Senti-me aborrecido/a
- ☐ Senti-me confuso/a
- ☐ Senti-me cansado/a
- ☐ Senti dores de cabeça
- ☐ Senti cansaço da vista
- ☐ Senti-me enjoado/a
- ☐ Senti-me tonto/a
- ☐ Senti vertigens

53. Gostaria que o videoclip tivesse uma sequência no futuro *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

54. Gostaria de ver videoclips similares por outras bandas musicais *

	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

55. Teve uma preferência pelo aspeto visual ou pelo aspeto sonoro? *

- ○ Sonoro
- ○ Visual

56. Na sua opinião quais foram os pontos fortes da sua experiência? *

Enter your answer

57. Na sua opinião quais foram os pontos negativos da sua experiência? *

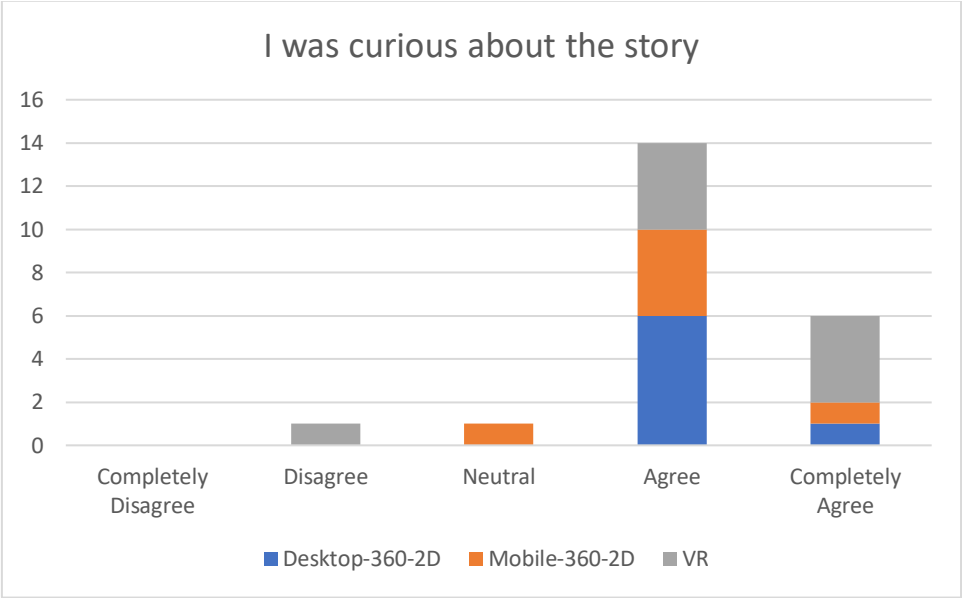
Enter your answer

58. De uma forma geral senti-me satisfeito com a experiência *

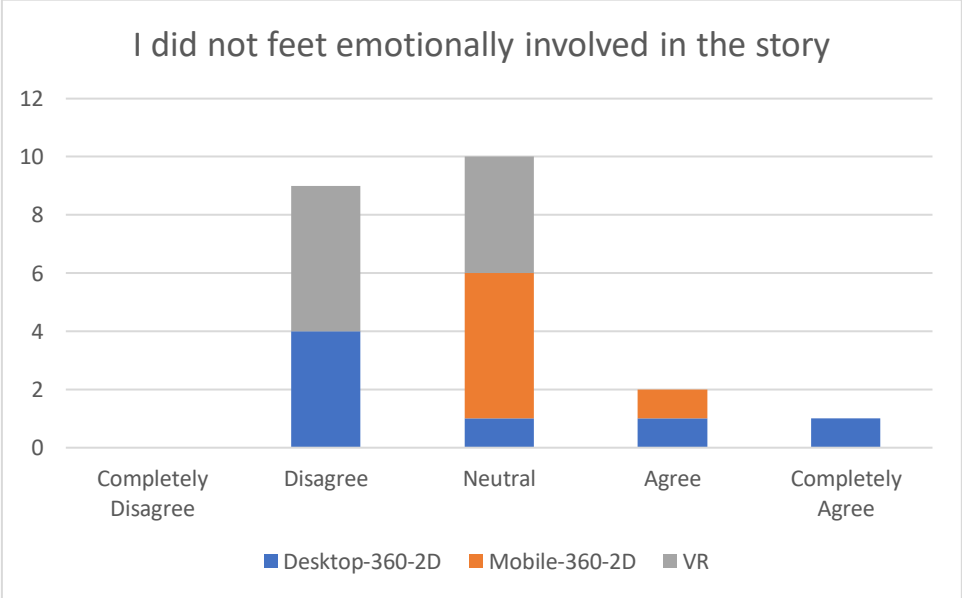
	Discordo completamente	Discordo	Neutro	Concordo	Concordo completamente
	○	○	○	○	○

Appendix J – The post-test questionnaire results

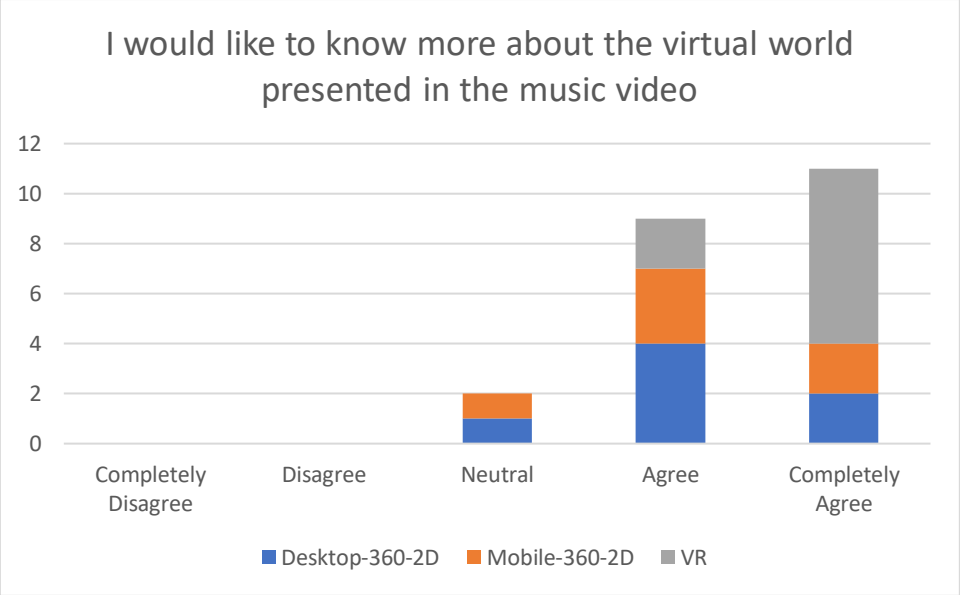
1 – I was curious about the story



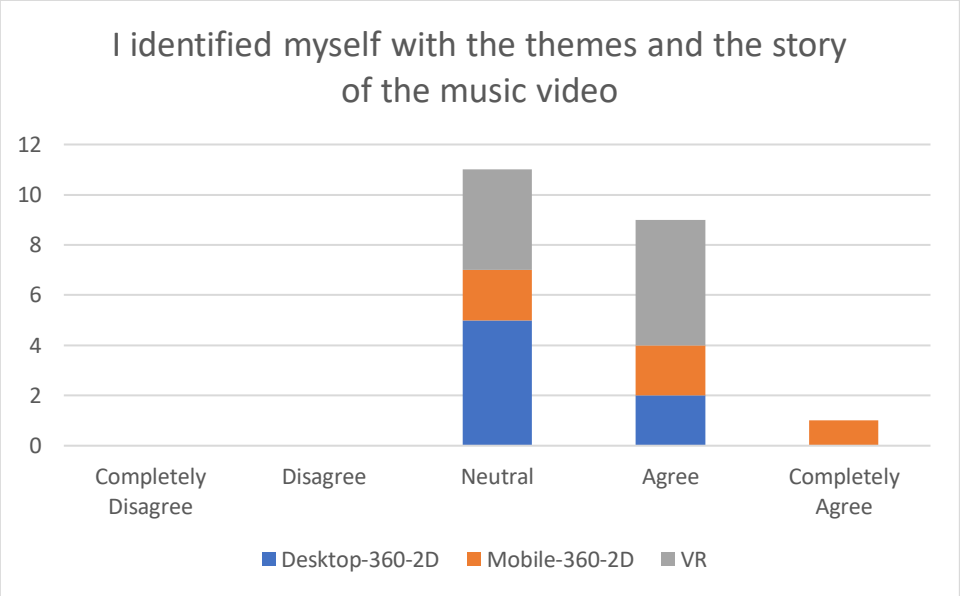
8 – I did not feel emotionally involved in the story



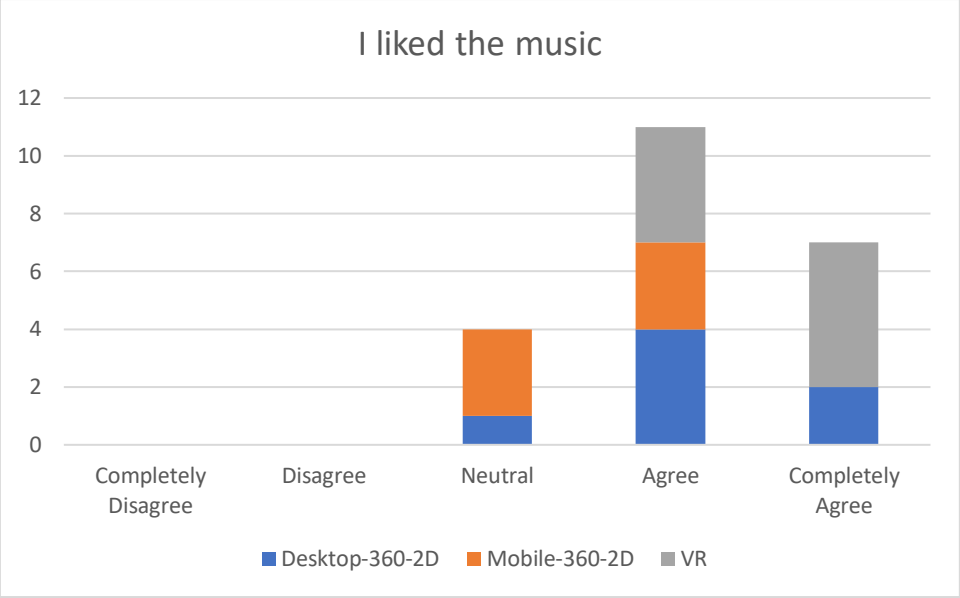
9 - I would like to know more about the virtual world presented in the music video



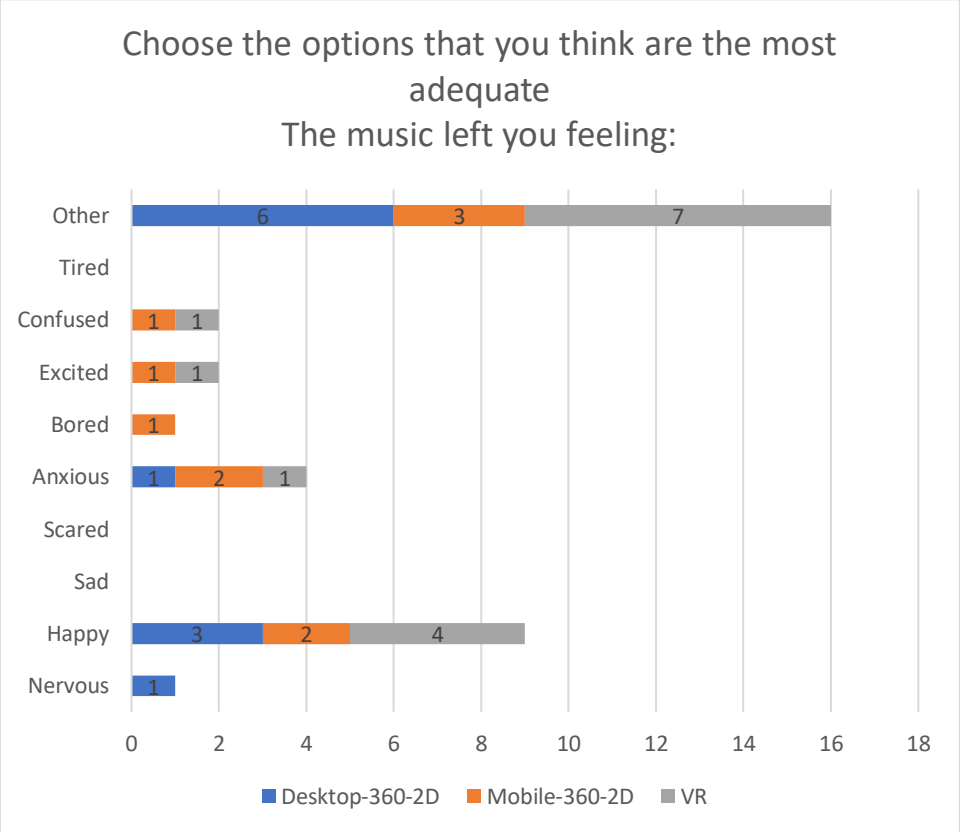
10 - I identified myself with the themes and the story of the music video



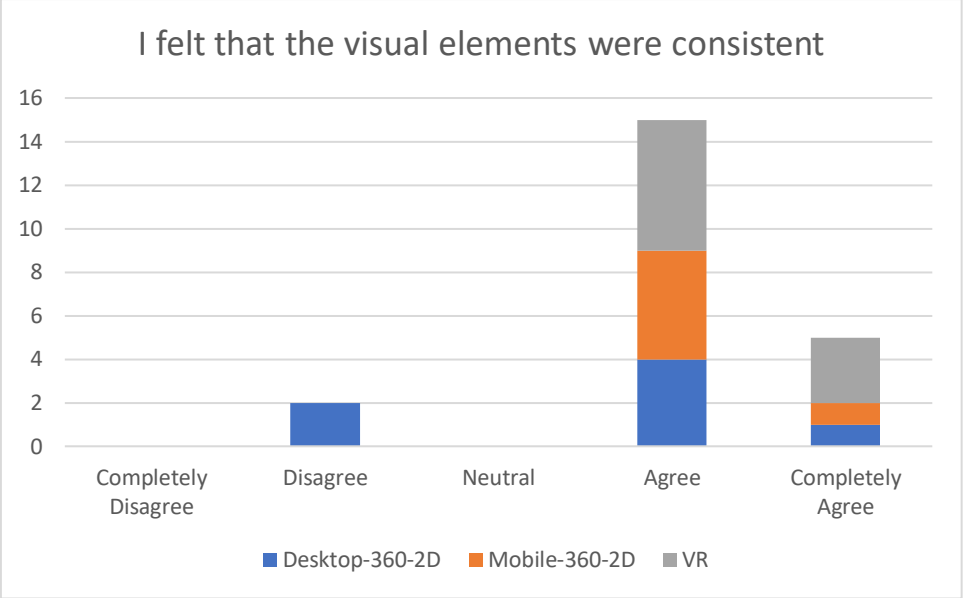
11 – I liked the music



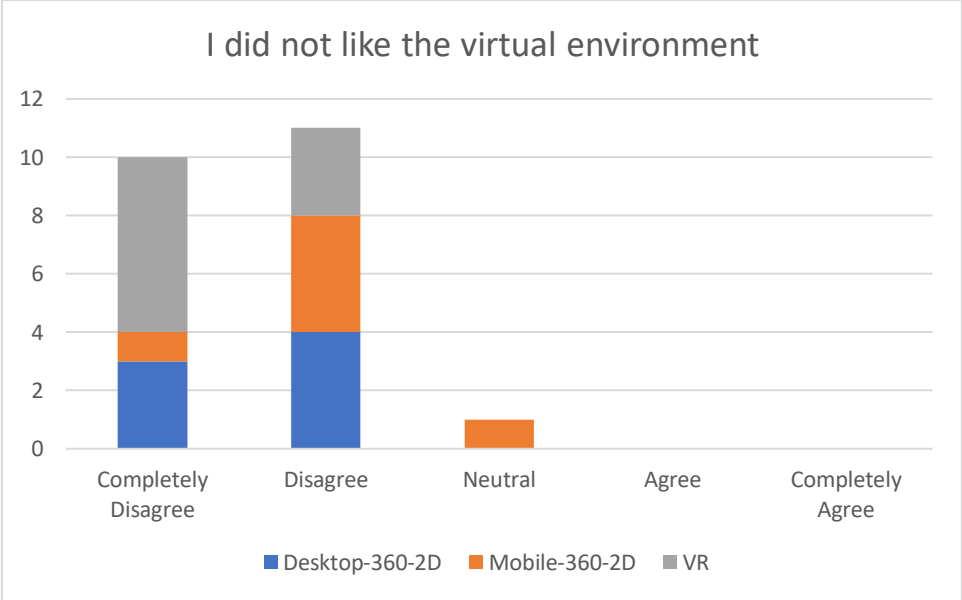
15 - Choose the options that you think are the most adequate. The music left you feeling:



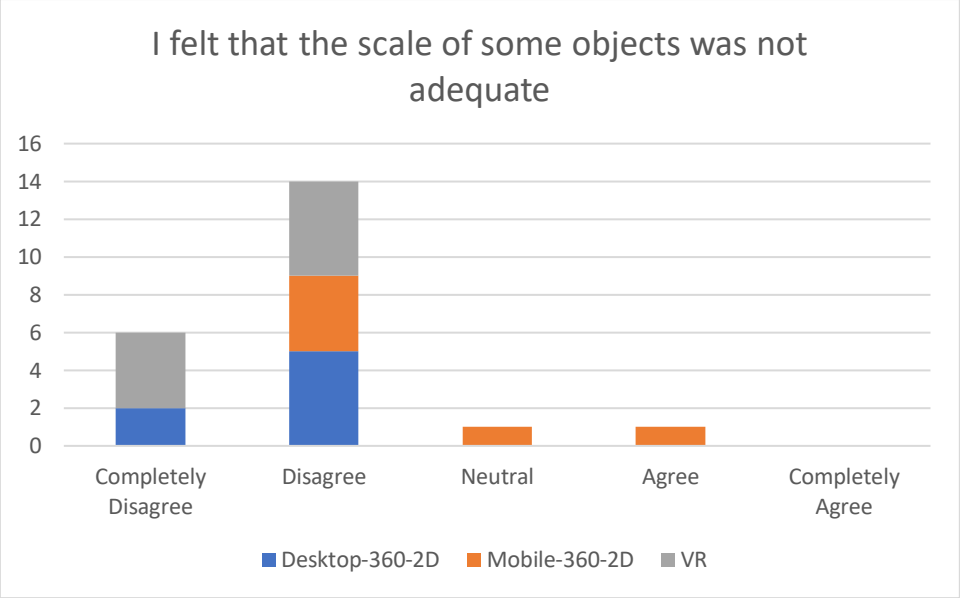
16 – I felt that the visual elements were consistent



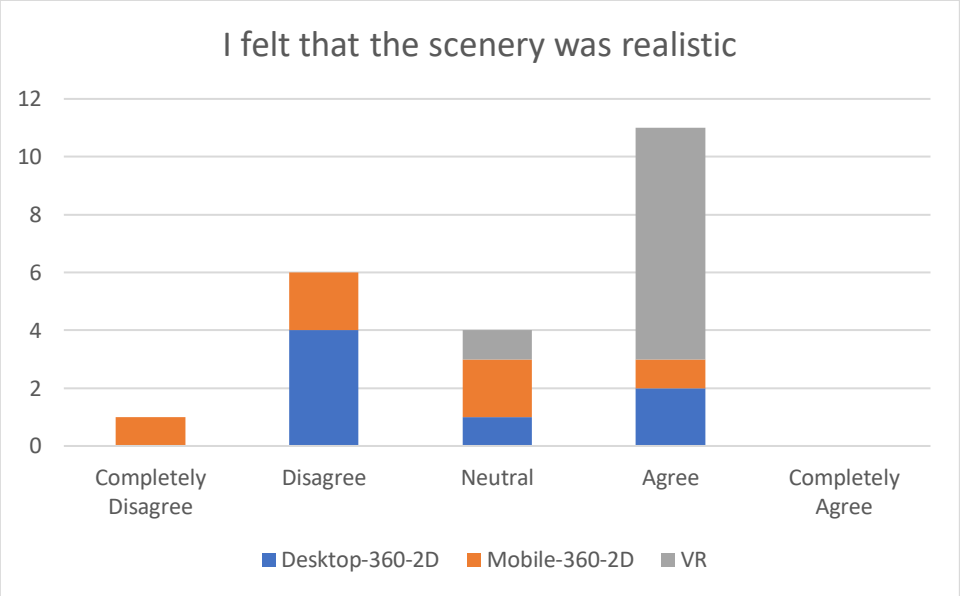
17 - I did not like the virtual environment



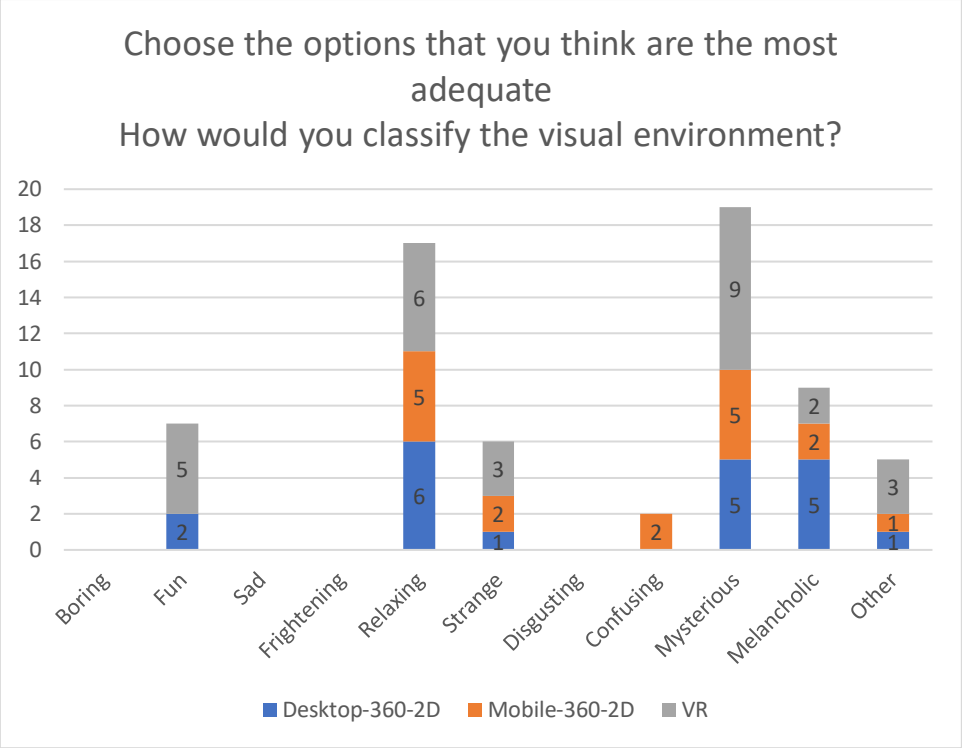
18 – I felt that the scale of some objects was not adequate



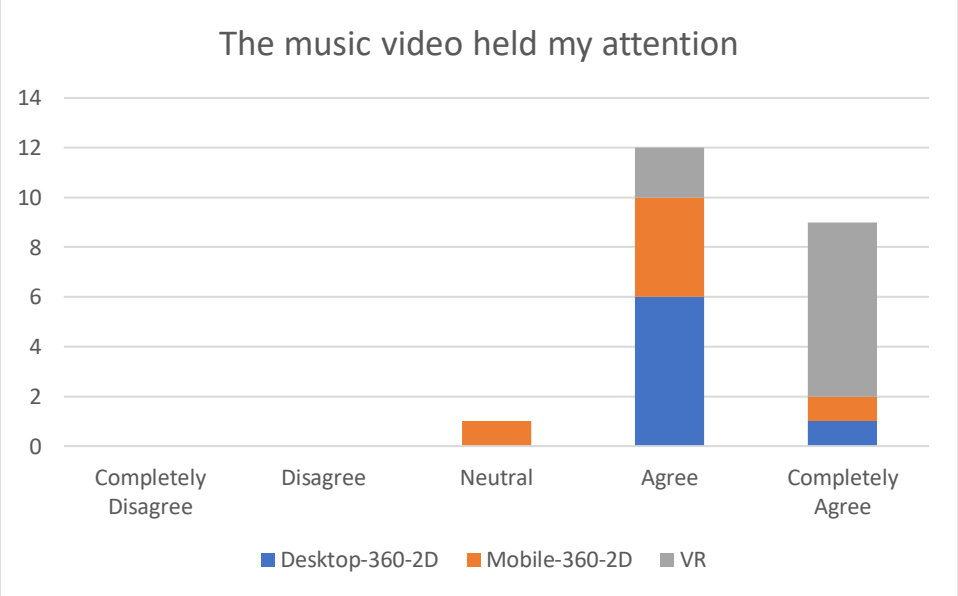
20 – I felt that the scenery was realistic



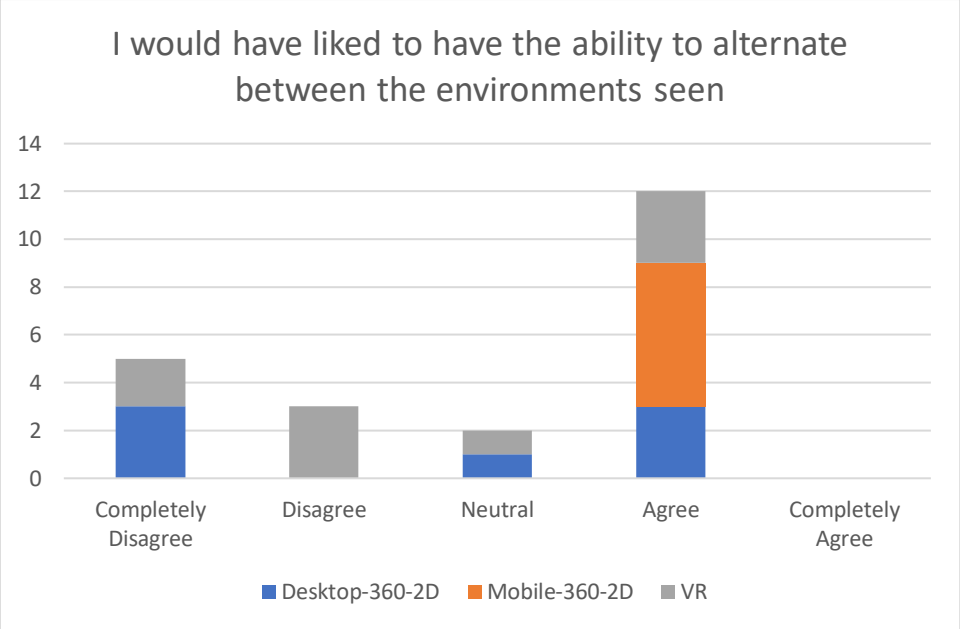
21 - Choose the options that you think are the most adequate. How would you classify the visual environment?



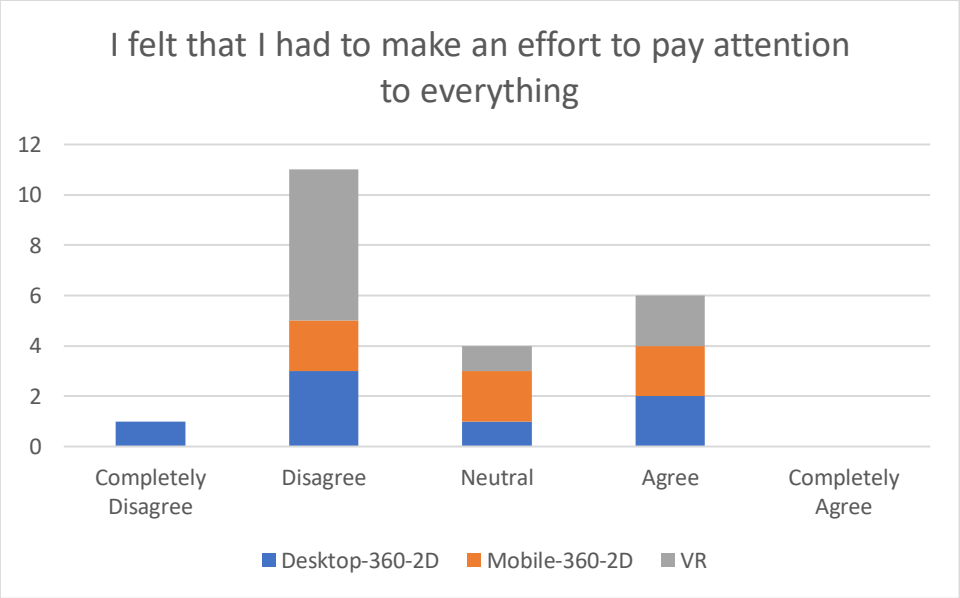
25 - The music video held my attention



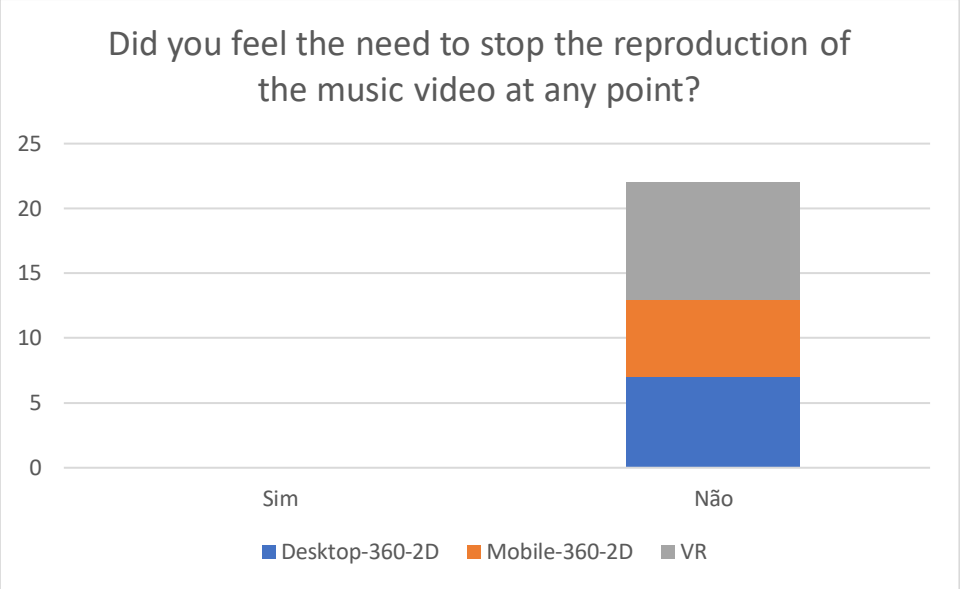
29 - I would have liked to have the ability to alternate between the environments seen



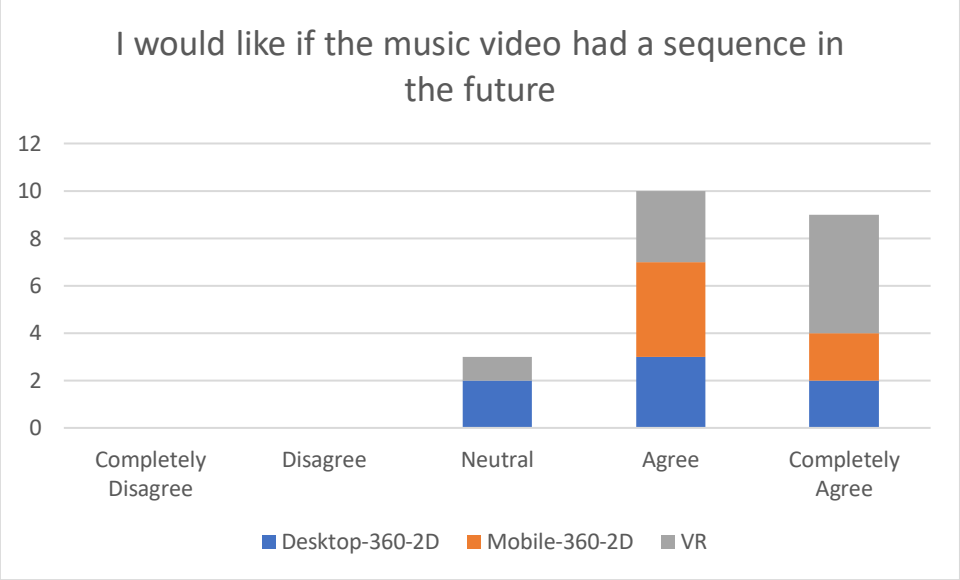
50 - I felt that I had to make an effort to pay attention to everything



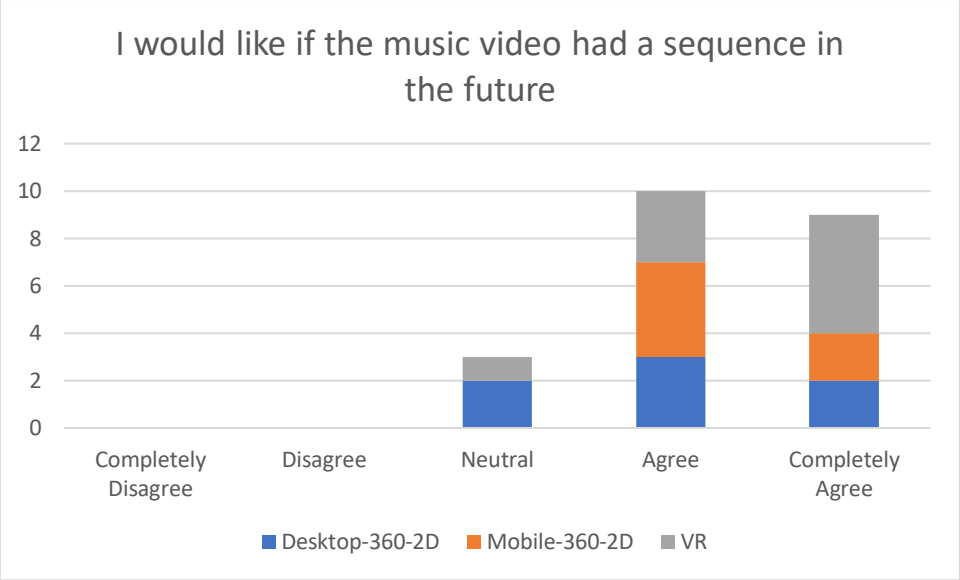
51 - Did you feel the need to stop the reproduction of the music video at any point?



53 - I would like if the music video had a sequence in the future



54 - I would like to see similar music videos by other bands



55 - Do you have a preference for the visual or sonic aspect of the music video?