

Influencing modern art experience through atmosphere
in a virtual reality museum

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Abstract

This project is about the influence atmosphere has on the visitor's experience of modern art in a VR museum. For this, the project was done with the contemporary artist Remy Jungerman, who provided us with a selection of his artworks. The influence of atmosphere in museums has been widely discussed, with different authors highlighting various definitions and aspects thereof. The consensus is that the atmosphere has an enormous influence on the visitor of museums. However, much of the research done so far was conducted with the help of historical art and physical museums, leaving the question of how this influence of the atmosphere translates to an exhibition of modern art in a virtual reality context. Furthermore, this project aims to investigate the way the atmosphere can be used to hint at the narrative of the art in different ways and how the visitors themselves would change the atmosphere to fit their own preferences. This was researched through a quasi-experimental setup exhibiting the art by Remy Jungerman in three different exhibition spaces, hinting at the inspiration and narrative behind the art. Two of the three exhibition spaces allow the visitor to change the lighting and music in the space, thus changing the atmosphere and individualizing their experiences. The results of the user testing indicate that the atmosphere influenced the visitors and allowed them in certain exhibition spaces to get a better connection between the art and the narrative. Additionally, the visitors had a clear preference for one of the exhibition spaces that featured a forest-like environment, with a combination of a yellowish light and jazz music that was used most often.

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1. Introduction

Museums are designed to create a lasting impact on the visitor whether that is through stunning art, an impressive narrative, or gripping interactions. This is of course very personal and individual for every visitor. Meanwhile, in recent years, more and more museums have started to incorporate virtual reality into their exhibition spaces, such as the Louvre [1], the Victoria and Albert Museum [2], and the Anne Frank House [3], to create a more diverse museum experience and change the way we look at art. The Guardian detailed this shift during the Covid-19 pandemic, as many cultural institutions took it upon themselves to expand their influence into the virtual realm, inviting people from all over the world, as social distancing made visits impossible [4]. Technologies such as VR have seen enormous development in the past decade, the applications and possibilities are almost endless. However, not what can be done but the user experience should be the primary concern when designing a product. This is especially true for cultural places, such as museums. Atmosphere has been stated to be “*at the root of a museum experience*” [5, p. 74] , so incorporating atmospheric choices into the design of art exhibitions is crucial.

In this project, we will work with Remy Jungerman, a Surinamese-Dutch contemporary artist, whose artworks have a rich narrative. Especially in such special art as Remy Jungerman’s the approach of using the atmosphere to strengthen the curiosity and personal enrichment taken from the art might be a useful way of hinting at this narrative. Within this project, the focus is on creating a virtual museum, that can be accessed from anywhere, not necessarily a traditional museum space. Focusing on the atmosphere is specifically crucial in such cases of virtual reality where the entire experience is separated from the traditional museum space. Here the atmosphere of the exhibition space plays a key role in the perception of the art by the visitor.

The atmosphere of an exhibition space plays a key role in the experience of the art by the visitor, especially in a virtual reality museum, where the virtual environment becomes the new context. This context has an important influence on the engagement and emotional connection of the user [6].

The experience of art, especially modern art is fairly individual, however, the concept of atmosphere suggests at its basis a shared sentiment of feeling [7]. Art that has such an extensive story and meaning behind it as Remy Jungerman's pieces further individualize the museum experience. This is why finding a common ground to create a fruitful virtual museum visit that is enjoyable for a variety of users and hints at the narrative behind the art without losing the personal connections we make is thus the main drive behind this project. Thus, the main research question we try to answer is how the experience of modern art provided by Remy Jungerman can be influenced by changing the atmosphere in a virtual museum. For this first, we have to answer how the experience of the context of the art can be influenced through atmospheric choices.

This will be done through a description of the Theory and Background behind atmosphere and its relation to art, next to an introduction to the State of the Art in Chapter 2. Following this will be Chapter 3, which focuses on the Design Process Method, and after that the Ideation and Specification in Chapter 4. Chapter 5 will revolve around the Final Product followed by the Realisation of the proposed design of three exhibition spaces and aspects of atmosphere. The quasi-experimental method will be described in Chapter 7 followed by the Evaluation of the within-subject study results in Chapter 8. The project will be discussed in Chapter 9, and finally, in Chapter 10 a Conclusion will be drawn.

2. Background Research

To appropriately address the project at hand, some research is necessary to assess the current trends, applicable theory, and overall peculiarities of the topic. This means specifically for this project it is important to learn more about Remy Jungerman, understand the relationship between Virtual Reality and museums, theories about atmosphere and art museums, and the current State of the Art.

2.4 Remy Jungerman

The artist the project is centred around is Remy Jungerman [8]. Remy Jungerman is a contemporary artist with Surinamese-Dutch roots that combines different aspects of his multicultural background in his artistic expression. His mother was a descendant of the Surinamese Maroon culture. Maroons were formerly enslaved people that escaped slavery and formed their own settlements. Jungerman explores this culture through his art. One important part of the Maroon culture is Winti. Winti is the combination of different religious beliefs and practices brought to Suriname by enslaved people. Jungerman uses for example the fabrics, music, and clay used in rituals in his work. This makes for a rich narrative behind the art, which when known to the viewer makes the art that much more impactful. His art is strongly influenced by his cultural heritage, as well as his surrounding environments. In one of the information texts of a previous exhibition Jungerman [9] stated that the exhibition space for him is “*comparable to an altar, a place where precious things are kept*”. In a conversation with him, of which the notes can be found in the Appendix [Appendix 1], Jungerman mentioned that for him the practice in his studio is a ritual and the produced art is a leftover of this process [Appendix 1]. Next to that, he described that he does not want to lead the visitor down one specific path to the Maroon culture, he wants them to be triggered by their imagination. Using aesthetics to create art he wants the audience to take something away from the experience, but it “*depends on the audience what to take from it, how much they take from it*” [Appendix 1]. His art serves more as a spark triggering curiosity and interest in the Maroon culture and the Winti practices than a strict way into this culture. Jungerman talked about having small hints that relate back to his narrative, urging the visitors to look at the art in a different way throughout the conversation. One of these hints could be including his film “Broos” made, which shows some of these rituals, thus relating

back to the art pieces and used materials, without giving the visitors a complete explanation of the art. This does not mean that Jungerman wants the visitors to be completely in the dark about the art and the meaning behind it, but it seemed important to him to point out that he does not want to provide one specific path for the visitors to learn about the Maroon culture, but that the interpretation and connection to the art that each visitor builds themselves are interesting to him. Furthermore, Jungerman talked about the exhibition spaces he likes to display his art in, explaining *"It's the space that makes the art"*. He stated that he likes to make the visitor curious and used a diagonal wall in his latest exhibition to do something different by creating a space that does not leave the visitor feeling like they *"saw it"*, but that they can *"circle around"*. He likes to create an atmosphere in the exhibition allowing the visitors to *"look beyond the surface of the works"*. Furthermore, he highlighted that using the atmosphere to give hints and make the viewer curious is something he is interested in as he is a fan of creating tension in a space that makes the visitors look back and revisit art pieces. However, because of the implementation in VR, he stressed that he would like to stay as close as possible to the work, and the material, stating *"I don't want to go fantasize"*, as there are so many possibilities offered by VR, before ending the conversation with *"keep it simple"*.

To explain more about the narrative behind his art I will use his so-called 'panels' as an example. They feature stripes of fabric treated with kaolin clay, which is used in Winti rituals. On top of this engravings are made that visualize the rhythmic sounds of the Agida drum used in rituals. Several aspects of Winti rituals come together in Jungerman's pieces and incite curiosity in the visitor about this culture.

The presented artwork [Figure 1] will be used as an example to further illustrate Remy Jungerman's art. Within the art, different patterns and colours can be seen. These are fabric strips often worn by the Maroon, which are layered on top of each other and arranged to form an interesting but balanced composition. The effect of making the fabric merely peek through here and there is achieved by layering kaolin on top of the fabric. Kaolin is a specific type of clay, which is used in many religious traditions, one of these being Winti rituals. The geometric lines have been described in one of the labels of his art [9] as a link between the aesthetics of Maroon culture and Western modernism.

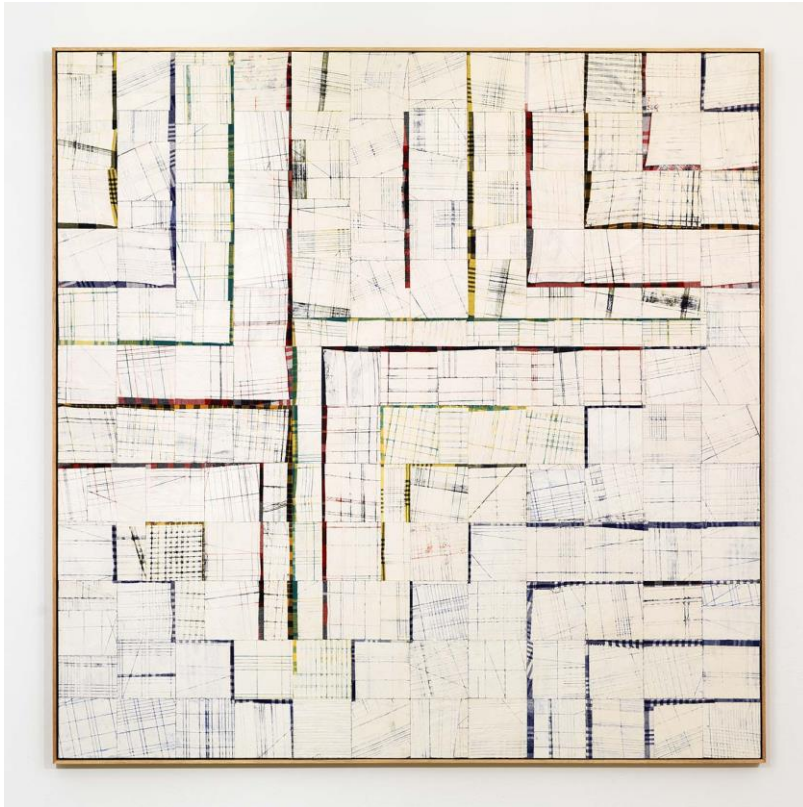


Figure 1: Pimba AGIDA V (2020) - piece of Remy Jungerman

2.1 Virtual Reality and Museums

Virtual Reality has been an area in technology rapidly developing in the past decades and reshaping the limits of technology and its experience. The limits of the technology have moved from big, bulky and restricting conceptualisations of an abstract idea to widely available wireless headsets the size of binoculars. This tremendous development has made its mark in various aspects and influenced different contexts. One of these use contexts where a significant impact can be seen is in culture, more specifically museums.

The incorporation of technology in museums is not a recent development and began in 1960, as mentioned by Hijazi and Baharin [10]. Over the course of a few decades, this transitioned to the incorporation of digital means and started with “*static display approaches*” [10, p. 143], for example, digital collections. Furthermore, they state that there has been an “*insatiable curiosity*” concerning the technology and the visitor’s experience in digital museums, as digital technology is becoming a “*tool of artistic expression*” [10, p. 151]. Digital museums are in these contexts museums that incorporate digital technologies into their

museum design, whether that is through the use of augmented reality, automated displays, interactive videos, or other technologies.

One of these technologies that has been getting particular attention and has seen many new application options in the field of museology is Virtual Reality (VR). Parker and Saker described the possibilities of VR as “*reshaping the lived experience in museums*” [11]. VR opens up limitless space and opportunities of presenting and experiencing art in a way that is not comparable to the traditional experience. This incorporation and transition to digital museums changes the experience of the visitor drastically to a “*multidimensional*” one through different interactions [10]. Serda stated, as cited in Hijazi and Baharin [10], that these technologies are “*significantly transforming*” the experience of the visitor and their “*frequent integration [...] is beneficial*” to the experience. Guo et al [12] agree that digital museums likely offer a one-of-a-kind experience in comparison to traditional museums. The museum visits are no longer bound to a specific physical space and the laws of nature can be transgressed. The visitor can be fully immersed in the experience with no regard to what the actual environment around the visitor looks like at the moment. Museums and other places can be visited from the comfort of their own home. Combining art with VR technology makes this art accessible to everyone all around the globe. Especially during the Covid-19 pandemic virtual museums showed their value, aiding in the exhibition of “*inaccessible or invisible works*” [13, p. 354].

Rahim et al. [14, p. 2], define virtual museums as follows, “[the] *Virtual Museum is an alternative to a museum in digital form with virtually the same aim as a real museum which is to showcase a museum’s collection, in turn, to provide knowledge to visitors through informal learning*”. This means that the general concept of a museum, whether it is a traditional, physical museum, or a virtual museum, does not change. The focus lies on presenting the collection and passing on a piece of culture to the visitor. Sun and Zheng [13] continue by explaining that the current academic research on virtual museums can be categorized into four areas. These areas focus on the virtual museum as a tool, the study of virtual technology, the study of users, and the evaluation of virtual museums. Even though these categorizations can be applied to structure the field of virtual museum research they do not imply that these categories do not intersect. In fact, they are not studied independently, but complement each other. Moreover, two types of virtual museums are identified by them: the reflection of a physical museum in a digital space, meaning the physical museum and the pieces shown in this museum are presented in a virtual 3D environment and the exhibiting of pieces in a virtual environment within a physical museum

setting. The first type however does not imply that the physical museum is merely replicated in a virtual setting, virtual reality offers many innovative possibilities for changing this space that is no longer a physical museum [13].

The visitor and their experience are at the centre of these innovations, as they now hold a different power in the museum narrative. With the change towards a focus on visitor experience in the new museology and the “*redefinition*” of the relationship between museums, the visitor, and each other, through virtual museums the visitor is now a subject of the narrative, actively participating in the completion and creation of it [13].

Museums have been through a drastic change, which has been furthered through the inclusion of digital technologies and especially virtual reality. Museums are no longer tied to a physical space or the laws of nature. Everyone everywhere can access works of art from the comfort of their homes and experience them in a very personal and individual way. The focus on visitor experience in museums in recent decades comes to its highest point so far with this shift to virtual museums. The visitor is at the centre of the entire experience actively taking part in the narrative of the museum. The design of the virtual museum revolves around making this experience as exciting and immersive as possible, which is strengthened by the limitless possibilities virtual reality has to offer. The pieces of art can be experienced in a drastically different way than in a traditional museum making this encounter more intimate and beneficial for the visitor. Virtual Reality has changed the experience of a museum visit and made culture more accessible to all.

2.2 Atmosphere and Art Museums

The following research about atmosphere as a concept and its connection to art museums was completed in the context of a supporting course focused on writing an academic research paper. The entire literature review was written by the researcher in parallel to this project.

Museums and especially extended reality exhibitions rely heavily on how the visitor experiences their visit and the presented artwork. Hijazi and Baharin state that the “*atmosphere is at the root of a museum experience*” [5, p. 74]. Thus, to create an impactful virtual exhibition it is important to understand how the visitor's perspective of the experience

can be influenced. This is particularly interesting from an atmospheric point of view [2] as an exhibition based in a virtual reality setting does not have the same 'space' and environment as a non-virtual, 'traditional' museum does. The space can be fully created and modified to accommodate any art piece and the perspectives of the visitor can be manipulated, as they are not confined to their own body, and neither are the pieces. To get to an understanding of how a virtual exhibition has to be designed to create an immersive and fruitful atmosphere, first, this concept has to be understood better. This is why in the following review of related literature insight into the ways atmosphere influences art and the visitor will be given.

2.2.1 Atmosphere – a definition

Atmosphere and the many attempts to clearly define this concept have been the source of some discussion, with various authors offering their take on a definition. Bjerregaard [5, p. 74] defines it as the "*in-betweenness of objects and subjects*", what the visitor makes out of the art piece, which creates a strong sense of "*being here*" for the visitor. Böhme [15] agrees that it is something experienced by the visitor, which is created by the object. More precisely, he defines it as the "*common reality of the perceiver and the perceived*" [15, p. 122], the space they share with both of them being actors in this situation. The definition of atmosphere can thus focus on the relation and space between the object and the person perceiving the object.

Some of the definitions of atmosphere attempt to point out which actor the atmosphere belongs to. Benjamin [16] relates it more to the appearance of a distance in which the object "*gains possession*" of the viewer. Schmitz [17] sees the relation of the atmosphere more belonging to the subject than the object. In his definition, the atmosphere is equated with what Böhme described as an "*affective power of feeling, spatial bearers of moods*" [15, p. 119]. Next to this, Bille et al. [18] clearly describe the case of not quite belonging to either party by defining atmosphere as a "*phenomenon that transgresses boundaries such as subject and object*" [18, p. 32]. In their view, the atmosphere is not a trait the object possesses, but it is neither only the feeling within the visitor. They point out the in-betweenness Bjerregaard also describes. Atmospheres seem to not have a clear belonging to either actor but encase them both.

These attempts to define atmosphere show some similarities while also bearing distinct differences. They all agree on the atmosphere being something that exists between the object and the viewer, a space is created that affects the viewer. Merely the assignment of the belonging of the atmosphere to the subject or object shows strong differences. This is particularly interesting as atmosphere is something most people seem to understand as something similar, but it is not quite graspable and describable to fit the understanding of the whole concept. When using the concept of atmosphere it is thus important to ensure that a description of what atmosphere is understood as is included, since atmosphere is a concept of many different definitions and personal understandings. In this project, atmosphere is understood as something that exists between the object and the viewer, a space affecting the viewer.

2.2.2 Aspects of Atmosphere

Following the attempts to find a definition it remains to clarify how this atmosphere can be influenced and changed deliberately. Here as well the ideas have some discrepancies. Dorrian [19] describes the work of Margaret Maed in the design of exhibitions as attempting to “*realise an encapsulated ambience*” [19, p. 197], as she recreated the original environment of the art pieces in the exhibitions. This in turn was described as “*purifying*” the meeting of the visitor and the object. Dorner had a similar perspective with a different, more abstract, approach. Dorner’s so-called “*atmosphere rooms*” were detailed by Germundson [20] as rooms that displayed the artefacts within their contexts, showing this more abstract approach. The context was in this case that information was given to the visitors about the art and the cultural background, as well as the incorporation of sounds and visuals that attempted to recreate the past. This information was, for example, given through illustrated booklets that included explanations about the religious and economical conditions, music and literature of the time period of the art pieces. The specific, and for this time quite new, approach was that Dorner detested the idea of white walls in museums, so to manipulate the atmosphere he painted the rooms in vibrant colours. These colours were meant to emphasize the atmosphere of the original landscapes and contexts of the art [20]. Both of these designers show that creating a space in a specific way can change the atmosphere of the museum exhibit.

Pilegaard [21] rejects, as Maed and Dorner did, the “*white cubes*” or “*black boxes*” museums traditionally use as a supposedly neutral space. This is done to aid the creation of atmospheres. However, Pilegaard [21] argues that the museum space itself has an atmosphere, which, if done correctly, can be “*activated*” to become a part of the exhibition fabric. Different to Maed and Dorner, Pilegaard incorporates the actual physical buildup of the museum space in the creation of the atmosphere for the exhibition instead of changing merely the exhibition space. Zomerdijk and Voss support this highlight of the physical space, stating that the context, which they define as being built up of the “*physical and relational elements*” [6, p. 4], has an influence on the “*engagement and emotional connections*” [6, p. 4]. Furthermore, Pullmann and Gross [22, p. 553] explain the occurrence of an experience as the visitor having any kind of sensation or gaining knowledge, as a result of an interaction with the context. This means that the physical setting and everything that is in relation to the visitor in the environment influences the visitor, their engagement and connection, as well as their experience. The architecture and overall elements of the museum itself can thus help strengthen and change the atmosphere of the exhibition in fruitful ways and in turn, influence the experience of the visitor.

The ideas discerning the practical aspect of influencing the atmosphere through the environment, including audible and contextual areas is what the authors agree on. This seems to show itself in wildly different variations and have different impacts on the atmosphere. If these influences are made as a deliberate choice it is thus important to understand which choices can be taken and how this will influence the atmosphere. Only through this can the atmosphere be influenced in a meaningful and controlled way. The described elements are namely, the physical layout, the use of colours for, for example, the walls, the architecture of the museum space, the incorporation of the (historical) context of the art, and sounds.

2.2.3 Influence of the Art

This perception of atmosphere is one part of the museum experience in the direct encounter with art, however, some authors make a distinction between the impact of atmosphere and

the influence of the art itself. Germundson [20] understands Dorner's view as focused on what the visitors can take from these paintings for their current times. The educational value is strengthened in his "*atmosphere rooms*", which disregard the museum as a space that removes art from the everyday, simply keeping the art in the past. Dorner himself [23] emphasized the way forward of art museums to give them an active meaning for the future, which can only happen by "*conveying the trend of cultural evolution*" [20, p. 272] [23], as Germundson quoted the unpublished manuscript of Dorner. According to Dorner the museum and the art pieces in the museums can have an active impact on the future.

Belfiore and Bennet [24] share this view on the impact of art. They write that art and the encounter with art can have "*transformative effects*" not just on individuals but on the collective, going like Dorner into the possible effects that are not reduced only to a single individual throughout the experience in a museum. Gadamer [25] takes it one step further, stating that the work of art has the power to rip the person encountering the piece out of their world and release them back into it after the experience. Grothen [26] agrees in a much less detailed way, writing "*art does something with us*" [26, p. 110], leaving more room for individual interpretations of readers. He does not specify what this something is or in what way it affects the viewer, but even through this short sentence Grothen captures this indescribable impression art leaves on the visitors.

All in all, the unanimous consensus is that the art itself, regardless of the strong impact the atmosphere has or the role atmosphere plays within this area of the experience of art, it has an immense impact on the viewer. Some describe it more simply and bluntly, some use more expressive ways, but overall it is agreed that the pieces deeply transform the viewer and affect them even in the future after the experience and direct encounter is over. A lasting influence comes from the art.

2.2.4 Influence of the Atmosphere

The described power of art and the consensus is clear with the authors underlining the deep effect art has on visitors and the way it transforms them. However, the impact of art stems from the atmosphere it creates, this influence of the atmosphere is more uniform between authors. For Grothen [26] the atmosphere and “*encounter*” with an art piece is a tool to generate a rift into another world. It opens up the visitor’s mind simply by existing and having a powerful atmosphere. Böhme [15] sees the power of atmosphere less on the side of the object and more on the side of the subject, stating that the atmosphere is the first thing a visitor perceives. In his description of Benjamin’s view, he writes that this perception is the absorption of the atmosphere into the visitor’s “*state of being*”. More precisely, the visitor “*breathes*” the aura, meaning it is taken into and spreads through the body. For Benjamin, the atmosphere of aura has a deep bodily component to it.

Korff [27] uses Benjamin's aura as a starting point, adding to this bodily component. However, he regards the spatial closeness of the encounter as well as the mentally distant and “*alien*” component of the art as a key to atmosphere. For Korff, the museum encounter is based on the “*perceived distance despite the spatial proximity*” [21, p. 12], as Pilegaard points out. Benjamin as well embraces the notion of distance as a fundamental aspect of the concept of atmosphere, pointing out the unattainability enclosed in the atmosphere. Pilegaard [28] picks up this notion of distance and relates it to the vitrines widely used in museums. According to her, these vitrines not only act as a protection of the art but simultaneously function to create a distance and separation between the object and visitor. The artwork is still close and “*seeps through*” the transparent vitrine, but it elicits a sense of distance. For many of the mentioned authors the distance versus proximity is a central aspect of the impact of atmosphere.

All three of these interpretations rely strongly on the fact that atmosphere has an immense influence on the visitor, being the first thing they perceive and absorb. These influences can be supported through external factors as mentioned by Pilegaard [28], by adding to the aspect of the distance of the object while being situated close next to the visitor.

2.2.5 Conclusion

The goal of the reviewed literature was to gain insight into the influence atmosphere has on art and the visitor in a museum space. This has been the topic of many discussions. Atmosphere as a concept has been particularly divisive, with no such thing as one true definition of atmosphere. However, there are many similarities in the understandings discussed within this literature review. Firstly, it is clear that atmosphere is understood as something that happens in the shared space between an object, or work of art, and the subject, the visitor. The atmosphere can be influenced by modifying this very space. The environment, or context, in which the object is presented can change the atmosphere and the perception of the viewer. The fact that the atmosphere is the first thing the visitor perceives gives it a very powerful position and due to this power it can deeply affect and even transform the person encountering the object. To create an immersive and worthwhile experience for the visitor it is important to understand the atmosphere the object emits, as well as the impact the curator wants the object to have. Once clear, the space the object is placed in should strengthen this atmosphere and allow it to flow freely to create a truly impactful experience.

A lot of these new ideas and conceptualizations of atmosphere and its influence in recent literature is based on the concepts of 'aura' by Benjamin and the highly influential concept of atmosphere as described by Böhme. This gives new research and ideas a similar starting point. However, due to the difficulty in defining atmosphere in a unanimously agreed-upon way, there are significant differences in the exact understanding of what atmosphere is and what exactly it entails. Furthermore, the use of atmosphere in the general everyday language has further diluted a clear understanding of atmosphere in the context of art museums. Art museums have seen a significant change in recent years, especially with the increased usage of new technology like virtual reality. Due to the changes and increased use of technology, there is a need for new research and new ideas of atmosphere and its influence in the realms of technology-infused art museums.

2.3 State of the Art

The availability of virtual exhibitions was especially interesting to museums worldwide during the Covid-19 pandemic, as many restrictions limited visits or the experience within the museum itself. This caused many more museums to include exhibitions that were available to visitors through the Internet.

2.3.1 Digital Art Exhibition

One option for realizing this is through cataloguing the art in an online database and making them available through the internet, as offered for example by the Louvre Museum in Paris [29]. Over 490,000 works can be viewed through this online database in cooperation with the Musée National Eugène-Delacroix situated in Paris. The artworks can be accessed through different collections focusing on the type of art, with categories like paintings, furniture, or textiles. Next to that, there are so-called 'Themed Albums' available, classifying the presented artworks. Furthermore, the viewer can choose to explore the Louvre through an interactive map [Figure 2], clicking their way through the individual rooms viewing the exhibited art [30].

However, this is only one possibility focusing on showcasing the art and does not offer a good user experience or immersion and is mainly for showcasing and documenting art, as well as research purposes. This is in itself a very useful application of virtual art and relates to this project in the focus on the art itself, but it focuses less on using the many additional values of the medium, which could change the user experience, and more on replicating a physical version of the museum spaces.

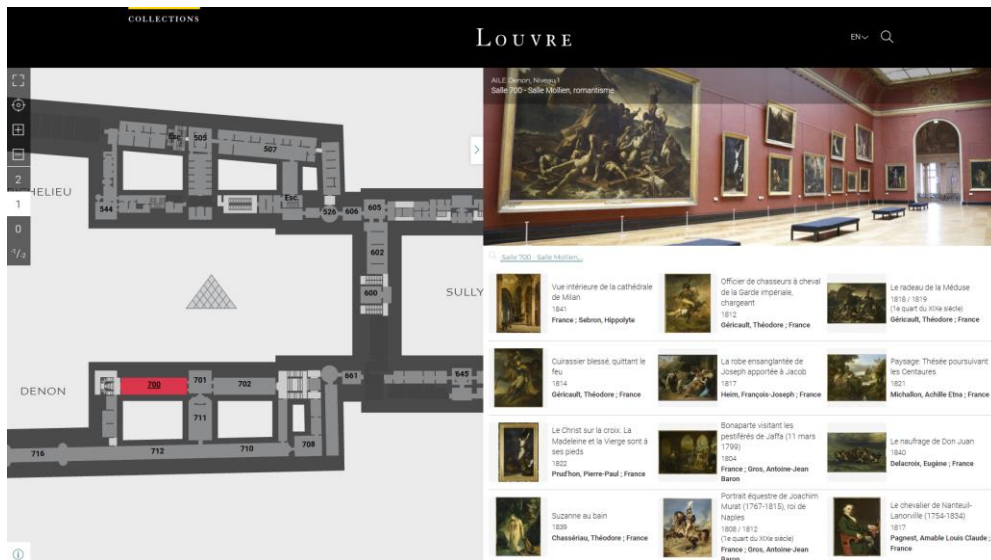


Figure 2: The Interactive Map of the Louvre

2.3.2 Virtual Tours

A multitude of museums, the Louvre included, have virtual tours available online. These tours consist of the visitor being able to click their way through the museum as it looks in reality. The visitor can access these tours through the museum website and launch them in their internet browser. Using their mouse they can turn 360 degrees and click spots on the ground to 'walk around' the museum space. The text accompanying an art piece can be read and thus a 'real' museum visit can be experienced virtually. As mentioned previously, the Louvre [31] offers this, as well as the Vatican Museums [32]. The Louvre currently has five virtual tours available each corresponding to a year of an exhibition available in the "Petite Galerie du Louvre", a space in the heart of the Louvre exhibiting works based on a chosen theme each year. The Vatican museums offer similar tours. These are, however, not focused on a specific exhibition or specific paintings, but on the different rooms in the Museum. The mouse can be used to look around in 360 degrees and displayed arrows allow the user to move through the rooms. While the Vatican Museums' virtual tours offer the possibility to look at the rooms in VR, the experience is hosted on a website and there are no other possible interactions apart from looking and virtually moving around the rooms.

The described virtual tours offered through websites come much closer to a traditional museum visit and do not only focus on the exhibition of art pieces but also on the location they are presented in. The Louvre offers additional information to the art, namely the

accompanying texts next to the pieces, while the Vatican Museums offer to experience the historical building with no contextual information. Both of the applications miss a level of immersion and focus on showcasing the actual museum instead of creating an experience, especially for the virtual use of the user. The way of presentation chosen is suitable for the contents of both museums, namely historical art, which is not the art presented in this project. Similar to this project, however, is the fact that these experiences offer more of a museum-like feel to the user and do not merely present individual works.

2.3.3 Digital Museum

Similar to the virtual tours offered by the Louvre and the Vatican Museums is the Virtual Online Museum of Art, in short, VOMA [33], which opened its 'sites' in November 2020. It is one of the first fully digital museums in the world. The aim was to create an *"immersive, photo-realistic 3D in-browser experience that brought the world's greatest art to anyone with an internet connection"* [34], as they state on their website. It offers a lot of different exhibitions that are designed

like traditional physical museum spaces. The entire



Figure 3: Entering the VOMA

museum space and setting around it is designed to be as realistic as possible [Figure 3], with added sounds and a changing, animated environment. The visitor can enter the museum and visit the various exhibitions. The museum space is built like a traditional museum with additional information either on the walls or available through a clickable symbol. Like the aforementioned virtual tours, the controls are similar, using the mouse to look around and spots on the ground to 'walk' [Figure 4]. Zooming the view in and out is possible as well, offering the ability to see the smallest details in the presented art.

The VOMA is not designed for virtual reality, but it is at its basis a new way of bringing art museums into the digital age. The visitor can easily access the exhibitions through their

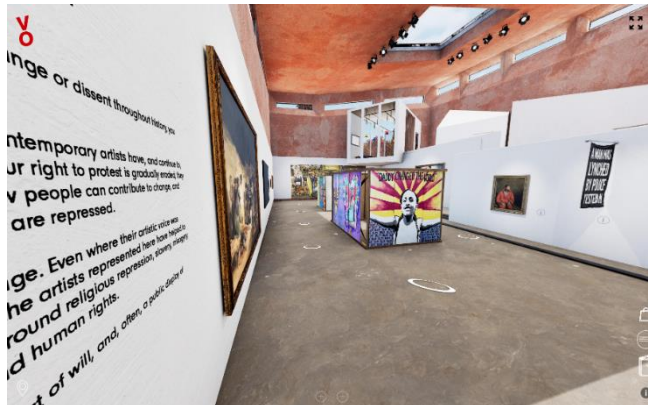


Figure 4: Inside the VOMA

computer and navigate the space through their controls. This does not provide a similar experience to a VR one but it has the same basic idea. The focus is on making art accessible to anyone anywhere, offering information about known pieces and highlighting lesser-

known pieces. While the museum is very close to a traditional museum in its

build-up it does make use of the possibilities of a digital environment in showcasing different works and its accessibility. However, the focus on highlighting different views, here mainly in the form of lesser-known pieces, and wanting to create something for the user is in line with this project. The VOMA takes the aspects of technology useful to its cause and combines them with their concept of what a museum is to create something unique for the user.

2.3.4 VR in Museums

Another option for using digital means in the field of museums and art is the incorporation of VR in physical museums, as an in-house virtual reality experience. One example of this is the



Figure 5: Behind the Scenes of the Curious Alice Exhibition

“Curious Alice” exhibition [Figure 5] of the Victoria and Albert Museum in London, which was open during 2021. It was part of a bigger exhibition called “Alice: Curiouser and Curiouser” [2] and featured VR glasses as well as some physically built aspects of the virtual environment [35].

During the visit of the museum, this virtual world could be

experienced, offering a different type of exposure to the world of Alice and creating a more

varied visit overall. The virtual part itself is based heavily on game-play aspects with riddles and races that match the whimsical wonderland world. The virtual experience focuses less on art and being exhibition-like but more on creating an immersive event for the visitor in this particular world [Figure 6]. However, the VR aspect and its possibilities have been put into practice. After the exhibition came to an end the VR part has been made available online, showing another strength of virtual reality, namely its wide availability and independence from physical space.

This differs from this project in the heavy game-like aspects included in the VR experience, which the topic of this project and the exhibited art is too sensitive a topic. Furthermore, it did not focus on art but on creating an immersive world and adding to the exhibition, instead of being a stand-alone exhibit. However, the use of VR and the focus on the user experience is an aspect that this exhibition and the described project share.



Figure 6: Inside the Curious Alice VR Exhibition

2.3.5 VR Experiences

Some museums opt to offer VR exhibitions that can be accessed anywhere. After the Leonardo da Vinci exhibition in 2020, which featured an immersive VR experience, the Louvre made this VR experience available online. It can be experienced anywhere by downloading the accompanying app on a smartphone or a VR headset through the corresponding VR platform. The VR experience is titled “Mona Lisa: Beyond the Glass” [1] and is the first VR project of the famous Parisian museum. It gives insights into the woman behind the painting, as well as into Leonardo da Vinci’s processes. Back at the original setting the “Mona Lisa” shows different aspects of her appearance, the background of her

dress, and a detailed view of her hairstyle. Next to that da Vinci's painting process is depicted and shows his special techniques. Another virtual experience that takes the viewer back to the original environment of a piece of history is the VR app of the Anne Frank House in the Netherlands [3]. Within this experience, the secret annexe and all the rooms it contains is furnished how it was during the hiding of the group within it from 1942 to 1944. This is a special view as the actual annexe is empty, so the virtual experience gives a unique insight into these rooms. Furthermore, additional background information is given during the virtual visit with seven languages available on the app, which can be accessed through VR headsets.

These two examples of VR experiences focus on providing additional information to a piece of history. To achieve this in an immersive way that centres the user VR was chosen, as it leads to a different impact on the visitor than merely reading or seeing it. For the Mona Lisa experience, this is mainly because it gives a different sense of the environment and of the way of life, as well as the circumstances behind the painting to the viewer. The Anne Frank House offers a unique glimpse into life in the secret annexe, which would not compare to simply seeing a picture of the furnished room. The use of VR gives the user the ability to experience this space differently, opening a more immersive way into the past. This is in itself very different from the described project, as it does not focus on history or the process behind the art. However, it offers insight into how a VR experience that is not intended to be visited in a museum can be structured. The two mentioned VR experiences come closer to a virtual reality experience and are thus less similar to an art exhibition, as it focuses on the background of a part of history.

2.3.6 Implications

These projects all have some similarities to the project of this report, but significant differences can be seen. The online collection of the Louvre and the Musée National Eugène-Delacroix focus only on presenting the art digitally to a visitor. This offers a lot of insight into different pieces and provides a great basis for research, but it lacks in the area of user experience. Similar to this are the virtual tours offered by the Louvre and the Vatican Museums, which are centred around the art, as well as the environment they are presented in. They are parts of the physical museums made available in digital form. This shows similarities in the focus on the actual art pieces but is greatly lacking in the immersion and

actual virtual reality aspect. The VOMA on the other hand takes the entire concept of an art museum and places it in the digital realm. This makes VOMA similar to this project, as it is at its basis an art museum that took the museum out of its physical space and into the digital age. However, the immersion and utilizing the potential of technology, like VR, is still lacking. The “Curious Alice” exhibition, makes use of VR technology and offers an immersive experience centred around the user. Similar to this project is additionally the fact, that the Curious Alice exhibition is built around one artist. However, the experience is not focused on the individual art pieces and the world-building done by V&A museum is very different to this project, there will be no games or quests as the story behind the art is of a too sensitive nature. The Louvre offers additionally to their virtual tours the VR experience “Mona Lisa: Beyond the Glass” which is similar in the way it focuses on one artist. This, however, is done in an almost fairytale-like fashion, which differs from the approach taken in this project. The Anne Frank House and its virtual experience is in this aspect closer to the project described in this paper, as it shows the room completely remodelled in 3D, treating the contents of it like works of art in an exhibition that is presented through an immersive experience. Additionally, background information is provided that tells the story behind the room. Overall the described exhibitions have similar aspects which serve as a basis for the ideation, as well as strong differences, offering a clear understanding of what this project is not about. This project will not be a mere virtual replication of a traditional museum but will focus on incorporating elements that VR offers.

2.5 Implications

The described background research and State of the Art show that museums and more specifically art museums have an enormous potential for the incorporation of technology. This is especially true for virtual reality as it offers a completely new way of experiencing said art. There are already some digital and even VR experiences of museums, which offer a basis for the design of this project. They focus on different aspects and ways to present their exhibitions with for example an online catalogue of art, building an entire museum accessible through the web, and a game-like VR experience surrounding one specific artwork. From each of the described existing works, different things can be taken away. However, since most of the presented experiences revolve around historical art which is quite different from

the contemporary art Remy Jungerman makes there are some basic differences. The biggest one is the focus on telling the history of the artwork, the artist, and the time they lived in. The definition of background is quite different for historical art and Jungerman's pieces. While the background for historical art is about how the artist lived and created their pieces, for contemporary pieces and especially Remy Jungerman's art the background focuses on the narrative and story behind the art. This is an incredibly rich and important part of his work, but his creative process and his life are not the aspects that he wants to convey in this project. Due to this the focus of the created virtual exhibition changes from the presented experiences. The art itself is the focal point and hinting at the narrative to create an impactful experience for the user is the main objective.

The project makes use of the concept of atmosphere to realize this. The atmosphere in a museum has a tremendous impact on the experience of the user and can be influenced in different ways. However, in the presented research the incorporation of atmosphere into the virtual reality world has not been a focus. As the literature shows the atmosphere has an influence on the visitor in a traditional museum, so we assume that the atmosphere in a virtual museum should have a similar influence on the visitor. This translation of the atmosphere into a VR context and research of the influence this has on the visitor's experience is what this project aims to do.

3. Design Process Method

The selected design process method is the “Creative Technology Design Process” as described by Angelika Mader and Wouter Eggink [36]. This process is divided into three main phases: Ideation, Specification, and Realisation [Figure 7]. Over all this method is cyclic and at every point a step back can be taken and another phase redone. This results in divergence and convergence and the best possible prototype, as at a very early stage actual ideas and prototypes are considered and evaluated.

3.1 Ideation Phase

The first phase is called the Ideation phase and leads to finding first ideas. This can have different processes, one is to start with technology. A new or interesting technology can be a motivating force to come up with ideas. The goal of this process is to find new applications for said selected technology which is often called “*tinkering*” [37] and is novel in its way to connect technology and user needs. However, new ideas can come from many sources, whether that is from sudden inspiration, a specific thinking technique, or related work. Within this project, the related work and state of the art will be used as a starting point for ideas and then new ways of combining VR and art will be explored to fulfil all the specific requirements for this particular project. After various ideas have been found they are evaluated with users or with the client through user-centred design techniques which can consist of for example user scenarios or mock-ups. Using interviews the needs, problem setting, and requirements are specified resulting in an elaborated project idea as well as the problem requirements. Additionally ideas of experience, interaction, and if applicable service and business ideas are another component of the result.

3.2 Specification Phase

The Specification phase follows the Ideation and transitions from an elaborated idea to different prototypes. These prototypes have the function to explore the design in a fast manner due to a short evaluation and feedback loop to quickly find the best design. The functionality and consequently the user experience is tested with users, or the designers, interacting with the prototypes. To find the optimal idea prototypes are discarded, improved upon, or merged using the results of the testing as its basis. The Specification phase is fast-paced and thus leads to many prototypes, which often are reduced in aspects to test different specific experiences that are elicited through these aspects. Some of these prototypes already contain some kind of technology to show a rough idea of the final aspects the future product will contain and thus enable a more fruitful first user experience.

3.3 Realisation Phase

From the previous phases, product specifications are given after exploring a number of ideas and prototypes, leading to the start of the realization of the final idea. This is done through engineering design methods, which Mader and Eggink describe as follows: *“[they] are characterized by decomposition of the start specification, realisation of the components, integration of the components and evaluation”* [36, p. 5]. This is often done through the V-Model, which is a linear model allowing the option to go back and fix decisions if needed. Within this phase, the evaluation focuses on validating the meeting of the subsequent requirements.

3.4 Evaluation Phase

The final phase of the design process is the Evaluation Phase. Throughout the entire process and within all phases some kind of evaluation has been done, however, in this final phase, the focus lies on whether all the identified requirements from the ideation phase are met. Often user testing is used as a means to verify that the decisions made in previous phases *“satisfy the user requirement and facilitate the experience intended”* [36, p. 5]. To position

the own work in the context of existing solutions related work is used. The final step is reflecting on the process to further one's own personal and academic progress.

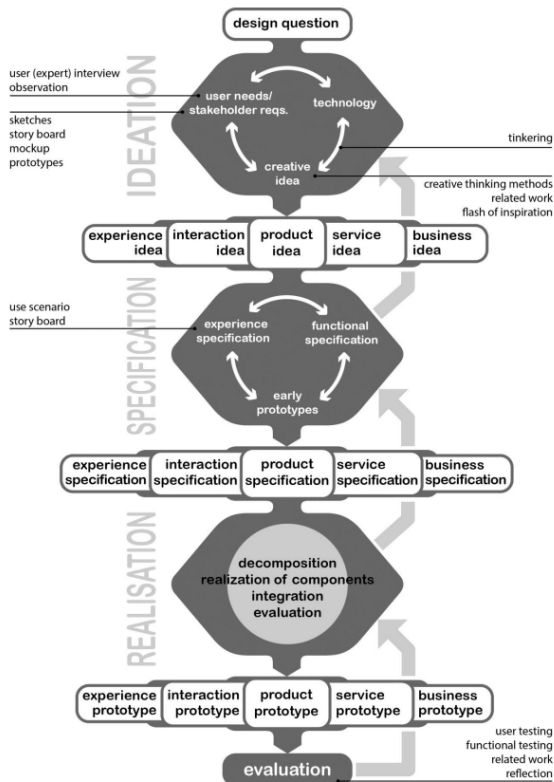


Figure 7: A Creative Technology Design Process

3.5 Significance

This method will be used in this project as it allows for an iterative approach. Starting from a technology and specific needs the method organizes the process of building a product in a technical but creatively open way that allows the designer to go through different ideas in a short time to select the most fitting one by constant evaluation and reiteration. Through the focus on the specifications and needs of the user, the main aim of creating a satisfying and innovative user experience is never lost. This is why this method was selected for the creation of this project. Furthermore, the ideas will be evaluated through thought experiments by the designer and connected designers working on similar projects to ensure a fast evaluation of ideas. The final user testing will be done through the exploration of an appropriate VR prototype and a following interview.

4. Ideation

To begin the Ideation phase, it is important to state the overall basic requirements for this project. The chosen technology is virtual reality, as it is implemented in an art museum context. The exhibited art pieces are Remy Jungerman's new and existing work, meaning it revolves around contemporary art. In conversation with him, he stated, that he does not want the experience to be too far away from a traditional museum and thus does not want "anything too crazy" [Appendix 1]. The focus should remain on the exhibition of the art. There should be some tension created to make the visitor curious and give hints about the narrative. Jungerman wants the visitor to take something away from his art, but what exactly and how much they take from the art, he wants to leave up to them. The art should trigger their imagination.

First, one round of brainwriting was done with collaborators in the same topic area. Brainwriting is a method to "*share new ideas, encourage creativity, and develop innovative ideas*" [38]. This method is similar to brainstorming in that it is a timed group ideation process, however, while brainstorming is verbal and mostly done in groups, brainwriting focuses on having each person write down all of their ideas individually. This makes it much easier for more introverted members and offers more time for coming up with ideas. Furthermore, it is easier to implement in an online ideation session. There are different ways brainwriting can be done. During this session, we decided to go a more simple route, with ten minutes of everyone writing down ideas freely. This led to a good basis of ideas. The written ideas were then grouped together to give a better overview of similar ideas [Figure 8].

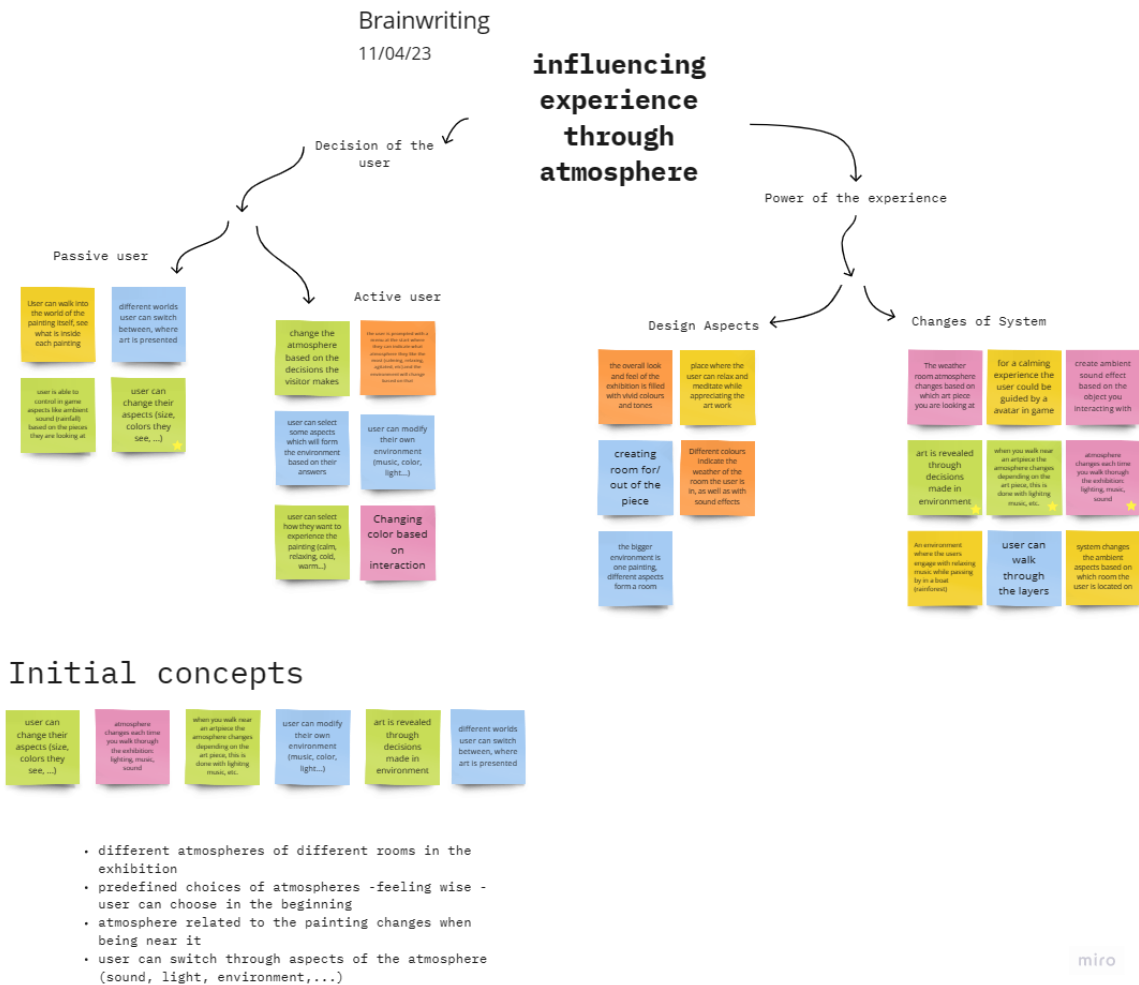


Figure 8: Brainwriting Results

From this grouping of the ideas, the individual notes were read, discussed, and finally, the favourites were marked with a star. These favourite ideas were then copied to a separate spot and once again discussed. This formed the basis of four different concepts for the final product.

These four initial concepts are:

1. The exhibition space has different rooms, which the visitor can walk through. Within these rooms, the presented art is the same, with only the atmosphere changing from room to room. This would offer the visitor the opportunity to experience the full exhibition of the pieces in different atmospheres throughout the VR museum experience.
2. At the beginning of the experience, the visitor can choose one of a few predefined atmospheres, in which they will experience the art pieces. Here the visitor can select

an atmosphere but they cannot experience the art in multiple atmospheres in one exhibition walk-through. These choices would present the visitor with different vibes, so they can choose which one they would like to experience and be a part of at the moment.

3. For each art piece, an atmosphere will be created that fits the specific work. When the visitor walks past one of the pieces this atmosphere will be presented, immersing the visitor in the experience of this particular art piece. This would give the overall exhibition space a more neutral atmosphere and feel to make the specific art-related atmospheres stand out more.
4. The atmosphere is the same for the entire exhibition space, however, the visitor can switch through some aspects of the atmosphere. This means the visitor has a more active role in changing the atmosphere they experience, and different combinations can be tried, but the aspects are predefined to not overwhelm the visitor.

After considering all four ideas more deeply and imagining how they could look in a finished version, as well as their match to the research question, the fourth idea was chosen to be pursued further. This idea offers the viewer a more active role in their experience as they can modify the atmosphere to fit their needs and the change in experience of the art can be felt by them. By not modifying the atmosphere completely, but switching through different predefined aspects different combinations can be tried, however, not too many options are given so as not to overwhelm the viewer. This idea fits, in my view, what Remy Jungerman described during the interview, as it explores different atmospheres and approaches to how an art exhibition can look, but nevertheless stays close to traditional exhibition concepts with an intriguing twist. The results of this research could be used by Jungerman in his future exhibition designs to create an atmosphere matching his artworks.

In a sketching session, the idea was visualized roughly. This helped in getting a better sense of and feel for the idea and how it could be realized. To demonstrate how this could look like three aspects were chosen that can be manipulated to change the atmosphere in a room. These were namely, the environment itself, the lighting, and music and sounds. The environment was sketched in three different ways, an older building, a more modern interpretation, inspired by Dorner's atmosphere rooms [20] with bright colours, and an idea incorporating the possibilities of VR, which featured an 'alive' wall, made up of plants. The

lighting was sketched in an exaggerated way to showcase how it would change the atmosphere, which is a warm yellowish light, a cold blueish light, and a white, neutral light. Due to its nature, the music aspects were not dawn, but different ideas could be classical music, sounds of the Winti rituals like the Agida drum, nature sounds, modern pop music, people talking in the background, or even no music at all. These basic sketches help to imagine the concept clearer and form a basis for discussions.

After working on these concepts the preliminary selection of provided art pieces by Remy Jungerman was analysed based on their colours and the main colours, complementary and aligning colours were determined. These colours were grouped together and arranged in a circle to give an overview of the ones used in the paintings and their accompanying colours. The main colours of the analysed art form the middle of the ring analysis, presented by the biggest colour circles [Figure 9]. The corresponding complementary colours lay on the bigger circle next to the main colours, these colours were averaged and the main complementary colours placed on the outside circle. On the circle inside of the main colours, the accompanying colours can be seen. Every main colour corresponds to two accompanying colours, which are to the left and right of the main colours in the colour wheel. These were averaged as well and placed in the innermost circle, presenting the main accompanying colours. The described circular colour analysis [Figure 10] presents the colours of the paintings of Remy Jungerman as well as their complementary and accompanying colours. This colour analysis will form the basis of the colour scheme used in the VR exhibitions and will mainly be used in the colourful modern exhibition space and for the lighting options, as well as used sparingly in the other exhibition spaces, following Dorner's colourful "atmosphere rooms" [20].



Figure 10: Main colours of the Art Pieces

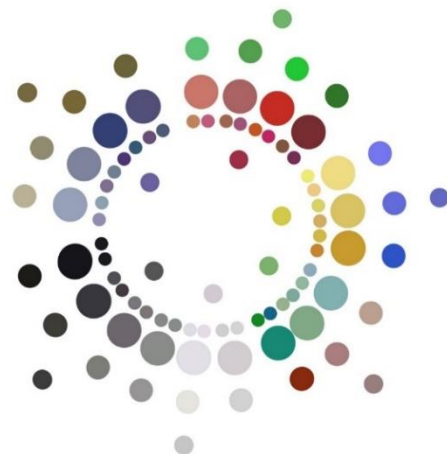


Figure 9: Colour Analysis of the Art Pieces

5. Specification

The project requires many specifications to enable the development of the final product from the starting ideas. These encompass goals, underlying principles, possible directions and explorations of the end product. Describing the specifications in detail provides a framework for the final product and is crucial to ensuring that everyone involved in the project has the same functionalities of the final product in mind.

The goals of the product can be differentiated into two groups: the goals of the system and the goals of the experience with the system. The goals of the system include being easily understandable by the viewer, having intuitive controls, and offering individually adjustable aspects of the system. Furthermore, the system should display the art of Jungerman appropriately and provide a reasonable basis for the exhibition of the art pieces, as the exhibition of his art is the focal point of the whole project. This should be done in a way that is respectful to the art and the artist, as well as the context of the art. To do this, the system has to be easily usable by the visitor and allow them to look at the art without being distracted by the system design. Ideally, the system would 'fade away' in the eyes of the user and become almost invisible to them, thus allowing the experience to be in the spotlight. The user should be able to roam around easily, feeling confident in their ability to guide their own experience. The main goal of the system is to facilitate the experience in a way that leaves the exhibition of the artworks as the focus, whilst allowing the user to be immersed in the experience.

The goals of the experience encompass having a good balance of the art and the atmosphere of the experience, having the art as the focal point and providing a variety of atmospheres in line with the showcased art. The balance of the art and atmosphere refers to the user not feeling overwhelmed and confused during and after the experience. The experience should be a well-rounded encounter that allows the visitors to connect with the art pieces. The atmosphere should support the experience and not overpower the artworks. The art is the focal point of the experience and should be presented in a respectful, professional and balanced way. With the cooperation of the artist on the project as a client this is crucial, as his work is what the project has as its basis. Ensuring the art is displayed professionally involves the balance of the atmosphere to the effect of the art. The atmospheres should be varied to investigate the influence they have on the experience of

the art pieces, but the balance of the amount, design and prominence of the atmosphere is important in creating a well-rounded experience and thorough investigation. This balance also means that the visitor does not just ‘play around’, but actually looks at and connects with the art. The overarching goal of the experience is to provide the visitor with the ability to encounter the art of Remy Jungerman in different surroundings and find an atmosphere which enhances the connection they feel to the exhibited art.

5.1 Client evaluation

In conversation with Remy Jungerman an experience leaning towards a more traditional museum experience was favoured with the incorporation of some aspects utilizing the possibilities VR offers. The artist highlighted that the focal point should be the art, with not “*too crazy*” ideas. The experience should revolve around exhibiting the art. To him, it is very interesting how the visitors experience his art and what they take from it. This experience of the visitors is exactly what I am interested in as well and is thus the point of interest of this project. Combined with the effect of the atmosphere of the environment the art is exhibited in, as it was established in the background research, this is the scope of this project. In response to the proposed idea, the artist was excited about the project and curious to see the environment consisting of ‘alive’ walls made up of plants.

5.2 Users

5.2.1 Target Users

The target users of the product are first and foremost people that are interested in modern art. This is a crucial aspect of designing a VR art exhibition. Furthermore, it is helpful if the users have some kind of interest in technology, as VR can be difficult for very inexperienced technology users to navigate, but if done correctly, it should not hinder the experience. The main target users of this product are adolescents and young adults between the ages of 16 and 26 years old. This incorporates mainly high school and university students, which was chosen as the product is supposed to be used in high schools, later on, to familiarize students with museums and a more multicultural museum experience. However, this does

not exclude the product from being used by people that are older or younger. For younger users, it is advised to use the product with a supervising adult as the level of immersion available through VR can be overwhelming.

Furthermore, because of the nature of physical museums, people that are uncomfortable in public spaces or crowds are another target user, as the incorporation of VR offers the move away from museum experiences in a crowd and towards individual experiences.

5.2.2 Use Scenario

Scenarios for usage are wide due to the location-unbound character of VR. For the specific locations, there are not many requirements, as the actual physical space used is very small in a one-user application. However, it is advisable to use a space that the user is comfortable in to facilitate an enjoyable experience and allow the users to connect easier.

The users will interact with the system by putting on the VR headset and grabbing the hand-held controllers. Starting from that point they will be guided by the system through the experience. First, a start screen will appear to explain the controls and what they will encounter in the experience. These controls include the way to navigate the world, like moving around, as well as how to tailor the experience to their needs. This entails, for example, how to change the volume of the sounds. The system is in one-player style so the surrounding environment should be calm enough to allow the user to stay in the experience for as long as they want and explore the virtual world.

5.3 Final Product

5.3.1 Interaction and Experience

The interaction of the final product will consist of the user virtually walking around the created museum space. The different environments will have different layouts and design elements to distinguish the atmospheres created by the space itself. The choice to create different environments was made, based on the research of Pilegaard [21], in which she explains that the museum space itself can be “*activated*” to become part of the exhibition. This incorporation of the space itself that houses the exhibition of art was deemed to be a powerful influence and thus selected as part of this project. In each exhibition space, the

user will be able to switch through different choices of sound and lighting. The addition of music to the exhibition spaces, as an aspect of the atmosphere was chosen based on the “*atmosphere rooms*” Dorner created [20], he included sounds of the time period of the presented artworks to give more context to the pieces. Furthermore, by incorporating music into the experience, another sense was added to encompass the visitor in the experience. Different light options were chosen, also loosely inspired by Dorner’s “*atmosphere rooms*”, as he painted the walls in bright colours to push against “white cube” museums, which he detested. This incorporation of colour instead of a supposedly neutral white, combined with the bright white lights I noticed in many of the accompanying pictures of the mentioned research inspired me to use the white lights as my walls and change them similar to Dorner. This was aided by the personal experience of the effect light has on a space that comes even from the slightest changes between warmer and colder tones. Through these combinations, different atmospheres are created which influence the experience of the art by the viewer. This adjustability and power of active influence are important to offer the user as they should feel empowered by the technology to be active and experience the art on their own terms. The visitor should have choices but not be overwhelmed by them. Rather the choices should encourage active participation and the user taking control of their experience. The experience is centred around the exhibition of art pieces by Remy Jungerman. This focus should not be shifted towards merely exploring the different environments and exhibition rooms. Connecting and being inspired by the art is what the experience is about, which is why the different environments should not overpower the art. This balance is key.

5.3.2 Functionalities

The product will focus on exhibiting the artwork made and provided by Remy Jungerman. These pieces should be presented in a way that allows for a lot of details, as the visitor should be invited to get close and really inspect the art. The level of detail should run throughout the virtual representation of the art to allow the visitor to look at the pieces from different angles. This detailed display of the art allows for an experience that comes close to the encounter with the art in a physical, non-virtual setting. Furthermore, the product will allow the user to watch a short film made by Remy Jungerman to give a better glimpse into his work. To give a more immersive atmospherical experience to the user, the product should be able to play audio. The user will be able to move around the exhibition spaces, These exhibition spaces will have different designs and layouts to give the feeling of being in

different museum spaces to intensify the researched effect. The user will be able to switch between these music and lighting options to create their own favoured atmosphere within each area to connect with the artworks. This will be done through active interaction with the environment further intensifying the realism of the experience, but still maintaining the virtual reality aspects and wide range of possibilities.

5.4 Product Requirements

The product requirements detail what the product needs and should have in its final version. This allows everyone involved in the project to have the same idea of where the goals lay as well as which features the product will have in the end. This accomplishes that everyone is on the same page about the project and there are no misunderstandings or different ideas. To classify these requirements there are two different categories: functional and non-functional requirements. To better show these requirements I used an approach as described by van Velsen, Wentyel and Van Gemert-Pijnen [39]. It features the development of a multidisciplinary requirements approach that uses a tabular template to classify and describe each requirement in detail. Thus allowing for a clear overview and structured documentation that enables every person involved in the realisation process to be on the same page. The requirements, as presented in the following figures are the functional and non-functional requirements of this system. The requirements are in no particular order and the priority can be seen in the figures. Additionally, the requirement type, value, attribute in the system, description, rationale and possible conflicts with other requirements are detailed.

5.4.1 Functional Requirements

The functional requirements include the description of what the system does. The main focus is the exhibition of the art by Remy Jungerman. This encompasses flat and sculptural pieces. The depictions of these should be detailed and as close to the original pieces as possible, as the visitor should get the same feeling as they would standing close to the actual piece. The

quality of the exhibited objects and the rendering of the objects within the chosen software needs to be high enough to allow for a good view of the art and show details, which include, for example, the textures of the individual materials used in Jungerman’s work. The system has to allow for movement by the user through the exhibition space. This enables the visitor to look at every art piece actively and independently. Furthermore, the system should allow for the display of audio and video, as a short film by Remy Jungerman will be shown and music used to immerse the visitor in different atmospheres. The system should therefore include different atmospheres or aspects of the atmosphere surrounding the artwork and thus allow the visiting user to evaluate the effect this has on their experience. These aspects are namely the display of different exhibition spaces, lighting options, and music. The technology should give the viewer control over their own experience and allow them to actively partake in creating an experience which allows them to truly connect with the art. These requirements are further shown in the following figures [Figures 11-17].

Requirement #: 1		Requirement type: Functional
Value: Experiencing the artworks		Attribute: 3D Models
Description: Having high quality 3D models of the artworks, with the appropriate textures and details.		
Rationale: To ensure an experience, as close to an exhibition of Jungerman's real artworks as possible, the pieces have to be remodeled in a way that allows for a good level of details. The visitor should be able to get close to the artworks and see the details Jungerman adds to his works. The system has thus be able to display this.		
Priority: High	Conflicts: Possibly the smooth experience, as the complexity and number of the models affect the necessary computing power.	

Figure 11: Requirement #1 – Representation of the artworks

Requirement #: 2		Requirement type: Functional
Value: Experiencing the video		Attribute: Film “Broos” by Remy Jungerman
Description: Being able to display the film “Broos” by Jungerman.		
Rationale: The film “Broos” is one of Jungerman's works and offers the visitor a better understanding of the narrative. The film hints at this narrative and should thus be included in the exhibition.		
Priority: Medium	Conflicts:	

Figure 12: Requirements #2 - Video

Requirement #: 3	Requirement type: Functional
Value: Adapting the atmosphere	Attribute: Music
Description: Being able to play and switch through the music option.	
Rationale: To give the visitor some power over their experience and allow them to adapt the atmosphere to their preferences, the system should be able to play audio. Furthermore, the playable music should be changeable by the visitor.	
Priority: High	Conflicts:

Figure 13: Requirement #3 - Music

Requirement #: 4	Requirement type: Functional
Value: Movement	Attribute: Virtually "walking"
Description: Being able to move through the spaces.	
Rationale: To give the user the ability to see different artworks and give them the power over their own experience, the system should allow the user to virtually "walk" around the space.	
Priority: High	Conflicts:

Figure 14: Requirement #4 - Movement

Requirement #: 5	Requirement type: Functional
Value: Changing the atmosphere	Attribute: Buttons
Description: Being able to interact with the environment and change the atmosphere.	
Rationale: To give the user some interaction with the space, they are able to push buttons to change aspects of the atmosphere, these are namely the light and music.	
Priority: High	Conflicts:

Figure 15: Requirement #5 - Changing the atmosphere

Requirement #: 6	Requirement type: Functional
Value: Adapting the atmosphere	Attribute: Light
Description: Being able to switch through light options.	
Rationale: To give the visitor some power over their experience and allow them to adapt the atmosphere to their preferences, the system should be <u>display</u> different light options. Furthermore, the lights should be changeable by the visitor.	
Priority: High	Conflicts:

Figure 16: Requirement #6 - Light

Requirement #: 7	Requirement type: Functional
Value: Having a smooth experience	Attribute: A minimum of 120 FPS
Description: Having a smooth experience that does not feel glitchy.	
Rationale: To ensure an enjoyable experience, the system should be running smooth enough to not have glitches in the visuals or audible aspects. According to research this means having a minimum of 120 FPS.	
Priority: High	Conflicts: Possibly the detailed representation of the artworks, as the complexity of the elements in the environment affect the necessary FPS to ensure a smooth experience.

Figure 17: Requirement #7 – Smooth Experience

The research, as mentioned in the rationale of Requirement #7 [Figure 17] is namely the research done by Wang et al. [40].

5.4.2 Non-Functional Requirements

In this version of the system, the functional requirements described above were translated into the following non-functional requirements, which illustrate how the system does what it does. The art needs to remain the focal point of the experience, every choice made and every design should work towards highlighting the art. The design of the environment will be created with the art of Remy Jungerman in mind, as well as the context of his work. Within the environment links to his life and the different locations often referenced in his work will be made thus creating a well-rounded experience. The design of the environment will take inspiration from Paramaribo in Suriname, New York in the United States of America and Amsterdam in the Netherlands, as well as the style of his art. These places are where Jungerman lived and currently lives, and are mentioned often in interviews as being sources of inspiration, particularly the combination of these three. More specifically this means the three exhibition spaces will be inspired by museums in these locations and the design will reference the clean lines of his works, as well as the balance of colour while maintaining a professional look. However, the art should remain the focal point of the experience, meaning the environment should not be overpowering or distracting for the user. The system should run smoothly and allow for easy movement, as well as have intuitive and logical controls. How to use the system should be easy to understand. The design of the interface should be intuitive as well and not overpower the experience or distract the user. This same process will be done for the adjustable controls to ensure a comfortable experience for various people. In the figures below these non-functional requirements are shown and classified regarding their importance [Figures 18-22].

Requirement #: 8	Requirement type: Non-Functional
Value: Different atmospheres	Attribute: Different exhibition spaces
Description: Being able to experience different exhibition spaces.	
Rationale: To give the visitor different atmospheres to experience the art in, different exhibition spaces are needed. This allows the user to compare the effect of the atmosphere on the users.	
Priority: High	Conflicts:

Figure 18: Requirement #8 - Different Exhibition Spaces

Requirement #: 9	Requirement type: Non-Functional
Value: Giving hints to the narrative	Attribute: Exhibition space designs
Description: Giving the visitor hints to the story through the design of the spaces	
Rationale: To give the visitor some insight into the narrative of the art, the design of the exhibition spaces should hint towards this, without giving the story away. This includes references to the three important locations.	
Priority: High	Conflicts:

Figure 19: Requirement #9 - Hinting at the Narrative

Requirement #: 10	Requirement type: Non-Functional
Value: Focus is on the art	Attribute: Not overpowering environment
Description: The environments should not be overpowering or distracting.	
Rationale: To give the visitor the ability to focus on the art and ensure the art is the focal point of the experience, the environments should not be overpowering or distracting to the user.	
Priority: High	Conflicts:

Figure 20: Requirement #10 - Focus on the Art

Requirement #: 11	Requirement type: Non-Functional
Value: Easily understandable by the user	Attribute: Controls and use information text
Description: Being able to understand the controls easily.	
Rationale: To allow the user to have an enjoyable experience the controls should be easy to understand for them. This should be easy enough for them to understand in less than 30 seconds.	
Priority: High	Conflicts:

Figure 21: Requirement #11 - Easily understandable

Requirement #: 12	Requirement type: Non-Functional
Value: Reasonable context of the spaces	Attribute: Exhibition space design
Description: To exhibit the art in a respectful, professional and appropriate way.	
Rationale: The context of the spaces should have an appropriate design that is reasonable in its interactivity and references to the narrative. This is important to create a professional and respectful experience.	
Priority: High	Conflicts:

Figure 22: Requirement #12 - Context of the Exhibition Spaces

5.5 Conclusion

The main takeaways from this specification are that the art should remain the focus and every additional feature and design should work towards the same goal of the user connecting with the art pieces. Presenting the art in a professional and balanced way is the most important. For this, the art needs to have a good virtual representation with a high level of detail to allow for close encounters. Next to that are some necessary features, for

instance, the ability to create different atmospheres consisting of different environments, lighting options and sounds. Furthermore, keeping the target group and described use scenarios in mind when designing these features and aspects is crucial to ensure the end product will be a well-rounded experience. Having all these different aspects that will make up the end product in one place and written down is important to ensure everyone involved in the project is on the same page. Additionally, it gives me a clear structure of what needs to be done and what I am working towards.

6. Realisation

After the Specification and the Ideation, I first chose to create four different exhibition spaces. Four were chosen to have a wider range of current museum spaces, as well as experimental spaces. Those four spaces were namely, a neutral exhibition space inspired by the 'white cube'-design that many traditional modern museums implement. This was chosen because Jungerman's art is modern and typically his exhibitions would be presented in such museums. This neutral environment does not allow for interactions and is thus closest to a traditional museum, providing a baseline for the responses of participants. The second exhibition space was a modern museum inspired by Dorner's atmosphere rooms [20] with a minimalist layout but the incorporation of bold colours, as well as the option to change the music and lights. This would provide a more experimental exhibition space whilst remaining close to the style of the art. The third exhibition space would be inspired by historical museums and designed to resemble a historical building with corresponding decorations. This exhibition space would allow for a change in light and music as well. The incorporation of a historical space was chosen because next to modern museums historical museum buildings are most common and allow thus the experience of Jungerman's art in a museum environment that is not typically used to exhibit modern art but is familiar to museum-goers. Lastly, an 'alive', forest exhibition space was chosen to include a more experimental exhibition space design, contrasting the typical museum design. In this space, a change of lights and music would be possible as well.

However, because of time restraints and a great reduction of realistically attainable participants for each exhibition space one of the originally planned exhibition spaces was scrapped. By merging the modern exhibition space and the neutral, non-personalizable exhibition space this reduction to three spaces was achieved. When designing the different spaces I chose to reference elements of Remy Jungerman and aspects he highlighted in interviews.

6.1 Modern Exhibition Space

6.1.1 Design

The modern and “neutral” exhibition space is inspired by museums such as the Museum of Modern Art [41] in New York and the Van Gogh Museum [42] in Amsterdam. These museums were selected as inspiration as these cities play an important role in Jungerman’s



Figure 24: New Entrance Hall of the Van Gogh Museum [56]

life. He continued his studies in Amsterdam where he lived until moving to New York. Both of these cities were and currently are his adopted homes after leaving Paramaribo, Suriname, to continue his studies and work. I focused on the new entrance hall of the Van Gogh Museum [Figure 24] which is minimalistic in its design and colour choices with a big open space in neutral colours.

The floor is made of concrete and it features a prominently placed staircase in the same concrete with a glass rail. Similar to this design is the Museum of Modern Art (MoMA) in New York [Figure 23] which has a very clean and minimalistic design. Most surfaces are unicolour in white, with a light-coloured wooden floor. The textures within the museum are minimal and the colour scheme is very light. The space is big and open with high walls and simple shapes. I grouped all of these elements together

and designed a modern exhibition space inspired by these two museums.



Figure 23: Impression of a MoMA Exhibition Space [57]

The exhibition space is kept in the same light colour scheme as the museums with white walls and a concrete floor. To add some interesting elements inspired by the Van Gogh Museum I added a concrete ramp with a glass rail. A ramp was chosen instead of a staircase to facilitate easier and smoother walk-up whilst providing additional display space. I wanted to add artwork onto the wall next to the ramp and using a ramp instead of stairs offers the visitor a smoother view of the art as they are moving up the ramp in one smooth motion compared to small vertical increments when using stairs. This ramp and hint at a second level make the space feel less empty and more open and interesting. As this exhibition space is the “neutral”, non-

personalizable exhibition space there are no buttons to change the lighting or add

background music. This exhibition space is designed to feel the most like a traditional museum and offer the user a similar experience to a traditional museum visit.

6.1.2 Implementation

These design choices were implemented by modelling each element of the design in Blender, a 3D modelling software. For the modern exhibition space [Figure 25], this entailed

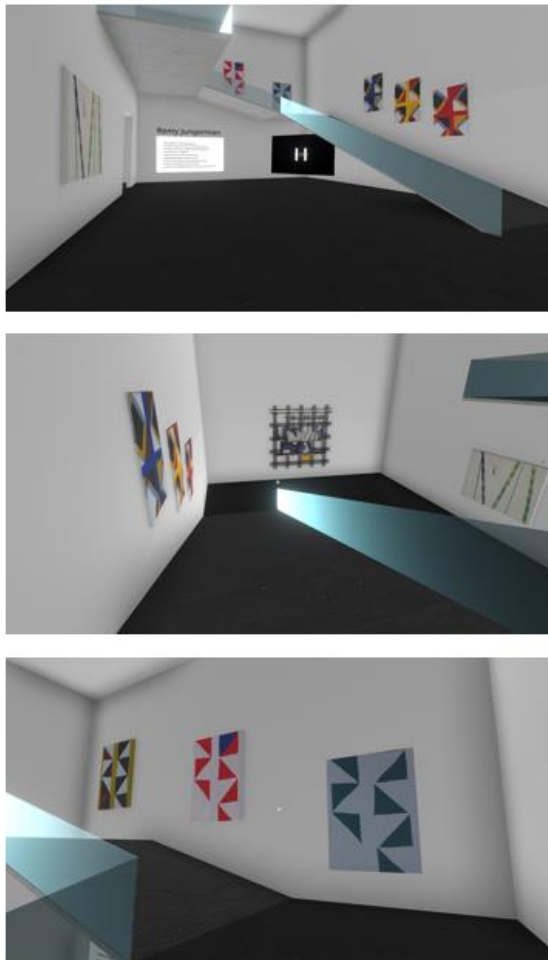


Figure 25: Impressions of the Modern Exhibition Space

modelling the exhibition room, as well as the spawn room, where the user would start their experience, as a cube. This first room is all white to provide a neutral entrance into the experience that looks the same for all exhibition spaces, complete with a short text that quickly explains the necessary controls of VR. The ramp and glass rail were modelled by shaping two individual cubes to create a slope that allowed for a steep, but not uncomfortable walk upwards. The individual faces of these models were then textured. The concrete texture of the modern exhibition space was found on ambientCG [43], which is a website that offers Creative Commons0 assets and textures. The used concrete texture is Concrete034. Additionally, I used a glass material from NeosVR, which is the software that enables the creation of a virtual environment. The modelled room with the glass rail and

concrete texture was imported into NeosVR. Here the exhibition space was turned into a realistic virtual environment. This was done by giving the glass rail a glass material named “P BS Rim Metallic” as well as adding lights, and colliders to the exhibition space. These colliders ensure that, like real walls, the user cannot walk through these and can walk up the ramp.

6.2 Historic Exhibition Space

6.2.1 Design

The historic exhibition space is inspired by museums such as the Metropolitan Museum of Art [44] in New York, the Willet-Holthuysen House [45] in Amsterdam, and the Presidential



Figure 27: Impression of an Exhibition Space of the Met [58]

Palace [46] in Paramaribo, which is the symbol of the Surinamese Independence from the Netherlands. The Metropolitan Museum of Art (Met) [Figure 27] is kept in subdued and neutral colours with big rooms in a clean design. The floors are mostly either light-coloured stone or wood and there are some design elements on the walls, for example, wall

panellings and other details typical in historic buildings. The walls where the art is displayed are mostly of a minimalistic design compared to the more opulent facades of the historic building. Contrasting this is the Willet-Holthuysen House [Figure 26], which has a more colourful and bold design. This museum has fully furnished rooms with many golden design elements. The walls are covered in bold colours and patterns, with golden bordures, and art in opulent golden frames. This design is continued with big golden chandeliers in most



Figure 26: Impression of a room of the Willet-Holthuysen House [59]

rooms. The Presidential Palace in Paramaribo [Figure 28] on the other hand is mostly white from the outside, with many arches and columns decorating the exterior. There are many different decorative elements, for example, different fences, windows, wall panellings, and columns on the façade of the palace.

All of these different buildings influenced the design of the historic exhibition space. After first planning on incorporating bold colours comparable to the Willet-Holthuysen House, I

was advised by my supervisors to rethink the decorations and the overall business of the first ideation designs. I decided to keep the colour scheme more subdued and closer to the Met than the Willet-Holthuysen House, moving away from the originally planned Dorner-inspired exhibition spaces, and basing the design of the exhibition spaces less on his “*atmosphere rooms*” and more on a simpler implementation of atmosphere.



Figure 28: Presidential Palace in Paramaribo [60]

However, I wanted to keep some decorations to create a historical-looking environment and try to catch the atmosphere of these historical museum spaces. To do this I took inspiration from the decorations present in the Willet-Holthuysen House, namely the square golden wall bordures and the chandeliers. This was done to create a more realistic-looking historical exhibition space. From the Presidential Palace, I recreated the arches to use instead of doors, as well as a simpler version of the columns to make the space more open and include some architectural elements to make the space more interesting. These architectural elements were given a marble texture, adding some dimension to the models. For the floor, I chose a fishbone wooden texture, similar to those found in some rooms of the Met. The walls were given a slightly rough off-white texture to further add to the old, historic feeling of the space. The overall layout of the space was chosen to be an octagonal shape, referencing the Dagwe art piece, which is a decagonal piece of Jungerman’s. The space is made up of two octagonal rooms, connected through a rectangular hallway. I chose this rather unusual layout to give the space an interesting feel, urging the visitor to explore the space. This was mentioned by Jungerman in a conversation we had with him. There he stated that in his exhibition spaces, he wants to “*create tensions in the space*”, where people can circle the space and are “*not simply leaving and entering*”. By creating two separate rooms with a connecting hallway I tried to make the visitors curious and allow them to explore the space [Figure 29].

6.2.2 Implementation

All of the described elements were modelled in Blender by me, including the different rooms, columns, arches, chandeliers, and wall decorations, as well as the room the user spawns in.

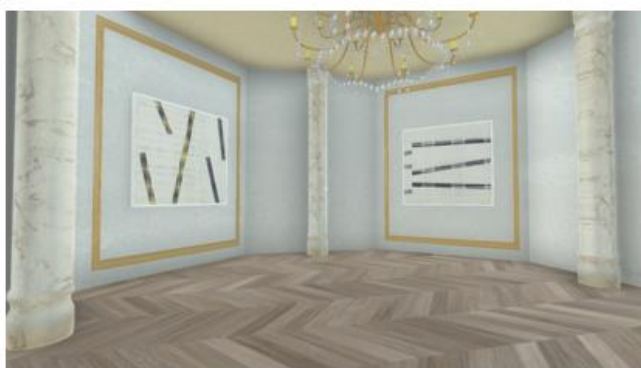


Figure 29: Impressions of the Historic Exhibition Space

The first room was chosen to be a neutral space, similar to the first room of the modern exhibition space, with only instructions on how to use the VR controllers. To keep for example the golden wall borders and the arches as close to the original inspiration as possible, I used pictures of these elements as references, modelling them as seen in the pictures. Additionally, the models were given textures from ambientCG [43]. For every golden surface and element in the historic exhibition space the Metal007 texture was used, the marble of the columns and arches is called Marble014, the wall texture is called Plaster001, and the name of the fishbone wooden floor texture is WoodFloor057. All of these models were imported into NeosVR, where the exhibition space was given lights and colliders to recreate a physical environment. For the gemstones of the chandeliers, the Center Glow Material of NeosVR was used.

6.3 Forest Exhibition Space

6.3.1 Design

To create a connection between the heritage of Jungerman, the story behind his art and the exhibition space, I chose to design an exhibition space reminiscent of a forest [Figure 30]. The space is inspired by Suriname. Suriname is the country with the highest percentage of forest in the world [47]. Many settlements of the Maroon were in these forests, and some Winti rituals are still held in the forest, as can be seen in the film “Broos” of Remy Jungerman, which is often featured in his exhibitions. The exhibition space features trees and other plants, which can be found in the Surinamese rainforest. The “forest” in the exhibition space consists of five different plant species. These plant species were selected from the iNaturalist website [48] and are namely, Yautia Madera, the Açai Palm, Taro, and the Rubber Plant. The plants were modelled and placed in an oval room, allowing the visitors to walk



Figure 30: Impressions of the Forest Exhibition Space

around a small island of plants, while there are plants surrounding them. I chose this circular layout to create a space that feels natural in its shape and allows for an open feeling of the space. For this exhibition space, I took the comment of Remy Jungerman in our meeting literally by designing a room where people can literally “circle around”. This is the most experimental of the three exhibition spaces, with which I wanted to create a space displaying art, that does not feel like a traditional museum. I meant for it to feel open, calm, and intriguing, while still relating back to the works of art it exhibits.

6.3.2 Implementation

The space was created by modelling the oval room, as well as a rectangular room, where the experience begins, allowing the visitors to walk into the exhibition space after reading the control instructions of VR again. All of the leaves of the selected plants were

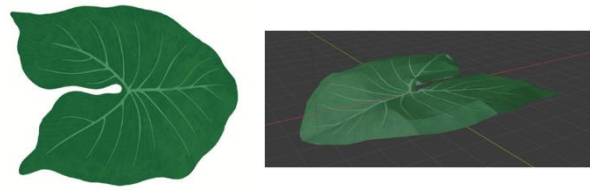


Figure 31: Hand-drawn Yauti Madera leaf and created 3D Model

drawn by me. For this, I used the pictures of the iNaturalist [48] as references and drew the leaves by hand using a tablet [Figure 31]. These pictures I imported into Blender and created models of the leaves. I then used Photoshop to create Normal Maps of the pictures and

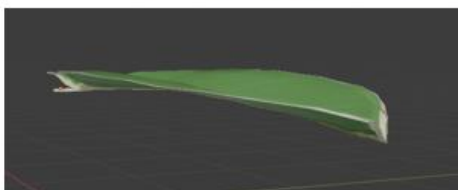
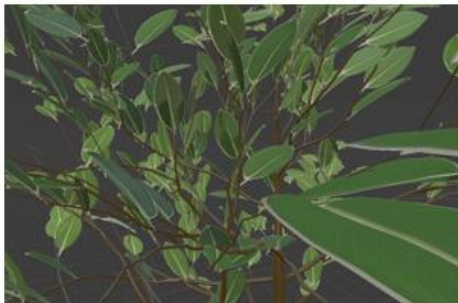


Figure 32: A closer look at the modelled Rubber Plant

combined these Normal Maps and drawn pictures to texture the leaf models. I created in total seven different leaves of the five plants I selected. Using the free modular tree add-on [49] created for Blender I made seven different plants [Figure 32]. Because of the limited computing power of my laptop and the high number of nodes of each tree I had to significantly reduce the originally planned amount of plants within the exhibition space. This is why I decided to take a picture of an assortment of plants to use as wallpaper for the exhibition space. With this, I tried to still keep the look of a forest, while keeping the number of trees manageable not only for my computer but also for Neos. The rest of the surfaces of the exhibition I decided to keep in a white colour, as well as a greyish floor, so as not to overpower the already busy environment. All of these different elements were imported into Neos, where colliders and lights were added to create a navigable space. To add some more dimension to the space I selected some of the plants to slightly move as if they were standing in a light breeze. I chose to add this to make the space less static and more like an actual forest. With the help of NeosVR and the Wiggle component, I realized these small movements.

6.4 Sounds and Lights

6.4.1 Design

The chosen interactions visitors could customize their experience and their space with are the lighting and sound. These were chosen by me, as they are two elements that do not influence the artworks themselves too much, but still have a big influence on how people experience spaces. Sounds and light affect the atmosphere of a space and are thus suitable for this research. Additionally, the incorporation of sound allows the inclusion of another sense into the experience of art. I chose for both sound and light each three different options, offering a selection, while still being manageable for the users.

6.4.1.1 Light Types

For the light, the three options manifested themselves in a white and “neutral” option, a yellowish, warm option, and a blueish, colder option [Figure 33 & 34]. At the start of the experience, as well as in the modern exhibition space this white light is selected and only changes when the user presses the light button.



Figure 33: Different Light Options in the Historic Exhibition Space



Figure 34: Different Light Options in the Forest Exhibition Space

6.4.1.2 Music Choices

For the sounds, I chose silence when the user is starting the experience and for the modern exhibition space. This can then be changed by the user to Jazz and classical orchestra music. The Jazz was selected as Remy Jungerman's first solo exhibition was titled "Brilliant Corners" after the album and song by Thelonious Monk. In an interview during a virtual walkthrough of his exhibition, he explained this title: *"For me, Brilliant Corners, the title, is actually making this triangle of Suriname, New York, and the Netherlands complete and that is especially in the sense that if you look at the latest works of Mondrian, they sort of became more vibrant [...] after listening to Monks rhythm, so I tried to combine all that and tried to understand or tried to get to a new language [...] I'm expressing in these works."* [50]. This explanation was why I chose to add Jazz music as an option, to refer back to this first exhibition and incorporate another link to the connection between Suriname, New York, and the Netherlands, the three homes of Jungerman. The second music option was chosen to be a more classical, orchestral piece, providing a very different feeling. I chose this as the other option because I wanted to have two different music options to show the difference in effects they have on the experience. I chose a more dramatic orchestral music piece to fit the historical exhibition space and the drama this space inhibits. There were other ideas, for example, using a piano piece similar to the film "Broos" by Remy Jungerman to link back to this piece, but I decided to go with the more dramatic orchestral piece to have very different choices available.

6.4.2 Selecting Light and Music

The specific light colours were chosen by me in the exhibition spaces in NeosVR, to see and feel the effect firsthand. I opted for a blueish and yellowish, which did not seem overpowering to me, but still allowed the effects of a warmer and colder light. The specific sound I chose was a Jazz loop, which sounded the most similar to me to the song "Brilliant Corners" by Thelonious Monk. It is not an exact match, but the closest I could find with a free licence. The song is called "Rusted Maid" [51] from the freesound.org website. For the classical, orchestral sound I chose a sound called "Orchestral String Loops" [52] from the same website. This sound was chosen as it was a contrast to the Jazz sound, and not too busy, making it great for background music.

To switch through these options I created two buttons in NeosVR [Figure 35 & 36]. At the



Figure 35: Buttons of the Forest Exhibition Space

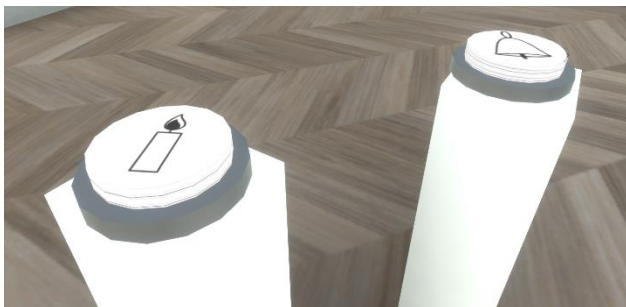


Figure 36: Buttons of the Historic Exhibition Space

beginning of the realization, I planned on having these as buttons in an ever-present interface. However, after feedback from my supervisors, I changed my plan to incorporate these as a light switch and a music source matching the environment.

The light switch would have been fitting the aesthetic of the exhibition spaces and the music source as well with, for example, a gramophone in the historical exhibition space. However, during the pilot tests the testers did not find even buttons on the wall to change the sound and light. That is why in the end I opted for white rectangular poles with a simple button on

them. I positioned these in the middle of the rooms, to ensure that the participants would find the buttons and know to press them. To make these button poles stand out I gave them a white colour, highlighting the miss-match to the rest of the exhibition spaces. With this, I hoped to draw further attention to these possible interactions, prioritizing the participants finding the buttons and being able to change the exhibition space over a more interactive experience. I gave the buttons a classic circular button shape and a picture to display which button is responsible for the light and which one for the sound. I drew two different sets of pictures, matching the environment to show symbolically which exhibition space they belong to, making them fit the environment more. For the historical exhibition space, I drew a candle, matching the chandeliers in the space, and a bell, to further show the historical feeling of the space. For the forest exhibition space, I drew a sun, matching the natural feeling, and a musical note. This music note was first a bird, but in the pilot test the participants were confused as to why a button with a bird symbol played Jazz and Classical Music instead of bird sounds. After the pilot tests, I changed the nature-fitting bird and opted for a simple musical note symbol.

To switch the sounds and lights through one button each, I used the `ButtonValueCycle` component of type `colour` to switch the colour of the lights in the space. For the sound changes, I used the `AssetMultiplexer` of type `AudioClip` and the `ButtonValueCylce`

component of type int. These, combined with the Physical Button component, allow this button to be pushed and switch through the lights and sounds. All of these, as well as the creation of the buttons and button poles, was done in NeosVR.

6.5 The Art

6.5.1 Design

To showcase many art pieces by Remy Jungerman, I decided to use different works in each exhibition space. The only constant is the film “Broos”, which I showcased in every exhibition space, as it gives more insight into the story behind the art and offers a different medium to experience Jungerman’s art. To still have some cohesion and fair distribution between the exhibition spaces, I chose to put similar pieces in the different spaces. This means that every exhibition space has one or more Pimba artworks, the film, at least one of the three-piece variations of silkscreens, and a more sculptural piece. This more sculptural piece is in the forest exhibition space in the SM collection, the Dagwe art piece in the historical space, and the WiseWorks piece in the modern exhibition space. With these distinctions and

Remy Jungerman is a Dutch-Surinamese artist.
In his work, he explores the culture of the Surinamese Maroon.
The Maroons were formerly enslaved people that escaped slavery
and created their own settlements.
Jungerman honors his ancestors and their culture
by implementing traditional materials into his art.
Another big role in his art play three defining regions, namely,
Suriname, the United States, and the Netherlands.
A connection to and between these places can be seen in many of his works.

classifications into similar art pieces, I hoped to create interesting exhibitions in each space. To highlight the artist and give some context to the art, I added a “Remy Jungerman” sign to each exhibition space, as well as a brief biographical text [Figure

Figure 37: Brief informational text about Jungerman, incorporated in every exhibition space

37].

6.5.2 Implementation

Remy Jungerman provided us with high-resolution images of his artworks and permission to remodel these, so they could be presented properly in VR. Every art piece displayed in the three exhibition spaces was modelled by me using Blender as software. The only exception to this are the silkscreens, which Jesper Hoogenkamp remodelled. Apart from these I remodelled and textured every piece as they are displayed in the exhibition spaces. For this,



Figure 38: Remodeling of 'Wise Words' by Remy Jungerman

I imported the images into Blender to accurately remodel the pieces. The textures were created through Photoshop, in which I compressed each image, to reduce the necessary space, as that is a limited resource in NeosVR, and placed it onto the models. To give some depth to the art, which is crucial for such sculptural pieces as Jungerman's, I created Normal Maps of each piece in Photoshop and added them to the texture in Blender [Figure 38 & 39]. After this, all of the remodelled artworks were imported into Neos where I placed them into the exhibition spaces. The film did not have to be remodelled, but could simply be played in NeosVR.

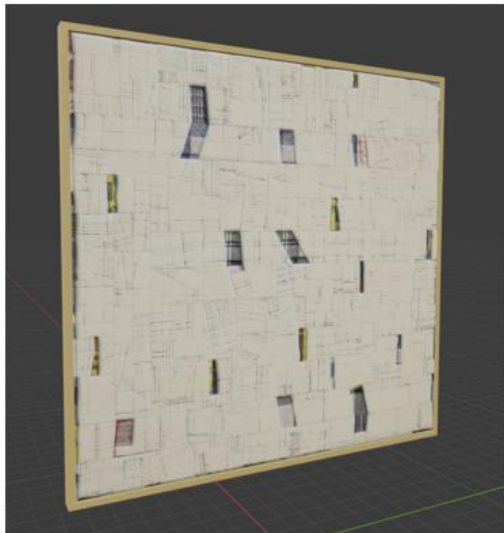


Figure 39: Remodeling of 'Pimba Agida XIII' by Remy Jungerman

7. Evaluation Method

7.1 Participants

The participants were recruited through an interest form that was sent to the group chat of the study program, asking friends and friends of friends to reduce the possible bias, spreading flyers around campus with a QR code leading to the mentioned interest form, as well as asking unknown people on campus. All of this was done with two additional researchers, with similar projects, which are also under the overarching theme of Remy Jungerman's art. These researchers are Jesper Hoogenkamp and Felipe Ramires. Because of this and the willingness of some participants to take part in more than one of these user tests, there might have been some learning effect between the participation in the different user tests. Additionally, this is the main reason a percentage of the participant knew Jungerman and his art before engaging in the research. The participants did not receive compensation, but to thank them for their time and feedback they were offered sweets.

The exclusion criteria used was that participants had to be older than 16 years of age, allowing them to give informed consent. This ability is essential and everyone unable to grant this would have been excluded from the research. Every participant has to have power over their upper body, allowing them to use the VR headset and the hand-held controllers. This is necessary for the participant to be able to have control over their experience and interact with the virtual environment. Furthermore, the participant has to be able to use the system and make independent choices. Because of the effects commonly caused by the use of VR, which are namely motion sickness or nausea, people that are prone to these were excluded. These effects are clearly stated in the information letter [Appendix 5] and consent form and were explained again by the researcher during the testing session. People that were over the age of 16, had control of their upper body, had no proneness to motion sickness and were able to make independent choices were included in the research.

The user testing was done with 15 participants. However, I decided to exclude one of the participants from the analysis of the test, due to the participant being stressed and thus rushing the testing procedure. This was mentioned by the participant themselves several times during the testing and answered one of the questions that because of the time stress,

they did not look at the art very long and thus couldn't answer the question. Because of this, I decided to exclude this participant, as the participant needs to be able to engage in the experience and be immersed in it to answer the questions in a meaningful way. The remaining 14 participants had a mean age of 21.57 years, with the youngest participant being 18 years and the oldest 26 years old. The majority of these participants did not know Remy Jungerman before their participation and had not seen art of his before. The ratio of participants that knew and have seen art of Jungerman before compared to participants that did not know Jungerman or his art was 64.3% to 35.7%.

7.2 Experiment Setup

The testing was done with an Oculus Quest 2 that was wirelessly connected to an ASUS Rapture Router. This was done to give the participants more freedom to move and not be reliant on cables. The Oculus Quest 2 was connected to an MSI GE66 Raider Laptop, lent from the Interaction Lab of the university, which provided enough computing power to support a smooth experience of the VR exhibitions. This laptop was in turn connected to the router, thus connecting it to the VR headset. The virtual experience was created in NeosVR [53], through which it was also shown to the participant. To connect with the headset and make the whole experience possible Oculus Rift and the SteamVR [54] software were necessary as well.

The testing was set up in a reserved room from the Interaction Lab, which provided a quiet and calm environment for the participants to experience the exhibitions in. In the room, there was an approximately two by two meters area dedicated to the use of VR. This gave the participant enough space to move around freely and not feel confined. Additionally, there was a table for the researchers to set up the laptops, take notes and place the headset on while it was not in use.

7.3 Testing Procedure

Every user test was done individually and I first informed each participant of the information letter [Appendix 5] and the consent form [Appendix 6]. They read through the information letter and signed the consent form. After this, I explained what they were about to

experience and the procedure of the testing. This entailed the length of the test of around 30 minutes once more and the two separate parts of the testing procedure. These parts each contain first experiencing the exhibition space, filling out a questionnaire, and finally answering some open questions in a conversation with the researcher. Once the participant understood this order I explained the controls of the VR and together with the participant we tried to make the headset fit as comfortably as possible to minimize discomfort and blurriness due to ill-fitting headsets. Once this was set, I gave them the hand-held controllers and started the first exhibition space. The first thing the participants see in each exhibition space is a wall, with a short explanation of the controls, so they can see how they work once more. All three of the exhibition spaces allowed for interaction. These interactions were clicking a video to let it play and or pushing two buttons for two of the environments. As each participant experienced two of the three exhibition spaces it was necessary that I control for order of the testing by randomly choosing which and in which order each participant would experience the spaces. Because of this design, I gathered 28 responses in total from the 14 participants spread over the three exhibition spaces. The complete testing procedure took about 30 minutes per participant, however, this timing was not strictly enforced. I did not stop participants during their experience in VR, as no participant spent more than ten minutes in one exhibition space.

7.4 Design and Analysis

The experiment was a within-subject research, as each participant tested two of the three exhibition spaces.

During the exploration of the exhibition space I observed and noted down what they were looking at, selecting, and how they were acting, as well as possible comments they made. Additionally, I stopped the time of how long they were in the exhibition space. Originally I planned on asking the participants to think out loud during their time in the exhibition space, as I was hoping to gain additional insights into what stands out to them and the effect the space and art have on them. However, after the first participant answered that they were less focused on the art since they were focused on talking out loud, I scrapped this technique. Once the participant was finished with the exhibition space I gave them a questionnaire. After the participant filled out the questionnaire I asked some open questions in a semi-

structured interview, taking notes of the answers and additionally audio recording the conversation, allowing for paraphrasing, as well as quoting elements of responses verbatim.

7.4.1 Questionnaire

The questionnaire [Appendix 2] used for this research has some general questions about the experience and the space, as well as an adapted version of the Aesthetic Experience Questionnaire as developed by Wanzer et al. [55]. The general questions were posed on a seven-point Linear Numeric Scale, with the answer possibilities of the rating of the overall experience ranging from 'poor' to 'great', whereas the rest of the general questions could be answered from 'not at all' to 'very much'. The adaption of the Aesthetic Experience Questionnaire was removing the scales of the cultural, perceptual, and proximal conditions of Flow dimensions. These were removed due to not fitting the context of this particular research. This is why I chose to use the emotional, understanding and flow experience dimensions for the questionnaire of this particular research. The Aesthetic Experience Questionnaire uses seven-point Likert Scales as well, with all answer possibilities ranging from 'strongly disagree' to 'strongly agree'.

7.4.2 Open Questions

The open questions [Appendix 3] focused on more specific aspects of the exhibition spaces and the displayed art. These asked the participant to describe, for example, the exhibition space and the art, as well as entailed questions about the lighting and music options [Appendix 4].

The analysis of the open questions was done via the inductive coding technique. For this, the individual answers regarding the three exhibition spaces were analysed. In the first analysis of these answers, they were not disaggregated according to the participants or the accompanying space visited. Because for this part of the analysis, merely the description and aspects mentioned within the answers are important to outline how the exhibition spaces and the art within them were experienced by the participants.

To find the appropriate codes to analyse the responses, I first read through the first response of the exhibition space and wrote down matching codes, after this, I read through the second

response for this same exhibition space and categorized, if possible, the response in the existing codes. If the response did not match the existing codes or the sentiment of the response could not be fully addressed by these codes, I wrote down new codes. With this new assortment of codes, I went back to the previous response and checked this response for the new codes. This was the process throughout the whole analysis and for each question and exhibition space. The described process is in line with the inductive coding technique which describes that every code comes directly from the responses and is not predefined by the researcher. I chose this technique to minimize bias and report the responses as accurately as possible.

With this procedure, I coded the responses to each open question per exhibition space and I will describe the results in the following chapter.

8. Evaluation

Overall the participants spent the most time in the forest exhibition space with an average of 4 minutes and 42 seconds, compared to 4 minutes and 19 seconds in the historic exhibition space and 3 minutes and 15 seconds in the modern one. This means that on average the participants spent more than one minute less in the modern exhibition space than the other two exhibition spaces.

8.1 Questionnaire

8.1.1 Averaged Responses over all participants

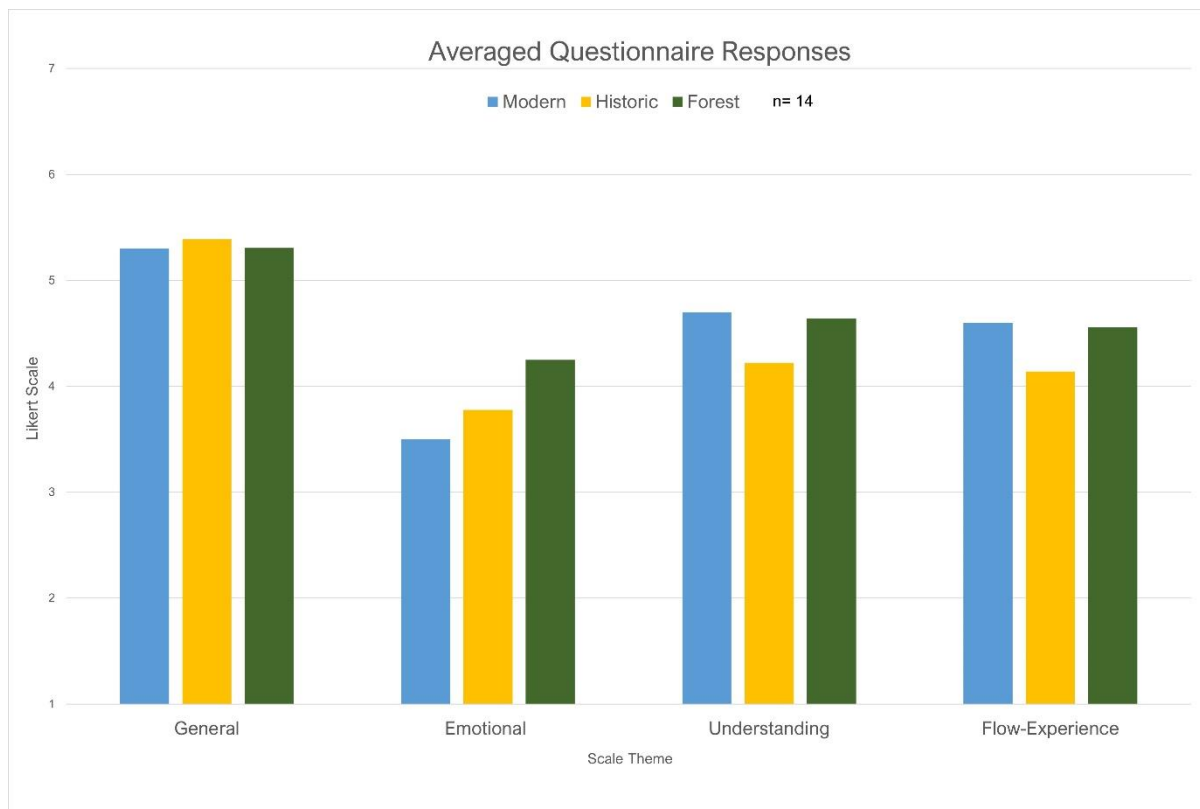


Figure 40: Averaged Responses to Questionnaire Scales

The diagram above [Figure 40] shows the averaged responses to the scales divided into the three exhibition spaces and the Scales. Here it can be seen that the historic exhibition space scored lower on average than the other two exhibition spaces, except for the General Scale. Here the historic exhibition space had the highest average score. The modern and forest exhibition space received similar scores with the modern one slightly higher, except for the Emotional Scale. For this scale, the modern exhibition space scored the lowest, followed by

the historic exhibition space and finally the forest exhibition space with an overall much higher score. However, these differences are not very big. If you look at the scores of the exhibition spaces for each item of the Likert scales clearer differences can be seen [Figure 41].

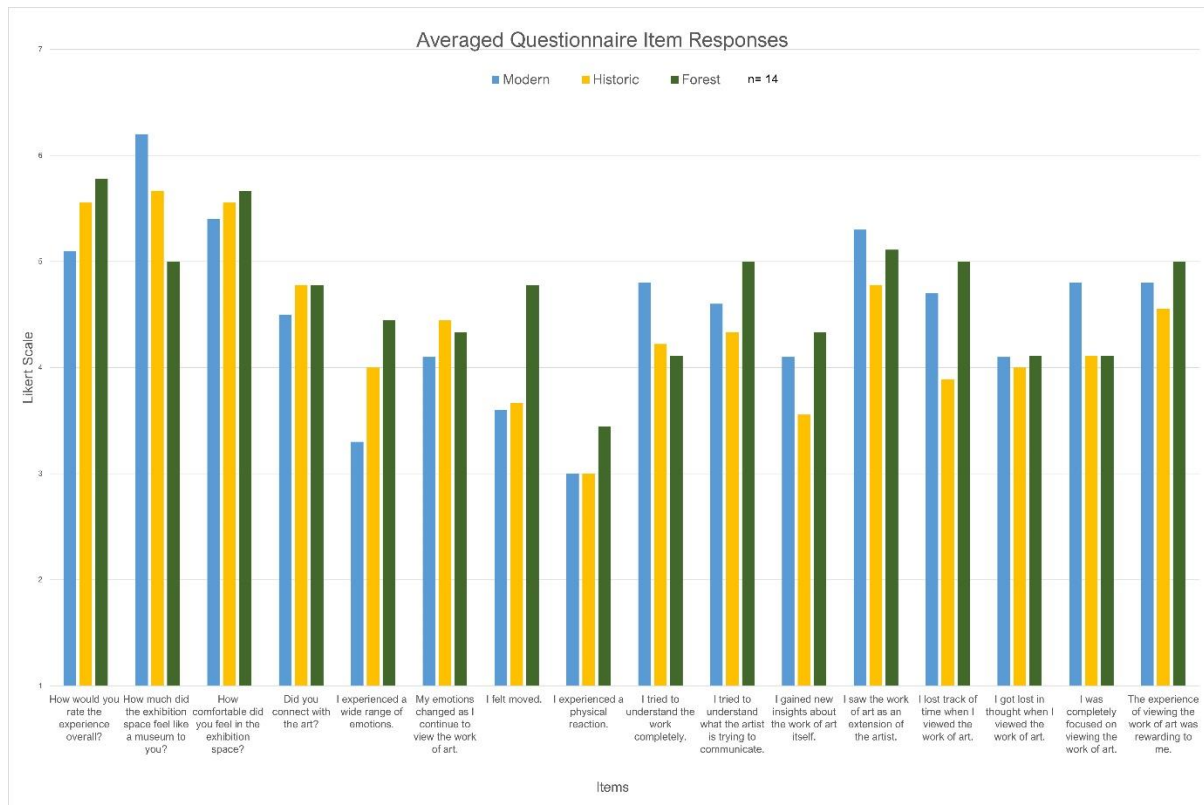


Figure 41: Averaged Responses to Items of Questionnaire

In the diagram above [Figure 21] these differences are presented. Regarding the General Scale, it is clear that the modern exhibition space felt much more like a museum than the historic one and the difference to the forest exhibition space is very big. However, the participants rated the experience of the forest exhibition space, as well as the historic exhibition space higher than the modern one. These exhibition spaces also scored higher regarding the level of comfort and the question of connection with the art. Regarding the Emotional Scale, the forest exhibition space scored much higher on each item, except for the change in emotions, in which the historic exhibition space leads. What stands out is that the forest exhibition space was rated to be more moving with quite some difference in scores. Concerning the Understanding Scale it is interesting to see that the modern exhibition space scores higher on average than the other two spaces, except for the questions about gaining new insights, as well as trying to understand what the artist is communicating, for which the forest exhibition space scored higher. Regarding the Experience Flow Scale, the modern

exhibition space scores much higher in being focused on viewing the art, compared to the other spaces which received almost the same score. Interesting is that the forest exhibition space scores much higher than the historic exhibition space on the “I lost track of time when viewing the work of art” item and still shows some difference from the modern exhibition space. This is the same, although less extreme, for the last item concerned with a rewarding experience.

Overall it can be seen that the modern exhibition space scored the highest regarding the Understanding and Experience Flow Scales, with mean values of 4.7 and 4.6 respectively. This shows minimal differences to the forest exhibition space, with a mean of 4.64 for the Understanding, and 4.56 for the Flow Experience Scale, and some difference to the historic exhibition space, with a mean score of 4.22 and 4.14 respectively. The historic exhibition space scored the highest on the General Scale, with a mean value of 5.39, showing slight differences from the other two spaces, which had average values of 5.3 for the modern exhibition space and 5.31 for the forest exhibition space. Regarding the Emotional Scale, the differences are the strongest overall, with the forest exhibition space having the highest score, with an average of 4.25, with some difference to the historic exhibition space, having a mean of 3.78, and quite a difference to the modern exhibition space, with a mean of 3.5. The mean sample standard deviations were for the modern exhibition space 1.29, 1.67, 1.54, and 1.65 over the different scales, in order of appearance in the questionnaire, namely, the General Questions, the Emotional, Understanding, and Flow Experience Scale. Compared to this, the historic exhibition space showed sample standard deviations of 1.46, 1.97, 2.02, and 1.85. The mean sample standard deviations of the forest exhibition space were slightly higher with values of 2.14, 2.13, 1.83, and 1.93 over the scales. However, these differences are quite small in the scheme of the individual scales, especially when noting the standard deviations of the different exhibition spaces. Nevertheless, this shows that the aesthetic experience was similar for the three exhibition spaces, with the historic one being on average slightly lower. The modern and forest exhibition spaces were rated similarly in their aesthetic experience. For the Emotional Scale, it shows that the forest exhibition space elicited more emotional reactions from the participants, while the modern exhibition space scored continuously lower on all items of this scale, and did thus not elicit such strong emotions.

8.1.2 Differences in Responses within-subjects

The research has due to its design strong dependencies between the results of the first and second tested exhibition space, as each participant tested two out of the three spaces. So to base the research and results on a robust basis the answers have to be distinguished between the answers of the participants. Due to the described method that included every participant experiencing two exhibition spaces, I will illustrate the difference between the responses of the participants for the different exhibition spaces. To assess this I calculated the difference between each answer pair of the participants and grouped them based on the combination of exhibition spaces. Within this, I did not separate which exhibition space was seen first or second, meaning the shown average responses are of participants that saw, for example, a combination of the modern and forest exhibition space. The diagrams show averaged responses over all participants that saw such a combination and show the difference in responses for each Likert Scale.

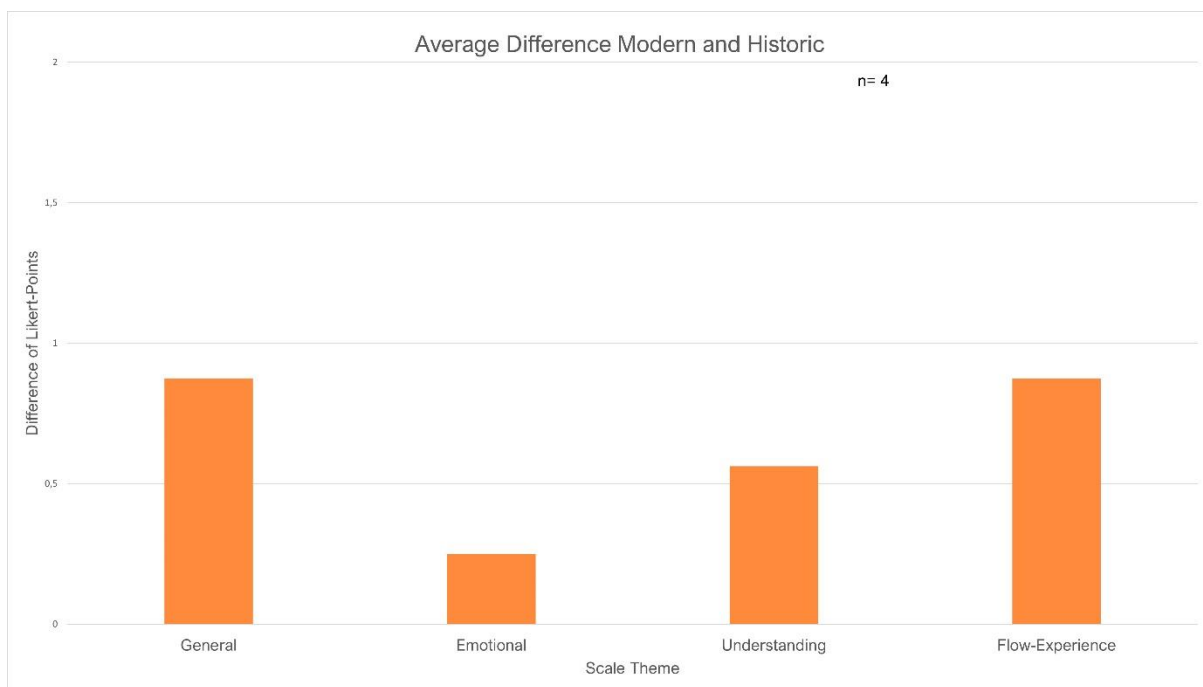


Figure 42: Averaged Difference in Responses of the Modern and Historic Exhibition Space

In the Figure above [Figure 42], the difference in responses regarding the modern and historic exhibition space, averaged over the scales is shown. For this, the responses of the historic exhibition space were subtracted from the responses of the modern exhibition space, of all participants that saw this combination of spaces. Thus, a positive difference refers to the modern exhibition space being rated higher on average than the historic exhibition space. A negative difference would indicate that the historic exhibition space was

rated higher on average, which was not the case for any of the scales. In the diagram, it becomes clear that the overall average responses were higher for the modern exhibition space than the historic exhibition space. The differences were the highest with a positive difference of 0.875 points regarding the general and flow experience scales, compared to 0.56 regarding the understanding scale, and 0.25 regarding the emotional scale. This shows that the overall responses were higher for the modern exhibition space, especially for the general and flow experience scale, with less difference in the understanding and emotional scale.



Figure 43: Averaged Difference in Responses of the Historic and Forest Exhibition Space

Figure 43 shows the average differences between responses regarding the historic and forest exhibition space. A positive difference indicates that the forest exhibition space was rated higher than the historic exhibition space, whereas a negative difference indicates that the historic exhibition space was rated higher. It becomes clear that for the aesthetic experience, with the scales emotional, understanding and flow experience, the forest exhibition space received better responses, whereas the historic exhibition space received higher responses regarding the general scale. The differences were, specifically 0.625 regarding the general scale, 0.81 for the emotional, 0.50 for the understanding, and 0.06 for the flow experience scale. This shows that on average the participants had a stronger

emotional experience in the forest exhibition space, as well as gained a better understanding or tried to understand the art more in the forest exhibition space compared to the historic one. The difference in flow experience is minimal, and generally, they rated the historic exhibition space higher, especially for the question “How much did the space feel like a museum to you?”, as well as for the question of feeling comfortable in the space.

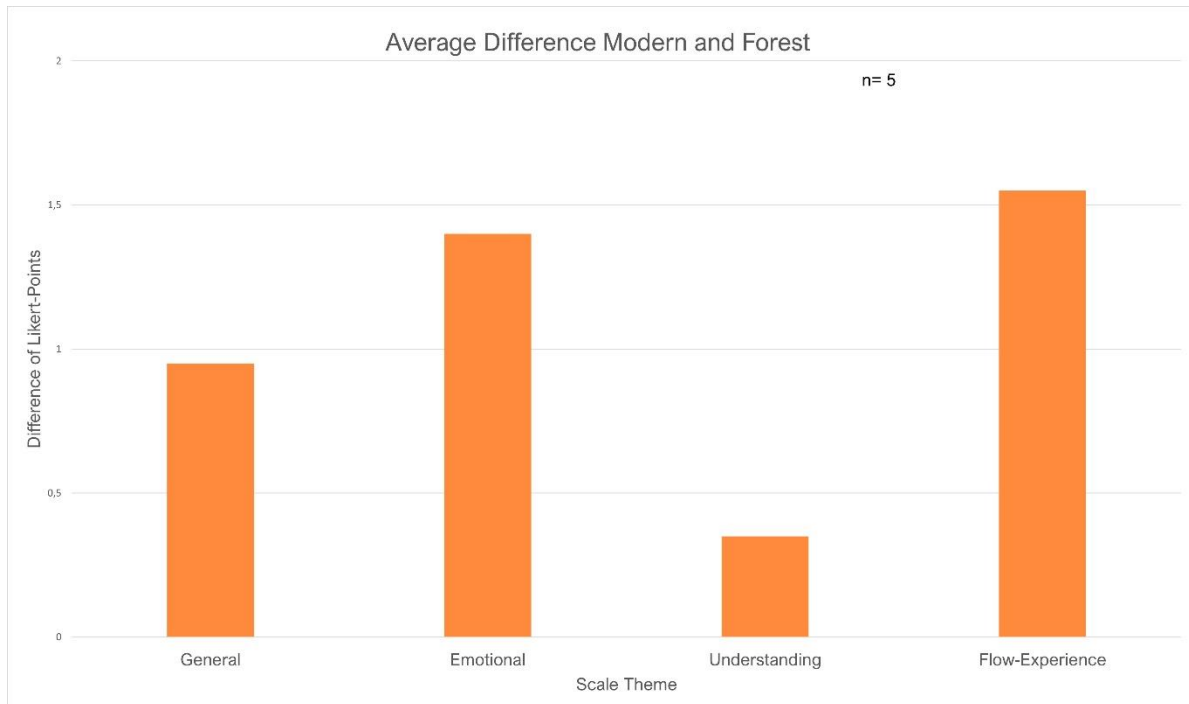


Figure 44: Averaged Difference in Responses of the Modern and Forest Exhibition Space

The figure above [Figure 44] shows the difference in responses between the modern and forest exhibition space. A positive difference indicates that the participants rated the forest exhibition space better, whereas a negative difference would indicate that the modern exhibition space was rated higher. All participants that saw a combination of the modern and forest exhibition space rated the forest exhibition space higher, which can be concluded since there are no negative differences for any of the scales. The flow experience scale shows the largest difference, with 1.55 points on the Likert Scale, this is followed by the emotional scale, with a difference of 1.4 points. The comparison of the general scale showed a difference of 0.95 points, whereas the understanding scale showed the smallest difference with 0.35 points on the Likert Scale. These comparisons indicate that the participants experienced more of a “Flow state” and had a stronger emotional experience in the forest exhibition space compared o the modern one. The participants also rated their general feelings about the forest exhibition space higher. Regarding their understanding of the art, and their attempts to try to understand the art the difference was quite small.

Overall the diagrams show that the participants rated the forest exhibition space higher on average in comparison to each the modern and historic exhibition space. The only exception to this is the difference in the general scale between the forest and the historic exhibition space. Here the historic exhibition space was rated higher. Between the modern and historic exhibition space, the participants rated the modern exhibition space higher over all scales. The biggest differences could be recorded between the modern and forest exhibition space, where the overall average over all scales is one point on the seven-point Likert Scale. This difference is followed by the average of a 0.64 point difference between the modern and historic exhibition space. The smallest average difference over all scales of the questionnaire was recorded between the historic and forest exhibition space with a difference of 0.19. This is divided into the historic exhibition space being rated higher with a difference of 0.625 on the general scale and the forest exhibition space being rated on average 0.46 points higher on the scales regarding the emotional, understanding, and flow experience aspects.

8.2 Open Questions

During the interview after the experience in the exhibition spaces, the participants answered open questions about these exhibition spaces and their experience of the art. In this chapter, the evaluation of these open questions will be explained.

8.2.1 What was your favourite moment of the experience?

When asked about their favourite moment of the experience the participants answered regarding the modern exhibition space with seven mentions of specific art pieces they had seen. These were along the lines of *"I liked the video"* or *"I really liked the sculpture"*. Within the participants, there were four mentions each of the exhibition space and a specific element of the exhibition space. Often mentioned was the ramp or the "interesting setup" of the exhibition space. One participant (P10) responded with *"turning the lights on and off"* as their favourite moment, even though the modern exhibition space did not have a button to switch the lights. This particular participant found the general light orbs illuminating the space and decided to shoot at them with the controllers. This response should therefore not

be counted, as it does not relate to the intention of the space, but should be kept in mind for further improvements.

The responses to this question of the favourite moment were more varied for the historic exhibition space. Here four mentions were recorded of the sounds, with responses like “[My favourite moment was] when I put the music on” (P8). Two mentions each were made regarding specific art pieces or the variation of the art, the exhibition space and specific elements thereof, as well as the changing of the lights. One response of a participant captures all of these elements and can be paraphrased as “I liked the change of music and change of colours. I liked that there are not only paintings and photographs, and also the video. I also liked the actual design of the museum, the columns and the gold details.” (P4).

Regarding the forest exhibition space and the question of the favourite moment, there were three mentions each of specific art pieces, the exhibition space, specific elements of the exhibition space, the lights, and the buttons. There were four mentions of the sounds in response to this question, three of them being positive and one being neutral, as they mentioned they liked the changing of the sounds, but pointed out that the selection of the music was “quite drastic” (P2). Some mentionable responses were “You can change the space exactly how you want” (P2), “[My favourite moment was] when I had the music on and I was looking at the art and noticed all the trees slightly moving” (P5), and “trying to add more senses really adds to the experience” (P9).

Throughout the different exhibition spaces, the responses were categorized by mentions of the art, which was done the most for the modern exhibition space, mentions of the exhibition space and elements thereof, as well as the interactive elements of the lights, sounds, and buttons. The interactive elements were mentioned more often regarding the forest exhibition space compared to the historic exhibition space, for which the responses were more spread out over the categories. One participant even responded with not having a favourite moment for the historic exhibition space. This was not the case for the two other exhibition spaces.

8.2.2 What was the most frustrating moment of the experience?

The second question was about the most frustrating moment of the experience. The answers were in total more varied within the different exhibition spaces.

Regarding the modern exhibition space, five mentions were made about the video, which had a glitch, causing it to sometimes not be playable or be playable but with the pause sign not disappearing. This glitch suddenly appeared during the testing and could not be fixed. Two mentions each were about specific elements of the exhibition space and not understanding or knowing much about the art. The specific elements of the exhibition space that were mentioned were in both cases that the ramp did not lead to anything, but just ended on a second level with no special element at the endpoint. One mention about the exhibition space was *“I felt bummed because this space is so harsh. It isn’t trying to connect to the artist”*, which *“really kills the mood”* as the participant continued, ending their response with *“[it] reminded me of a museum, but not in a good way”* (P10).

About the historic exhibition space, three mentions were made about the movement, which was hard to get used to and two mentions were made about the video. One person commented that the video was too fast for them and another person did not like the images in the video. Three people responded with not having a frustrating moment.

The participants that experienced the forest exhibition space responded even more varied with one mention each of feeling small, the video, which was too fast, not knowing the meaning behind the art, and not having a natural endpoint in the exhibition space layout. Two mentions were made about the movement being the most frustrating and two people did not have a frustrating moment.

Overall the answers about the most frustrating moment were more varied, with most mentions regarding the modern exhibition space being about the video. About the historic and forest exhibition space most mentions were about the movement or not having a frustrating moment. Although because of the small sample size, these majorities are small.

8.2.3 How would you describe the space you have just experienced?

Concerning the modern exhibition space three mentions were made about the space seeming ‘like a museum’ and the exhibition space being ‘big and open’, which comments such as *“very new museum-y”* (P10). Two mentions of the space feeling empty were recorded, with one participant summarizing these last two points as *“[it] felt like a really big museum, but then there wasn’t a lot in it”* (P5). The space being ‘structured’ or ‘minimalistic’ was mentioned three times by the participants. Two mentions each were recorded about the ‘vibe’ or ‘energy’ of the space, as well as two mentions of specific elements of the exhibition

space, both of which were about the slope. One person did not like the slope and would have preferred stairs, stating it felt “*weird*”, while the other person mentioned they liked the glass rail of the slope. Individual participants mentioned that the space was “*intriguing*” (P14), “*calm*” (P4), and “*cold*” (P10). One answer I would like to point out is “*very much not focused on doing an artist’s art justice*” (P10), which is very interesting given the goal of the research. It shows in my opinion that while there were answers about the space being ‘like an actual museum’, it was also perceived as cold and having less or even no connection to the art.

The answers about the historic exhibition space were similarly varied. Four mentions were made about the exhibition space feeling like a museum, which sounded like “*it is closely related to an actual museum; it looks like a museum*” (P15) and “*[the] space tries to replicate a museum*” (P14). Two mentions each were recorded about the paintings, the space feeling ‘old’, and ‘open’. One participant combined two of these stating “*vintage, historic rooms with big artworks in it*” (P1), another one responded with “*it gave a classical feeling, which was really cool*” (P3), continuing to explain that the space has a good feeling. The opinions about this space differ quite a lot, with participants stating direct opposites when describing the space. But overall the answers were mostly positive, with one person even stating that the space made the art seem more special. Only one participant had a brief and more negative answer, responding with “*[it] felt kind of empty in a way*” (P11).

The responses regarding the forest exhibition space were varied as well, however, seven mentions were recorded of participants pointing out the plants in their answers. These can be summarized by this response of one participant, stating that they liked the trees, as they “*created a different environment*” (P13). One participant described the plants by responding “*I wouldn’t say it felt like a forest but like you’re in animal crossing*” (P1), illustrating that the realism of the plants was lacking, continuing with explaining that it was clear the plants were in VR, but for plants in VR, it looked similar to a forest. Four mentions were recorded of the participants describing the space as ‘oval’ or ‘circular’, as one participant pointed out “*I didn’t feel trapped, in a circle you could go forever*” (P2), continuing that this added to the experience and made the experience more open. One of these four responses was negative, as they mentioned that in theory, they like the idea of a circular room, but in practice it makes them miss a defined path to experience the space in. Three participants each highlighted the ‘atmosphere’ or ‘vibe’, as well as the openness of the space. Two mentions were recorded of the space feeling ‘comfortable’ and similarities were drawn to a museum, with one participant describing the space as “*a friendly and open space to walk into; a mix of*

museum and forest” (P5). One participant called the space a “*non-conventional museum*” (P13). The art, as well as the ‘calmness’ of the space, were mentioned once. “*I could focus on the exhibition; I was alone so it was very calm*” (P6) is what the participant stated, in contrast with the answer of another participant, explaining “*[it] had some nice aesthetic touches to it, which really connected to the artwork presented, but it felt a bit liminal; you’re all alone and it’s a little of a cold environment*” (P10). This juxtaposition is interesting, as both participants seem to have the same general sentiment of the exhibition space connecting to the art, but the fact of being alone in the environment, made the space seem calm to one participant and cold to the other. One answer I would like to highlight is “*I would say it fit more with the culture and creativity of the artist. [The decoration] fit more with the story behind it*” (P3), which is particularly interesting concerning the aim of this research.

Overall the descriptions were quite varied, with very different descriptions for each exhibition space. One of the few similarities was the comparison to museum spaces. Most of the descriptions had a positive undertone, with some individual exceptions.

8.2.4 How would you describe the art you have just experienced?

When asked about the art and how they would describe the art they had seen, the participant’s answers had some variations but stayed in similar concepts.

In the modern exhibition space, three mentions were recorded about descriptions of the style of the art, with keywords ‘abstract’, ‘modern’, and ‘minimalistic’. Three other mentions were made about the interpretation of the art, one participant said that everyone can perceive the art in their own way, while another participant responded with their interpretation “*[It is] trying to communicate what his [the artist’s] emotions and feelings are*” (P14). Two responses contained descriptions of elements of the art, namely the colours and shapes. Furthermore, two mentions each were made about the personal opinion of the participants of the art, the art being ‘cool’ or ‘interesting’, as well as about the different art pieces. One participant elaborated “*Since it is in this environment now I felt way less engaged with the art and searching for ‘is it even connected’, ‘does it have a connection?’ Or am I just looking at random stuff*”, continuing with “*I didn’t feel the artist’s connection to it*” (P10).

Regarding the historic exhibition space, the answers can be classified into similar categories. Three participants mentioned the style of the art, with the use of the same keywords, namely, 'abstract', 'modern', and 'minimalistic'. Three participants responded with not understanding the art, with responses such as "*no idea what the art was trying to say*" (P6). Two participants thought the art was 'cool' and 'interesting', whereas two other participants thought the art was "*boring*" (P8). Individual mentions were made regarding the elements of the art, the variation of art pieces and mediums, interpretations, and description of the art as "*really emotional*" (P14).

When asked after the forest exhibition space the answers were similarly varied, but seven participants described the style of the art, also using the keywords 'abstract', 'modern', 'minimalistic', and 'busy'. Four mentions were recorded of participants describing the art as "*cool*" or "*interesting*". One person pointed out that they think the art made more of an impact now that they were floating in the air than the pieces did flat on a wall. Two participants each mentioned elements of the art, and the context of the art, and described the art through their own personal opinion of it. One of these responses was "*[The art is] not necessarily my cup of tea, but it is nice to see [the art] in relation to how the room is addressed*" (P10). One participant each mentioned the cohesion between the different art pieces, the interpretation of the art, as well as one participant said they understood the art "*a bit better [now]*" (P6). "*There was more energy in the paintings*" (P3), is how one participant responded to the question, and another one answered, "*From the text, I knew that it was trying to take you back to Suriname and like trying to make you feel like you're really there, which is really cool*" (P2). This shows that this participant understood the intention of the exhibition space even with the little provided information.

Overall the answers varied quite a bit, with some participants confused about the art, not necessarily being into modern art themselves. However, it is noteworthy, that seven out of the nine participants that tested the forest exhibition space responded by describing the style of the art, compared to only three out of the ten participants for the modern and three of the nine participants of the historic exhibition space described the style of the art. This corresponds to 77.8% of the participants mentioning the style of the art for the forest exhibition space, compared to 30% of the participants in the modern exhibition space and 33.3% of the participants in the historic exhibition space. Furthermore, four participants mentioned the art was "*cool*" or "*interesting*" or something along the lines that, compared to two participants each for the modern and historic exhibition space. Corresponding to 44.4%

for the forest exhibition space compared to 20% for the modern and 22.2% for the historic exhibition space.

8.2.5 How would you describe the effect the art had on you?

When asked about the effect the art had on them, the participants had more similar responses than to the previous questions.

Regarding the modern exhibition space, five participants mentioned that the art did not have an effect on them. Five mentions were along the lines of *“It mostly left me wondering”* (P5). One participant combined these two sentiments in their answer, responding with *“[It] didn’t do much, but I did try to find some meaning in it [...] Honouring the culture is an interesting and fun idea for art”* (P9). One participant answered that it made them happy.

Regarding the historic exhibition space five participants mentioned to effect again with one participant explaining *“It was just art”* (P7), however, two participants mentioned the story and culture behind the art. *“You do feel the culture and meaning of it”* (P3), was the answer of one participant. Two mentions were made regarding the understanding, two of these mentions were that the participants were confused and tried to understand the art, whereas one of those mentions was about understanding the art better because of the collage. One participant pointed out that they were moved.

Concerning the forest exhibition space three participants answered that the art did not affect them, with one additional participant highlighting that they were not moved, but felt intrigued. This feeling of being intrigued or left wondering was mentioned three times, with one participant calling it *“thought-provoking”* (P13). One mention each was made about the art having a ‘calming’ effect or being ‘cool’, as well as the story behind the art.

Overall the answers were mainly that most participants did not connect with the art. This does not mean that they did not like the art, as one participant pointed out by responding that they didn’t feel moved or connected emotionally, but that they would like to see more of the artist. What is interesting is the difference between wondering and trying to understand the art. For the modern and forest exhibition space the same number of mentions were

made about not having an effect versus wondering about the art, with three mentions for the forest and five mentions each for the modern exhibition space. Whereas for the historical exhibition space, five participants mentioned not feeling an effect, two participants responded with the story and culture and three mentioned not understanding (2 participants) or understanding the art (one participant).

8.2.6 Which lighting did you choose and why this lighting over the other options?

The question about the light options is only applicable to the historic and forest exhibition space, as the modern exhibition space did not allow for these individualisations.

Regarding the historic exhibition space, five participants liked the white and neutral light option the best compared to two participants favouring the yellowish light and two participants not having a preference, trying all. One participant that tried all lights responded by saying they didn't feel that the light had an effect. However, the participants described the white light as follows. One participant said the white light "*fit*" the space, explaining "*[the] colours seemed real and how they're supposed to be*" (P1).

The yellowish light was described as 'cosy' and making them feel good by two participants, as well as 'warm', 'artificial', and just a personal preference by one participant each.

The blueish light was described as 'cold' twice, and 'artificial' and 'comfortable' once. One participant said that they had a personal preference against blue light, stating "*I just don't like blue lighting*" (P11).

Two participants described the different effects the coloured lights had on the art, with one explaining "*The yellow changes the blue the most and blue is cool so it makes the red clearer. White lighting is like 'meh'. The others (yellow and blue) allow certain elements in the art to pop more, which is cool [to see the changes]*" (P3). It is very interesting to see that some participants take such an analytical approach to the change of lighting.

Regarding the forest exhibition six participants preferred the yellowish lighting, whereas two participants chose the white lighting and one participant selected the blueish lighting. Two participants described the white light as 'boring', one calling it 'artificial', and another participant described it as 'brighter'. One participant described the white lighting and their

decision to choose a different option as follows, “*white was just a standard one for me, I like to switch it up*” (P7).

Most participants described the yellowish light as fitting the exhibition space better. Four participants mentioned that the light is ‘warm’, with one additional participant stating that the yellowish light felt “*too warm*” (P7). One participant each described the light as ‘cosy’ and detailed the influence on the art. “*There was more of a positive feeling attached to the lighting*” (P5), as one participant explained their decision. Another participant stated that the yellow light “*makes everything look more vibrant*” (P9), similar to the statement of another participant detailing “*I think the yellow was the coolest one, it complemented the green and the plants*” (P3). There were two mentions of the light looking “*natural*” (P7), with one participant describing “*It felt like sunset and I think that gives a warm feeling that fit with the nature theme*” (P1).

The blueish light was described by the participants as ‘cold’ twice, once as fitting the space and once as not fitting the space. One other participant described the blueish light as a personal preference. This participant explained, “*I think it [the blue light] just added onto the forest vibe*” (P7). Other descriptions used by the participants were ‘*sad*’, ‘*dull*’, and ‘*bold*’.

Overall, there were differences in how people felt about the light options, but the majority of the answers were similar. Often individual deviations of the general opinion were explained as personal preferences, indicating that the participants understood what the light colour feels like to most people and specifically stated that they personally have a different preference. This is interesting to see that the light colour has a ‘generally understood’ effect on the atmosphere of a space, with many participants mentioning the same keywords and sentiments attached to the light options. There were some differences between the light choices of the exhibition spaces. This points towards people selecting the light choices based on what matches the environment the most in their opinion. This could be an indication of people selecting and preferring specific choices to create an atmosphere that fits their understanding of the space and makes them feel comfortable in the space.

8.2.7 Which background music did you choose and why this one over the others?

The option to vary the background music is only available for the historic and forest exhibition space. The modern exhibition space does not allow for this individualisation.

Regarding the historic exhibition space, three participants preferred silence, whereas three participants preferred jazz music. Two participants preferred the classical music over the other choices. One participant did not have a clear preference, stating "*I liked the first one (jazz) the most; I feel like [it] fit the art the most*" (P3), continuing to explain that the classical music fit the environment more.

Two participants described the silence as a personal preference, whereas the other participant preferred silence to focus. One of them stated, "*I just didn't know if I wanted to listen to anything and I decided not to*" (P11). The jazz was described as not fitting the space twice, and twice as fitting the art, whereas one participant did not think it fit the art. Two participants described the jazz as 'lively' and 'happy', and one participant mentioned the jazz was "*playful*" (P4).

Regarding the classical music, two participants described it as 'calming' and 'quiet'. One participant each described it as "*dramatic*" and fitting the exhibition space. "*[It] felt like a movie song*", was the description of one participant of the classical music. One participant that stated they 'enjoyed the classical music more', explained that after reading the text the classical music connected better to the art.

Regarding the forest exhibition space six participants preferred the jazz music and three participants preferred silence. No participant preferred the classical music. Two participants each described the silence as a personal preference and two as uncomfortable and even "*liminal*" (P10). One participant stated "*Both choices didn't really add onto the experience*", continuing that it would be more of a distraction to them.

Five participants described the jazz as 'lively' and 'happy', whereas three participants mentioned that the jazz fit the exhibition space. One participant described this by saying "*[the] jazzy feel fit into the environment more*", with another participant explaining "*I thought it [the jazz music] really contributed to the experience*" (P7). One participant was unsure if the jazz fit the space, wondering about what the artist is trying to convey.

Four participants did not think the classical music fit the space. Two of those went on to explain that the classical music would fit better in a big space and would have made more sense to them in a 'history museum'. One participant each described the classical music as 'soft' and 'dramatic'. Regarding the fit of the classical music, one participant explained that it would have fit 'quite well' for just watching the video, specifically at the start, "*where the struggle is shown there*" (P5). Another participant described the feeling of the classical music in the forest exhibition space as making the space feel "scary" and "bizarre" (P2).

Overall the division of the music in the historic exhibition space was almost balanced as three participants each preferred the jazz music or silence. Regarding the forest exhibition space, the majority of the participants preferred the jazz music with a ratio of six compared to three participants that preferred silence. This shows a percentual difference of 66.6% that preferred the jazz compared to 33.3% that preferred silence. The descriptions of the music were relatively similar between the participants and the exhibition spaces but the results of the sounds fitting the exhibition space were quite different for the two. This is in line with what the analysis of the light options pointed towards, namely that the participants seem to have a similar understanding of the feeling the sounds induce. The participants seem to select the options that make the most sense to them in the environment, thus creating a comfortable, well-rounded atmosphere for them. There are of course individual differences and variations but from the categories and answers it seems to point to the question 'Which options fit the best into this space', after which the light and sound were chosen.

8.2.8 Do you think the exhibition space changed your experience of the art?

When asked about the influence the exhibition space had on their experience of the art, most often the participants answered with a yes or no and gave more details as to which exhibition space influenced them in which way.

Eleven participants answered that, yes, the exhibition space did influence their experience of the art. Two participants were unsure and one participant said it did not change their experience. This participant answered that they didn't feel more or less involved in the space or the art, continuing "*I can see that the first one (forest exhibition space) could be more interactive for people, but not for me*" (P7). One of the participants that were unsure of the

change described, that they were more interested in the space and the art, but that they were not really sure if that changed their experience.

One participant described the overall feeling as *"It [the exhibition space] changed the feeling of the art and my mood while looking at it"* (P1), and how if the surroundings did not fit the art they were more aware of the surroundings, *"but if it did fit, it would bring out something of the art and make it easier to enjoy it"* (P1).

Two participants responded that the modern exhibition space influenced their experience the most in a positive way, mentioning the feeling of the art, as well as the space being more interesting. One participant described it as *"since the space made sense with the art, everything else is blurred and you can focus on the art, otherwise you are too focused on other things"* (P15).

Regarding the historic exhibition space one participant each mentioned feeling comfortable, the customizability, the understanding of the art, as well as being more interesting. One participant explained that the structure of the space, placement of the art, as well as the *"customizable things"* (P4) added to their personal preferences, allowing them to look at the art in a certain way and understand it.

About the forest exhibition space, two participants mentioned the feeling of the art, the exhibition space 'bringing out the art', the story of the art, as well as the space being more interesting. There were mentions of the space being *"edited"* (P3) specifically for the art about the forest exhibition space. One participant that responded that the exhibition space had a *"major"* (P10) effect on their experience explained, *"If the rest of the space also has a connection to the artist and what they're trying to portray with their art, it feels like something you are more likely to engage in and actually be interested in"* (P10).

One answer I would like to highlight is a participant that compared the modern and forest exhibition space, explaining *"The first one (modern exhibition space) was so industrial I felt I had to be quiet, strict, straight 'look, look, look'. The second one (forest exhibition space) felt much more comfortable, [like a] familiar place, kinda jazzy, kinda cool, so I felt more comfortable to roam around however I wanted. I felt more free in my choices."* (P2).

Overall, the majority of participants answered that the exhibition space influenced their experience of the art with eleven participants confirming an influence, whereas two participants were unsure and one participant did not think the space changed their

experience. This corresponds to 78.6% of participants reporting a change in experience due to the exhibition space, 14.3% of participants being unsure if an effect occurred, and 7.1% of participants not feeling an effect. These answers definitively show some differences and strongly indicate that the exhibition space influences the experience of the art. However, due to the design of the research, it is important to remember that each participant only saw two of the three exhibition spaces, meaning some of these answers may have been different in a different exhibition combination. Nevertheless, the big difference does point towards an influence of the exhibition space.

8.2.9 Which exhibition space made more sense to you in the context of the art?

This question asked the participants to compare the exhibition spaces, meaning the responses are descriptions of how or why the exhibition space fit the art.

Seven participants answered that the forest exhibition space made more sense to them, whereas four participants answered the historic exhibition space, compared to two participants who responded with the modern exhibition space. One participant answered that they were not certain, but that it did not make much of a difference.

Two participants each mentioned the modern exhibition space fit the art, as it is more ‘*abstract*’ and ‘*modern*’, describing the space as ‘*industrial*’ and closer to a “*normal museum*” (P1). One participant responded “*I think of more of a modern museum, that is what the space was like*” (P11), after explaining that the art was more modern and abstract.

Two participants mentioned that the historic exhibition space seemed more like a museum, with one participant each mentioning that it fit the art and that the space was more “*realistic*” (P14), which made it easier to understand the meaning of the art to them.

Three participants mentioned that the forest exhibition space fit the art, which one participant detailing “*There was energy in the art and the second room (forest) fit that*” (P1). One participant described the forest exhibition space matched the emotions. Two participants mentioned the sound and light in response to the question, with one participant combining this with the aforementioned sentiment of matching the emotions, stating “*It [the forest exhibition space] conveyed the emotions much more through the light as well as the music. [...] It just helped a lot to convey the emotions attached to the artwork*” (P5). Another participant described the space as having “*more personality with the whole history of the*

art” (P13), similar to a different response stating “*When watching the video it [the forest exhibition space] makes sense, with the tribe in the middle of the forest. [It] makes sense if the art about the tribe and lifestyle is surrounded by forest*” (P9).

From the answers, one can see that the participants overall had a clear favourite. The forest exhibition space made the most sense to the participants in the context of the art. However, it is important to remember that no participant saw all three exhibition spaces, so every participant only had a comparison of two of the spaces. This means that this description is to be taken with a grain of salt. However, the majority of participants preferred the forest exhibition space for Remy Jungerman’s art. The most popular combination thereof was the forest exhibition space with the yellowish light and the jazz music.

Since every participant only sees two of the three exhibition spaces, it is necessary to give some more comparative conclusions of the research. This gives the answers more context and compares the responses of the participants fairly.

Five participants saw a combination of the modern and historic exhibition space. Three of those five participants preferred the historic exhibition space over the modern one. Two participants preferred the modern exhibition space over the historic exhibition space.

Of the four participants that saw the forest and the historic exhibition space, two preferred the forest exhibition space over the historic one. One participant preferred the historic exhibition space over the forest exhibition space, whereas one participant did not have a preference, stating that “*both fit the art very well*” (P6), but that there was no difference in effect or matching the context of the art.

All of the five participants that saw a combination of the modern and forest exhibition space preferred the forest exhibition space. Meaning no participant preferred the modern exhibition space over the forest exhibition space.

Meaning that overall seven of the nine participants that saw the forest exhibition space preferred it over the other seen exhibition space.

9. Discussion

The findings of the described background research could be confirmed through this project, as the different aspects of the atmosphere that were selected had different effects on the visitors and their experience of the art. However, because of the small sample size of fourteen participants, which equals a total of twenty-eight responses for the exhibition spaces, the sample size is too small to draw proven conclusions. This means all following conclusions that are drawn from the project are merely implications and hints toward what possible future research with more participants could prove. Interesting was the wide consensus of the participants regarding their feelings about the exhibition spaces, as well as the possible light and music options. The majority of the descriptions thereof were similar, however, the personal interpretations would sometimes differ. This could be seen for example in the descriptions of the light as “cold” or “warm” for the blueish and yellowish light respectively, which led some participants to say they prefer “warm” environments, whereas others would describe them as ‘too warm’ or preferring ‘colder’ environments. Here the strong influence of personal preferences can be seen, which argues for a more individualized experience of art.

If one were to continue this project improvements to the current version could include a more interactive experience, where the visitor can have a bigger influence on the changes in the atmosphere. This could result in a more engaging and enjoyable experience, as the interaction now is limited to pressing buttons. Possibilities for this could be changing the layout of the exhibition space or the size of the user, as well as giving the user more options to interact with the art pieces themselves. The sounds would be changed as well in a new iteration of the project, the classical music would be replaced by, for example, the Agida drum and other sounds of the rituals Jungerman hints at through the art. The rationale behind this is that the classical music was deemed by the participants to not properly fit the art, so further hints towards the narrative through the music would be favourable. Next to that, the interaction of the buttons to change the music and light could change. As originally planned, but not implemented in this version because of confusion on the sides of the pilot testers, the light could be changed through light switches that match the exhibition spaces and the sound could be changed through interacting with music. The implementation thereof would require more research and prototypes to ensure its usability. This again would provide more interactivity to the experience and thus potentially more engagement of the user. In the

historic exhibition space, which I would not use again in a future version of this project due to the responses of the participants, this could have been implemented through a gramophone. This would not only make the interaction more integrated into the environment but would also give a better hint to the visitors about what to expect from an interaction. It would make the experience more intuitive. A more complex version of this improvement could be modelling and animating musicians that play the sound the visitors select and hear. This version would allow the visitor to have a bigger effect on the exhibition space and see their influence manifested in the environment. For example, jazz musicians playing the Jazz sounds currently implemented in the experience and once the visitor changes the music the jazz musicians change into an orchestra playing the currently selected classical music. This would give another layer of realism and interactivity to the experience.

Additionally, from my perspective, other possible changes could include the creation of a more realistic-looking forest, which was not possible in the time frame of this project. The plants could be modelled better and more detailed, and with a more powerful system, the number of plants could be increased immensely. In a perfect iteration, the forest space would look and feel like the actual forests in Suriname it was based on, where the walls wouldn't be visible anymore. But even more different virtual exhibition spaces could be thought of, remodelling the big apple, Central Park or a building block to visit the art pieces in the busy streets of New York would be possible. Exploring the connection to Amsterdam through the incorporation of a tulip field or the 'grachten' could be another possibility. These have to be approved by the artist of course to ensure that he is happy with the way his art is presented. For this another meeting with Remy Jungerman would be necessary to establish his vision of possible exhibition spaces that are not possible in real life through the implementation in VR.

The technology of VR allows a more individual experience and thus also more personal choices, however, the applicability of changing the way we view and think about art exhibitions is very wide and traditional, physical museums are not excluded from this range. Dorner showed this by the creation of his "*atmosphere rooms*" [20], but as shown the possibilities do not end with a different wall colour, booklets, or sounds. This project took Dorner's work as one of the main inspirations and applied it in a different context. The influence he described could also be seen in this project, as well as the "*activation*" of the museum spaces themselves as researched by Pilegaard [21]. All of these effects could be seen in the atmosphere and felt by the visitor. However, one could think of adding even more

senses to art experiences by incorporating, for example, smell, temperature, or haptic elements.

Especially in a VR application of a more personal art exhibition the interactivity could be improved and widened. The ability to zoom in closer to the art, touch the art, or even have the walls move to 'invite the visitor in' could be possibilities. The exhibition space itself could change and new rooms could appear through an exploration of the space by the visitor, this could further strengthen the curiosity of the visitors. The possibilities of combining art and the experience of art with the atmosphere in a virtual space are endless and could be explored further by researching the user experience of different levels of control on the sides of the user in virtual art museums, as well as the implementation of atmospherical concepts in traditional museums, such as the interplay of distance and proximity, as detailed by Pilegaard [28].

Next to adolescents and young adults, the system is also targeted towards people that do not feel comfortable during visits to traditional museums. This selection of target users could be widened to include more people whom traditional museums are not accessible for, whether that is because of sensory overload, a disability, uneasiness in crowds or other factors. Because of the isolated experience with the VR headset in a virtual exhibition space, this experience can be modified to fit the individual needs of the user.

10. Conclusion

This project started with the art of Remy Jungerman and the exhibition thereof in a VR museum. Research about the influence atmosphere has in art museums on the visitor was done and a quasi-experiment was performed to investigate the influence atmosphere has on the visitor in a VR museum exhibiting modern art by Jungerman. This project was mainly exploratory in its design and thus does not aim to provide statistical presumptions about the atmosphere in VR art exhibitions. Instead, the aim of this project was to gain new insights about this topic and how it can be applied specifically to the art of Remy Jungerman. For this approach, research was done and three exhibition spaces were designed, which were then evaluated through user testing.

This project showed that the atmosphere has an influence on the experience of modern art and can be deliberately influenced by manipulating aspects thereof. Furthermore, it has an influence on how the context of the art is experienced by the visitor. In this specific case of Remy Jungerman's artworks, the participants of the user test could connect the narrative and context of the art the most with the created forest exhibition space. Here they saw the connection to Suriname, the Maroon and Winti culture through the provided brief biographical text, as well as the film "Broos" by Jungerman. Furthermore, they had similar connotations to the proposed light and sound options and preferred the combination that "fit" the exhibition space the best in their opinion. This means that the choices of the light colour, as well as of the music and exhibition space can be used to create a specific atmosphere, in which the visitors are supposed to experience the art. Additionally, similar to this project, the control can be given to the visitors themselves, allowing them to experience the art in whichever atmosphere they prefer.

This project and the results of the user testing could help Remy Jungerman, or any other artist with the design and presentation of their art. As described above the majority of the visitors were pleased with the availability of options to change the space and thus the atmosphere to their preferences. This allowed them to experience the art in a different way and opens the possibilities to many new experiences of and with art.

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Appendix

Appendix 1

Notes of the Interview with Remy Jungerman at the Beginning of the Project

Researchers: What is important to get right?

Jungerman: In total, how to create a space, where works are interactive to each other; create an atmosphere in exhibition; looking at individual works; can connect with other works; looking beyond surface of works; use of materials that can relate to certain languages/ stories/ practices; Create atmosphere with 3 rooms; film getting extra hint looking different at work; looking back; create a place where people can circle around, not just leaving and entering, "saw it"; create tensions in the space

Certain way to convey story?

Exhibition not literary audience also triggered by imagination; doesn't want to direct a way to maroon culture; use aesthetics to create art and work; create links again; depends on audience what to take from it, how much they take from it, how much they want to learn after, how different the interaction would be

VR new ways to interact?

Unfamiliar with VR, first time know VR, often gets lost in the VR, leads to different room,

→ should have clear and understandable navigation

Curious how we will do this and examples how to zoom into work, zoom into grid, into surface of piece, clay, carvings, textile, relate to part in the film, using same material in body without making it literally

Open to it, curious how we will deal with it

Interaction part

Zoom into art, see textures, use artwork, know the materials and textures, certainly possibility; Curious about material, rhythm, way of using it, wondering about scratching by making material, doesn't have the footage, zoom into work, seeing part of process, how complicated that would be to make for him

Would be okay if filming of the process of working on art

Depends, not giving away all details, not a workshop, work should be the face and from there on, give little hints like the film, not the story

Giving hints to story, not giving away?

Yes, the work should not become a ritual for instance, should be in between that space, entitling the works according to maroon settlements, latest panels Agida, drum low tones using sound would be possible maybe using low tones connecting to the artwork giving a hint in rhythm, not explaining what specific ritual is about, ritual makes a difference by saying that a practice in the studio is a ritual, art leftover of that ritual, act and left behind is the work, leftover of the process

Hint would be sound, maybe part in the film, there's a part where people are putting clay on body or throwing it, drum in clay, giving hints not explaining the ritual but giving hints at the ritual

Aesthetics; making the viewers curious, diagonal wall used in one exhibition; getting viewers more curious

Atmosphere give hints and make viewers curious, revisit art pieces

It's the space that makes the art and way that enthralled the work, making a large and narrow space in Stedelijk museum, thought about creating a different atmosphere

In the Stedelijk museum: diagonal wall, happy that doing something different

Expect for making square spaces

What emotions do you want to evoke?

That's difficult, like to stay as close to possible to work, every zoom to work, every change, still close to work, not become the avatar, I don't want to go to fantasize, stay close to the material, textiles, clay, find ways to deal with that, different objects he's using. Might find it back in the film, not the chicken dance/party in the extreme

In VR you can get so crazy, refers back to work, wants it to be the experiment to the material, the

3D in VR , there are 2 ways: Sculptures in VR? 3D -scan with phone with for an okay model or completely remake it, it's not the original work anymore it would be a model of the sculpture

Not the sculpture, get as close as possible to the piece itself, understands, doesn't have the possibility to go around the piece in the storage

Guess go with the pictures, from different angles and detail pictures and maybe find a way to build it in 3D

Even if completely model it in 3D is fine?

Yes, task to get it as close as possible to the real work, have some changes in perspectives, that is alright

Behind the forest book - designer used colors in pages, look at the book

Inspiring, looking at color combination used in Winti, not just color yellow, but color yellow and black for pantheon

Very open to new ideas and techniques

How do you build a collection for an exhibition?

What kind of knowledge do you associate with the pieces and choose them

Different meanings for colors, get into knowledge behind the pieces for visitors

Knowledge presented on the spot or after

Both, knowledge presented on spot

In Stedelijk museum text on walls

Categorizes by grid work, cubes, horizontals

Not necessarily give text every time about cubes and horizontals

Open about giving knowledge also before, have a little knowledge about

Give little text, yes

In exhibition space often read a text about what the topic is about, what the artist is thinking and how to approach the exhibition; good to have introduction text

Keep it simple

Appendix 2

Questionnaire Template

Please state your age.

Which gender do you identify with?

Did you know the artist Remy Jungerman before this VR exhibition?

Have you seen art of his before?

How would you rate the experience overall?

How much did the exhibition space feel like a museum to you?

How comfortable did you feel in the exhibition space?

Did you connect with the art?

When I viewed the art...

I experienced a wide range of emotions.

My emotions changed as I continue to view the work of art.

I felt moved.

I experienced a physical reaction.

I tried to understand the work completely.

I tried to understand what the artist is trying to communicate.

I gained new insights about the work of art itself.

I saw the work of art as an extension of the artist.

I lost track of time when I viewed the work of art.

I got lost in thought when I viewed the work of art.

I was completely focused on viewing the work of art.

The experience of viewing the work of art was rewarding to me.

Appendix 3

Open Questions Template

Participant :

PART I

Exhibition Space:

What was your favourite moment of the experience?

What was the most frustrating moment of the experience?

How would you describe the space you have just experienced?

How would you describe the art you have just seen?

How would you describe the effect the art had on you?

Which lighting did you choose?

White

Yellow

Blue

Why did you choose this lighting?

Why did you decide against the other lighting choices?

Which background music did you choose?

Silence

Jazz

Classical

Why did you choose this background music?

Why did you decide against the other background music choices?

PART II

Exhibition Space:

What was your favourite moment of the experience?

What was the most frustrating moment of the experience?

How would you describe the space you have just experienced?

How would you describe the art you have just seen?

How would you describe the effect the art had on you?

Which lighting did you choose?

White

Yellow

Blue

Why did you choose this lighting?

Why did you decide against the other lighting choices?

Which background music did you choose?

Silence

Jazz

Classical

Why did you choose this background music?

Why did you decide against the other background music choices?

Keeping the first exhibition space in mind, which exhibition space made more sense to you in the context of the art?

In your own opinion, do you think the exhibition space changed your experience of the art? And if so, how?

Do you have any additional remarks, comments or insights you want to share?

Appendix 4

Responses of Participants

Participant Questionnaire/Event Topic	1 Habit 08:12	1 Forest 08:01	2 Museum 03:20	2 Forest 04:10	3 Habit 04:14	3 Forest 02:30	4 Museum 08:00	4 Habit 08:20	5 Forest 04:50
Observations	comments on chandelier, buttons too high, but hard to read 'forest', seems to have jazz music, music doesn't fit (too too smooth) colour/classical music fits better the lines of the paintings, feels small, doesn't like yellow light looks like 'V' blue lighting, no collage, but then chandelier too warm still	classical music doesn't feel natural, trees look nice, not realistic but VR realistic, starts changing, jazz, jazz looks like but not orange enough, outside lighting would make it cozy, blue lighting feels like space theme winter, wickerland but snow, music, rest of the screen fits the blue, feels cold with the blue	looking at art quite quickly	"very different," "much more my style", "so sick," "this is what I think when I think of a VR art exhibition", buttons were confusing, light changes "oh", "pretty cool", comments inartistic would be cool	"so pretty, wow", pretty surprised by music changes, also light changes, "cool" chooses yellow light & classical music, turns off after a while & light back to yellow	"wow", "so cool", leaves buttons, immediately goes to them; yellow lighting, jazz, jazz starts dancing, looks at art, video, headset, such a quicker in this one	confusing controls, headset adjustments, didn't turn around at first until prompted, walking through quite fast, looking at art quickly, more than that, "very cool", adjusts the VR environment, looking up & down, move dithered	directly to back looking at buttons but not pressing them, very quick and quiet, prompted by buttons one back and forth, jazz & classical music switches, just switching through, light only prompted to touch buttons and only quickly going through	"so wow", "cool", "the forest", pretty immediate on the buttons after the jazz music, white lighting, looking at tree cause of the movement, also looking at art, changing to classical music then turning it off, goes to the firm not for long, turns the jazz music back on and continues watching for pretty long then moving on back to light
Did you know Henry Jagger was born?	no	yes	yes	yes	yes	no	no	yes	
How you saw art of this better?	no	yes	yes	yes	yes	no	no	yes	
How much did space feel like a museum to you?	5	6	6	6	6	6	7	6	
How comfortable did you feel in the exhibition space?	5	6	6	7	7	6	7	6	
Did you connect with the art?	6	6	5	6	5	6	6	7	
All Experiences? When I viewed the art I experienced wide range of emotions.	4	6	3	6	4	5	5	5	
My emotions changed as I continued to view art.	5	4	4	6	5	6	6	6	
I had more of a physical reaction.	3	7	6	6	3	3	6	1	
I tried to understand work completely.	3	3	4	5	4	4	7	5	
I tried to understand what the artist is trying to communicate.	3	5	5	5	5	5	7	6	
I gained new insights about art itself.	2	4	5	5	5	5	7	3	
I saw the work as an act of creation of the artist.	4	5	6	6	5	7	7	4	
I had back of mind without viewing the art.	3	4	5	6	3	6	6	5	
I got lost in thought when I viewed the art.	4	3	4	4	3	7	7	5	
I was completely focused on viewing the art.	1	2	4	4	5	6	7	5	
The experience of viewing the artwork was rewarding to me.	5	5	5	6	4	4	7	6	

Participant	1 Habit 08:12	1 Forest 08:01	2 Museum 03:20	2 Forest 04:10	3 Habit 04:14	3 Forest 02:30	4 Museum 08:00	4 Habit 08:20	5 Forest 04:50
Open Questions									
What was your favorite moment of the experience?	Liked the paintings in the second room (Pembic) it was fun to have things to do, choose between different art styles, modern, video and sculptural art	SM painting the room fit nice, "liking the trees"	looking at the art on the ramp, "no need to walk," "you can keep looking at the art while walking", museum never really do that	"finding the buttons, those were really cool", "you can change the space exactly how you want", music selection is quite basic, maybe middle ground, because this was way different, light/ambience was very cool	sound was interesting, I liked the lights the most, I liked pop different colours because of colour theory	liked colours, "I liked the interior more than the first one (Pembic)", "the green contrasts with the red in the paintings", other one was more empty, feeling "this one is a good sized room", pretty plants	stair and the art on the stairs	liked the change of music and change of colour, liked that there are not only the paintings and photographs and also a video, liked also the actual design of the museum, the columns and the gold details	"when I had the music on and I was looking at the art and not at the trees slightly moving, I gave off the blue, even more after the video gold details
What was the most frustrating moment of the experience?	having to press the buttons, feeling so small, not seeing the buttons	"feeling small"	own blindness (glasses didn't fit into the headset, made it hard to focus on art if not seeing it clearly)	navigation glitch	turning, because it feels less normal (non-smooth turning and back, turns at an angle) and confusing, got stuck in objects and VR in general	none, controls were familiar, everything worked	video was glitchy	no frustrating moment	not really knowing what the meaning of the abstract art is, because with abstract art you never quite know

How would you describe the design you have just experienced?	"Vintage, historic, rooms with big artworks on it"	circular room with natural scenery trees and flying artworks, "I wouldn't say it felt like a forest but they're in an animal crossing", virtual forest could see it was but for in like forest "all encompassing"	abstract, had one direction to go, no need of wandering where to go, "I was very confused", making it through while installations, quick like a cut scene, nice to incorporate a down slope or teleport back to art	"tick, pretty cool, exactly what I wanted before a circular space to walk around", "I didn't feel trapped, in a circle you could go forward", "it really adds to the experience more than the plants make super good", they stuck out the 3d models, walls could have moss or a bump bump to be tactile	really pretty, "I liked the design of the building", "it gave a classical feeling, which was really cool", "paintings are cool but not my taste", good feeling of the space	plants, "it was more atmospheric", "I would say it fit more with the culture and creativity of the arts", "it was good, well shaped, cool, liked colour more, "it more with the story behind"	clean, minimalist, good energy due to white, peaceful, quiet	even though the space is busier than the other one (modern) it was more atmospheric, more interesting, and along with the music and the change of colour to customize it you can make it more personal	"cool, it's a nice space to walk into, mix of museum and town"
How would you describe the art you have just experienced?	first room: "very pop art, very colorful, very bold and it felt very New York", second room: felt more simple and modern, video felt real	art was feeling more together, very clean, especially with the central art but not really, he likes primary colours mixed with white, clean art	"pretty", "pretty cool, not as self-explanatory as the previous one (find another art experience before)", looking at the art hasn't seen before	"I wish I could have seen them", "pretty cool, space was very clean, art is primary colours, contrast, many directions, liked the idea of the red and blue colours with the triangles", "very sharp, hard", "from the start I knew that it was trying to take you back to Surrealism and is trying to make you feel like you're really there, which is really cool", music changes that a little, make nature ambience options	art is really cool, the different variations, video, tables in the contrast, "also the information was nice because it gave more context to the experience"	they were a bit different, more abstract, "there was more energy in the paintings", "modern person was cool, more abstract, more colourful, likes busy art"	abstract, colourful, everyone can perceive in their own way	minimal, you can take it as you want, different perspectives can see it	abstract, based on shapes and textures
How would you describe the effect the art had on you?	"I was kinda distracted because of thinking out loud and couldn't really focus on what the art felt like", "art painting looking the story, art busy feeling of New York, in the other room the video was moving"	artworks were kinda calming, very clean, especially with the one painting (Pembic) it felt more natural	"wow, art is art"	art was really cool, quite short as a player, looking up and down (at was sitting down) nice seeing the feature map	"you feel the culture and the meaning of it", "together of the people and the sounds", "good immersive sounds"	"I think this one displayed better the meaning and story behind the art", "different colours worked", "the light did more to these painting colours", "it better overall"	didn't know the artist, so it made them wonder, appreciated the colours and patterns	it was easier to understand this art than the previous art because of the video and the collage	in combination with the video and music, that to get the connection between the art and the personal story of the people in the video and the artist
Which lighting did you choose?	tried all of them	tried all of them	white lighting, make it more like an artificial museum, "its artificial view of it"	tried all	yellow	yellow	yellow, switched between them		
Why did you choose this lighting over the other options?	white light was "bling", "colours seemed real and how they're supposed to be", yellow light had too much of contrast between the walls and the paintings, paintings were cooler in contrast with the walls, "the cool lighting in the back and white paintings made the paintings fit to the room" but the chandelier was still very yellow	liked the warm lighting most, "it felt like sunset and I think that gives a warm feeling that fits with the nature theme", "cool lighting was cool but didn't feel natural with very green forest theme, looked for lighting that matched the forest, more outside lighting"	did not notice the blueish, beige, lighting plays a huge role when looking at art, really changes the art, no blue, no in your face, yellow more natural, "I want to be the white one because it looks cool"	"the yellow changes the blue the most, blue is cool so I make the red/darker, white lighting is like 'meh'", "the other yellow and blue allow certain elements in the art to pop more, which is cool to see the changes", "it highlights some aspects of the art"	"I think the yellow was the coolest one, it complemented the green and plants", yellow is often more happy, "blue makes it more dull and cooler", "warm tones was more pleasant, blue makes it sad, historic more for blue"	liked warmer colours the most, it makes it more homely and also because it was a personal preference	I chose the warmer tone, it reflected the mood, sort of a happy mood, but also regarding the video you could see the struggle of the people, "but there was more of a positive feeling, applied to the lighting", "I felt nice, it felt more appropriate, "it fit the story better"		
Which background music did you choose?	tried all of them	tried all of them	mainly jazz	tried all	jazz	switched			

<p>Why did you choose this background music over the other options?</p>	<p>first silence to focus on the art, jazz didn't fit, maybe too loud, was more listening to the music, no connection to the art work, classical flower in volume "it was nice and calming and I could concentrate more on the art work", nice background music</p>	<p>"jazz bit lively and like good vibes", classical felt like you needed to listen to it in the space matching it like an opera house, but liked more than silence, best sounds would've been nice, jazz also kinda fit, also connects to the art</p>	<p>first one playing initially, was already familiar to the space in this city, classical made the place feel scary and a little bizarre, jazz made a more happy environment, made more lighter, while the scary sounds more like "what's going on?" neutral (natural) sounds would also be nice, "jazz was like you were meant to feel happy in the space"</p>	<p>"I liked the first one (jazz) the most", "I feel like the first one fit the most" (jazz), more energetic, classical fits more with the environment</p>	<p>"I really liked the jazz, it fit better", "the other one (classical) is more atmospheric", more quiet, soft, jazz more energetic</p>	<p>enjoy the second one (classical), the more dramatic one, after reading the text I connected better to the art, than the other one, which was more playful</p>	<p>first one (jazz), "because it put in a good mood as well", the second one (classical) would've been well also just for watching the video, especially at the start of the video, when the struggle is shown there", but decided to keep the happy music, even though I didn't fit there, but it was more positive</p>
<p>Keeping the first exhibition space in mind, which exhibition space made you want to be the context of the art?</p>		<p>"first space (historic) felt more like a normal museum, liked the second one more (brast) let the art be more active", there was energy in the art and the second room (brast) fit that"</p>	<p>second one (historic), "the first one (modern) felt very industrial"</p>		<p>brast</p>	<p>second one (historic)</p>	
<p>In your own opinion do you think the exhibition space changed your experience of the art? If so, how?</p>		<p>"yes, it changed the feeling of the art and my mood when it was looking at it", looking at different things, notice how it does and doesn't fit the surroundings, more aware of the surroundings if I don't think, but if I think I would've noticed something of the art and also it easier to enjoy it"</p>	<p>yes, much more immersive, "it forces you to adapt to a different environment", "the first one (modern) was so industrial" felt like I had to be quiet, strict, straight look, look, look", the second one felt much more comfortable, familiar place, kinda lazy, kinda cool, so felt more comfortable to own around however I wanted, I felt more free in my choice"</p>		<p>"in the second one (historic) the story was more involved", "but (historic) made the art seem more out of place, it felt more like a general museum, like a general museum", "this one (brast) looks like it was made specifically for the art"</p>	<p>yes, 100%, I think the way it was structured and how everything was placed and the customization things all add to your personal preferences that allow you to look at the art a certain way and understand it</p>	
<p>Do you have any additional remarks, comments or insight you want to share?</p>		<p>no</p>	<p>no, if neutral nature videos, song choices a little less different, maybe more choices, a little better in v to see the buttons and maybe the walk in section one (brast in most)</p>		<p>looks great, liked the interaction</p>	<p>found it very interesting, didn't do anything like this</p>	

5	6	6	7	8	8	9	9	9	10	10
Modern	Forest	Historic	Forest	Historic	Historic	Modern	Modern	Forest	Forest	Modern
02:11	05:25	03:06	05:00	02:30	04:00	02:10	02:20	02:44	05:27	02:08
reads but again quickly, video doesn't play but she sees it before, looks at video, goes up the ramp pretty straight away, goes up and down quickly, walks around again even though seems like already finished, seems like wanted to look at more stuff	controls take some getting used to, goes by buttons straight to move but doesn't watch it, looks at the art, reads the text about rainy, moves through forest, tries to select the paintings, prompts to press the buttons, quite surprised by the mark, all quickly changes it, prompts again for clicking the second button, "hey" at lighting	tries buttons first, chooses white lighting and ignores music completely, reads text again, looks at art quite slowly, trouble moving again, really looks at the art, stands in front of it like in a physical museum, looks at video but shuffles then before	moves hand, no problems at all with controls, "furr", "m", selects movie, quick to switch and move, tries to select art, reads text about rainy, moves around buttons, switches, not "hey" about the music, quick to turn on and off	looks through, same last, quick to go through, no problem at all with controls	focus on controls very easy, goes straight to text, moves around quite quickly, second room, look but not quite quickly, quite restless, prompts to push the buttons, doesn't see changes, prompts again "jazz" "oh yes", switches to yellow light and walks around again, quick look around with classical music, changes light to blue, looks around again	looks at text, tries to read, starts video easily, looks at art quickly, moves around quickly, looking at art, blick at space, very easy with the controls, no problem at all with vr	in first space space feels tiny, fast looking reads text, looks at video, pause of video somehow stays out, looks at art more or less slowly, likes video, "quite cool at piece", looks at video, moves up ramp	"oh", looks around much more, "oh" buttons, light changes "rise and say", yellow light, changes music, starts dancing, looks almost a bit from art, looks at art, looks back at movie every now and again, turns around between small divider and tries, turns off light or, continues a bit of dancing, prompts to try other music, looks around a little, button finished	goes to left, ignores buttons, goes straight to movie and plays it, watches for a while, pauses and moves on, "hey's read", "all the things you can do in vr" "trazy", "its hard to read Rem's name, ignores buttons again, turns light off, "oh", prompts to push the buttons, "oh" music buttons, yellow light" reads", looks around, "oh my god", when music changes, able with the jazz, switches light and looks at yellow one again	turns easily, watches movie again a bit, "I see the like here", "yeah" interacts with light disc, "make me feel like a video game" played "on", really cool, looks at art, goes up ramp, looks around
no	no	no	no	no	no	yes	yes	no	no	no
3	5	6	4	5	7	6	4	5	7	4
5	7	7	3	6	5	7	5	5	3	6
4	5	7	5	6	7	7	3	5	4	2
3	3	4	2	3	5	5	3	5	5	2
1	3	2	2	2	6	6	3	5	2	1
2	3	3	2	2	6	6	4	4	1	1
4	6	5	3	2	4	4	5	5	2	4
5	6	5	2	3	2	3	5	4	6	4
3	5	3	3	2	3	3	3	4	5	1
3	6	6	3	3	4	5	5	7	6	6
2	5	3	4	2	6	6	4	5	7	5
1	3	2	2	3	6	6	4	6	6	2
2	3	6	2	4	4	4	3	4	6	6
2	6	6	2	2	6	6	4	4	6	3
being able to see the big installation from above (like work), that was quite nice	the video was interesting in vr, changing the lights, "I wish I saw that earlier, cause it made me more comfortable"	adding in the beginning, very colorful (colorful) that was interesting, it featured actual people, didn't understand other works as much	"I liked the general atmosphere", felt more in v to look at	"I liked the chandelier, it was very pretty", "I liked the environment	"when I put the music on"	"when I got to the main room, to see everything, the ramp", "I like the big space"	really liked the sculpture (like work), something that is more interesting to look at in vr, better fit has to depth to it, liked walking into the main room, interesting setup, "like like I could explore it"	"music was unexpected, but it added something, other one (modern) just silence, trying to add more senses really adds to the experience", wouldn't do it like that in normal museums, was nice, also really liked that the art pieces were floating, this is something you cannot do real life", could imagine but with vr, but it's not quite the same, liked that it can only be done in vr	"the moment I (brast) could actually interact with the light", actually pressing the buttons through machine, out your hand, interactive feel	turning light back on and off again (found lights, not supposed to do that)
"not really knowing much about the art and not really getting a lot of information about it"	moving around, not used to vr, when walking felt like looking balance	moving	didn't like the video, too many pictures to say	wasn't really a frustrating moment, video was too fast again	didn't know, maybe it was the video, the images were awful	when I got to the top and there was nothing	didn't really like that at the top it was over, pause sign in the video was glitchy	didn't have one, only things that didn't have a natural point, "I do like it when there's sign of a path in a museum"	couldn't look behind the artwork, like to walk around it, if possible	"I felt surprised, because this space is so fresh, it isn't trying to connect to the art", do whatever, really kills the mood", see in lots of modern museums, really a shame, "reminded me of a museum, but not in a good way"

quite a massive room, "felt like a really big museum, but then there wasn't a lot in it"	felt quite spacious and open, "I could focus on the exhibits", "I was alone so it was very calm"	different, felt more like an actual museum, also very open, very comfortable	nature kind of vibe, felt comfortable	"for sure felt more like a museum" "in general the architecture helped with that, it felt cleaner"	pretty big, I would've liked another hallway	first room, as frustrating since it was a cube it didn't feel very open, the main room is great, like the glass rail	first room (open room) was a bit uncomfortable, too big, made feeling, didn't like that the stairs weren't actual stairs, just a slope felt weird	"felt more comfortable than the first one (modern) a lot more comfortable, especially the stairs, felt like a normal height, "a lot more cozy", nice touch with the plants, didn't feel like real plants, knew what they're trying to convey, was nice. Like the idea of a round room, but not in practice, no path to it"	"had some nice aesthetics touches to it, which really connected to the artwork presented", but felt a bit weird, you're all alone and a little of cold environment"	"very new museum", very cold, very much not focused on doing an artist's art justice, need to fill the space, cold environment, "I didn't like it"
abstract, using materials, from some elements like the bottles that are quite clear what they are trying to communicate, it paints a picture of what's going on	modern, open to interpretation, "not quite as much of a connection", but understood a bit better	"no idea what the art was trying to say"	very abstract, not really my type of art	abstract, "thought I felt like the art pieces didn't match each other", didn't fit the rest, didn't understand the circle (square)	a bit boring	better than the first one, the addition of the photos was less awful, but still not good, and there was some paintings but less	"very abstract and minimalist, one painting in several variations is interesting, "not my kind of art"	slightly different from previous one, "I think they make more of an impact if they're floating in the air instead of on a wall", was more interesting, but not 100% sure but more that was the art or environment"	quite abstract, "not necessarily my cup of tea, but nice to see in relation to how the room was addressed"	same as before, or at least comparable, "like it as in this environment now I feel less engaged with the art and kind of more searching for it or even connected" does it have a connection or am I just looking at random stuff? abstract art, "I didn't feel the artists connection to it"
"truly felt me wondering", most expressive one was the installation (was works) other one's left wondering what the meaning behind the colours are	felt intrigued, didn't feel moved or connected emotionally, but would like to see more of the artist	confused, pleasant, but didn't feel moved	didn't really have an effect, didn't feel connected	didn't really have an effect, "I was just art"	not a lot, didn't really have an effect	not a lot	didn't do much, but did try to "find some meaning" in it, the reasoning behind it, honoring the culture is an interesting and fun idea for art, "but for me if it is too abstract, I will just not care"	was more interested in this, but says the same as previous, "not really my thing"	didn't really have an effect more like observing it, not emotionally touched	"that nothing", didn't have an effect at all, "I also did not so much feel like I was trying to convey something to me"
	white	white	blue	white	yellow, switched			yellow	yellow	
	felt brighter, also liked the mix of warm and bright	felt brighter	"I think it just adds onto the best vibe", more cool toned "I prefer that", didn't like the yellow, it was too warm and "didn't really go well with the overall atmosphere", white was just a standard one for me, I like to switch it up"	felt more natural in that setting, other ones felt more artificial	no idea, I felt like I used the green one and then the blue one, "it made me feel good", blue light reminded of the nighttime in video games, where you can see everything perfectly even though it is the night, which is very comfortable		white was boring, blue was way too cold, people naturally tend to go for more yellowish colours, feels warmer, "makes everything look more vibrant"	"felt like the room was a little bit more warm and more welcoming than the one"		
	none	none	silence	silence	jazz			jazz	jazz	

	didn't really like the music, felt a bit overwhelming, preferred silence	preferred silence	"both choices didn't really add on to the experience", would be more distracting	preferred silence, maybe elevator music, but silence is preferred	first one (jazz) puts you in a mood, "I just wanted to walk slowly down the hallway"		jazz, didn't even check if another one, "I did like it a lot more over silence", "I was going to go, classical can be nice, but it didn't add to the art, made more sense in a history museum with old paintings, not sure if jazz really fit, but not sure what the artist was trying to convey, if more uplifting than the, if moving then no"	silence plays more into limited feel, not necessarily anxious but slightly uncomfortable, classical was nice, but "jazz felt fit into the environment more", "reminded me of elevator music, which I find very nice music"		
first one (broad), "I connected the emotions much more through the light as well as the music", "without sound and neutral light, there was nothing around", "it just helped a lot to convey the emotions attached to the artwork"	not sure, "both fit the art pretty well", more similar to an actual museum, good, but didn't make much of a difference			second one (historic), switch some of the paintings, more abstract ones to feel more complete		"first one (historic), definitely"	second one (broad), first one (modern) felt more like a real museum, "first makes sense to me now", "when watching the video it makes sense, with the time in the middle of the forest, makes sense if the art about the tribe and the tribe surrounded by forest"			the first one (broad) for sure, very nice environment, it felt like it was put together with care to do the art and artist justice", "also having some resemblance of sound that was nice", also changing the lights, "right now it's just very industrial, very ugly", warmer lights are just a more cozy vibe
yeah absolutely, "second one (modern) didn't really catch me, but first one (broad) it didn't make me feel like I was there, but it gave me a good idea of what the artist was feeling when he was making these and what he was thinking about"	second one feels more comfortable, first one was a bit dark			not really, didn't feel more or less involved in it, second one for sure more museum like, "I can see but first one could be more interactive for people, but not for me"		also it's not real, but really feels real, having like a box space level and having some more rounded shape and hallways, also it's perspective, the first one was more perspective because of the hallway	I was more interested in it, not really sure			maybe, yes, "just the layout of the spaces makes a huge difference and how you close the rest of the space, if the rest of the space also has a connection to the artist and what they're trying to portray with their art it feels like something you are more likely to engage in and actually be interested in", "except for just having white walls with art, which is kinda sad, but unfortunately it's mostly the form"
really enjoyed the first one, "really like the idea of having a living environment around the art but not part of the art"				"loved the chandeliers, it was very pretty"		focus on the space instead of the connection with the art, liked the experience, walking down a museum but not in real life is amazing of				the second one (modern) reminded of a video game situated in a museum, which was nice

11 Historic	11 Media	12 Media	13 Forest	14 Media	14 Historic	15 Historic	15 Media
0323	0417	0324	0615	0748	0617	0248	0154
goes pretty straight to text and reads it; ignores buttons; looks around; looks at art; no comments about the music an dlight changes; vibas to jazz; back to silence and white light; goes to second room; looks at movie; looks at art; tries to select art	goes to text but doesn't stop; plays video; looks at it for a while; then pauses and moves on; looks at art; looks at everything; stops in front of paintings; look at them; goes back down; plays movie again but stops quickly	easy controls; reads text; looks around; pause in video is glitchy; looks at video; moves on after a while; looks at art; goes up the ramp; looks around; moves quite smoothly; turn around; looks around and looks at art quite closely; moves through space easily; pretty quiet	looks around; reads text again; quite focused and looks at it closely; walks around; looks at art; looks around a lot more than in previous one (modern); looks at each art piece for a long while; looks at video again for quite a while; prompted to try buttons; changes light to yellow and sound to jazz; looks at art again with music and yellow light; looks at video again and for quite a while; changes light and looks around again; changes back to yellow; tries classical movie with white light	controls quite easy; reads text first; looks at video for quite long; moves on; turns and looks around; looks at art quite closely; especially wise works; goes up ramp and looks at art; also looks at silk screen quite closely; looks around at top; looks down from ramp; when going down also looking at art again pretty long; looks at wise works again	walks around; looks at art quite closely and intensely again; finds buttons quite easily; switches through light and goes back to white one; stops when finding jazz music (first one); looks at art closely; goes to second room; watches video for a while; looks at art for a while; moves back; prompted to try classical music; moves through quickly; mentioned motion sickness	easy with controls; reads text; walks around; walks to buttons; looks at art quite fast; buttons "am i supposed to select stuff?"; jazz music; "tip toes" to see buttons (was sitting at first); looks around; changes light to blue one; moves around quite quickly; back to white moves around again; yellow light and classical music; moves around again	"can I click." "no"; walks around quickly; silk screens; walks down again; plays video when asking if anything's clickable; pauses and moves on; walks around; looks at text
no		yes		no		no	
no		yes		no		no	
3	5	6	7	6	7	4	5
4	6	7	6	7	7	3	6
3	5	7	7	7	4	4	6
4	6	5	6	6	6	3	4
2	3	4	6	4	7	2	3
3	4	6	6	6	7	2	2
2	4	4	6	5	6	2	2
1	2	2	4	2	7	2	2
4	4	6	4	7	7	2	3
4	3	4	6	7	7	2	3
1	4	6	5	6	7	2	3
5	5	6	5	7	7	1	3
2	5	5	6	6	5	4	3
2	3	5	5	6	6	2	3
1	5	6	5	7	5	4	5
3	6	5	6	7	7	2	4
"Clicking the buttons was fun"	liked the staircase, liked the art there	liked the video, also the three pictures (silk screens)	"I really liked the buttons and when the music started", "both made the experience way more immersive", "the sounds itself felt like an actual environment", "felt like walking b. it, interactions with the buttons felt real"	liked seeing the video after and first the art, relation to video	liked when changing the music and it also changes the perception of the artwork, "the first music had a different energy, it really affected the way to see the art"	didn't have one, "pretty cool effect that I don't have to leave to see art", felt like a game	was interesting, there was a video, "nice it's minimalist", "modern art museum"
walking and understanding the movements, when done it was okay	pause button on the video (video glitchy)	didn't have one, pause in video (glitchy)	didn't have one	not really frustrating, just not understanding the art	motion sickness, but about the art and stuff back, the textures seemed off on some elements, it wasn't as real, wasn't the same quality, might have an influence on the art perception	figuring out what to do, but not really frustrating	not knowing what to do, didn't understand it was a video

"It's kind of empty in a way"	"bit more like a modern museum", liked the vibe	"It felt like a museum"	"different and immersive", liked the trees, it "created a different environment", a "non-conventional museum"	"intriguing"	"makes you reflect and think", gives a privilege to the art (makes it seem special) "space tries to replicate a museum"	"It is closely related to an actual museum", quite small, "looks like a museum"	"minimalistic, modern, much whiter in a sense", second level gives space appearance of being bigger, "not a lot of stuff screaming at you just a wall with a painting, not much else"
"It was a little boring in my opinion", more interested in walking in VR than the art	"I don't know if it's the same, but I liked this one more, the shapes and colours"	interesting, original	hard, original, different	"the art is emotional", "trying to communicate what his (the artist's) emotions and feelings are", intrigued by the fact that it's not very direct, not aggressive or intense, more an extension of trying to describe his feelings	"the art is really emotional"	never heard of artist before, didn't know what to expect, "the circle one (digwe) was confusing", interesting, but nothing calls to me"	"very contemporary, modern art", "anything can be art"
not much to say, "It was nice, but I wasn't influenced"	"made me maybe a bit happier", nice shapes	"immersive", "thought provoking"	can't describe it very well, "thought-provoking", "I was thinking and feeling the art"	"reflection of reality and our perception of the world based on our own experiences"	similar to the first one, "I was trying to understand some of the symbols, how these have a different perception (meaning) on his reality (the artist) than mine", trying to understand how artist used the symbols, and different fabrics	no effect, "I'm not really an artsy person", was very extreme, very different from each other, nothing that connected	"I'm not an artsy person, so nothing"
white			yellow		white	tried all	
"I didn't realize there was a yellow one", "I just don't like blue lighting, it doesn't feel good", too harsh maybe and odd			"It felt more comfortable, it matched more the trees environment"		not a specific reason, "just changing and picking this"	didn't feel like the light had an effect, "red light might have more of a horror feeling"	
silence			jazz		jazz	jazz	

kind of didn't know what it was for, just playing around with it "I just didn't know if I wanted to listen to anything and I decided not to", "maybe it was stashed somewhere that you can have this for the whole experience", unsure if it would stop when walking away			first one (jazz), "I thought it really contributed to the experience"		first didn't know there was more, prefers jazz more, "gives a different perspective", "more energetic"	"other one felt like a movie song", "jazz fit more with the actual style"	
	second one maybe (modern), the art was more abstract in a way, shapes and bold colours, "I think of more of a modern museum, that is what the space was like"		second (best), felt more complete, had more to do with it, "had more personality with the whole history of the art"		second one (historic) was more realistic, had more elements of reality, a little easier to understand what he's trying to put on the art (meaning), "also the music during the whole exhibition is nice", both are really interesting, liked the music, good idea		second one (modern), contemporary, modern artist, "for the first (historic) an 18th century artist would be nice"
	"I think so", maybe it was the flow of the space, "going up and because of that I was looking at the art more" instead of turning around all the time in the rooms, "I was a bit more focused on it"		"yeah, totally", when experiencing art it's a "combination of feelings", music, the environment all contributes to the experience of art in general, watching a movie in a theater it's more immersive, combination of environment, experienced with sounds, engages all kind of senses		yeah, "like when it's just a normal room without many elements it doesn't feel so special", "when there's more elements in a space it feels more premium and special"		yeah, "since the space made sense with the art everything else is blurred and you can focus on the art, otherwise you're way too focused on other things instead of focused on one thing"
							maybe making it more obvious that it's a video

Appendix 5

Information Letter

Information Letter – Influencing modern art experience through atmosphere in a virtual reality museum

07/06/2023

Dear reader,

in this letter, I would like to inform you about the research you have applied to participate in.

In this research, titled 'Influencing modern art experience through atmosphere in a virtual reality museum', you will explore a virtual reality museum. This exploration will be observed by the researcher and interview questions will be asked. The information will be gathered through an audio recording, a screen recording, and written notes.

The aim of the research is to improve the perception of the art and the understanding of the story behind the art through the atmosphere in a VR museum. The research could provide useful information about the changes in perception and understanding visitors have if the atmosphere changes.

If you are known to have motion-sickness or nausea related to a virtual reality environment, you are advised not to participate in this study, as you will explore a VR museum.

Your anonymity in the gathered data will be guaranteed, as the audio and screen recording will be deleted and the notes and transcripts will be anonymized.

Your participation is and will remain voluntary at all times. You can refuse to continue and end your participation at any point during the research. You also have the option to refuse afterwards, within 24 hours after completion of the research, to have your data used for the purpose of this research. The research session will last approximately 30 minutes.

This research project has been reviewed by the Ethics Committee Information and Computer Science.

Yours sincerely,

Researcher

Lilly Stelzer

l.m.stelzer@student.utwente.nl

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: ethicscommittee-CIS@utwente.nl

Appendix 6

Consent Form

Consent Form for 'Influencing modern art experience through atmosphere in a virtual reality museum'

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Please tick the appropriate boxes

Yes No

Taking part in the study

I have read and understood the study information dated 07/06/2023, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study involves exploring a virtual reality environment and being observed throughout the interaction, with written notes, audio, and screen recording to capture information. Furthermore, I understand that it involves an interview, where the information will be captured through written notes of the researcher and an audio recording. These recordings will be destroyed after a transcription.

Risks associated with participating in the study

I understand that taking part in the study involves the following risks: possible motion sickness or nausea due to the virtual reality environment.

Use of the information in the study

I understand that information I provide will be used for a report and a bachelor thesis publication.

I understand that personal information collected about me that can identify me, such as my name, age or profession, will not be shared beyond the study team.

I agree that my information can be quoted in research outputs

Future use and reuse of the information by others

I give permission for the written notes and anonymized transcript of the audio recording so it can be used for future research and learning.

UNIVERSITY OF TWENTE.

Signatures

Name of participant

Signature

Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Researcher name

Signature

Date

Study contact details for further information:

Lilly Stelzer, l.m.stelzer@student.utwente.nl

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