

The Immersive Experience of Museum XR Technology: Based on Heidegger's Theory and the Flow Effect

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Abstract. In the current era, where extended reality (XR) technology is prevalent, museums and visitors have experienced a huge breakthrough from passive viewing of "static objects" to active interaction with "living objects". Museums that utilize XR technology to create immersive exhibitions have received considerable attention. However, many technical issues have arisen, such as the adaptability of virtual content and the level of participation in the visitor interaction. To understand the immersive experience created by XR technology and its impact on visitors, this paper will analyze recent museum exhibitions that integrate XR technology with other theories to construct a framework. The paper ultimately concluded that the flow effect is the key to shaping immersive experience with XR technology, enabling visitors to achieve a high-dimensional immersive experience. Based on this conclusion, this paper argues that XR technology serving people should match with interaction and narration to shape immersive experience, and awaken people's emotions and cognition, as the primary focus.

Keywords: Heidegger, flow effect, presence, authenticity

1. Introduction

With the aid of XR technology, virtual experiences have gained popularity and acceptance as entertainment. As cultural and informational dissemination centers, museums have begun adopting XR technology to make visitors' experiences as immersive as possible, aiming to achieve both entertainment and educational outcomes. Researchers examine how museums leverage XR technology to create immersive experiences. Song et al. presented a theoretical framework for the use of Heidegger's philosophy of immersive museum experiences [1], while Jiang and Fan et al. discussed how to create a sense of happiness among visitors [2]. According to these scholars' study, it can also be concluded that when XR technology and immersive design are out of balance, visitors will not be able to successfully assimilate the information. The outcome will be museums reduced to a straight technological show. The story of the exhibits is what the museums should pay the most attention to, and XR technology is nothing more than an auxiliary tool. Over the past few years, many museum exhibitions have sustained both high-quality virtual content and a fluent narrative. The purpose of studying such exhibitions is not only to comprehend the elements that make up immersive experiences, but also to advance the development of immersive technologies. By doing

so, the museums may evolve into an important medium through which individuals can perceive the history and culture of the world in modernized, virtualized formats.

The paper explores how museums incorporate XR technology alongside narrative and psychological cognition theories to develop immersive experiences during museum visits. Drawing on recent publications about the museum's XR exhibitions, the paper will offer a framework for immersive experiences grounded in the philosopher Heidegger's fourfold model. The cognitive psychological factors comprising this framework are taken into account in the happiness that fits the concept of flow. The final discussion findings indicate that the essence of immersive experiences can be understood as a path structure that incorporates the four components: the visitors, the construction of the virtual environment, the design of the virtual content, and the emotional resonance. The experience of presence and genuineness in this path structure will facilitate the flow effect, enhancing the efficiency of the transformation between the design of virtual content and emotional resonance.

2. Theoretical introduction

2.1. Heidegger's fourthfold model

As presented in the paper, the theoretical framework for analyzing how visitors immerse themselves in the museum experience builds on Heidegger's fourfold model. The framework aims to establish an embodied experience that combines XR technology and interactive, guided design.

To start analyzing the framework, it is necessary to understand the four major components of the fourfold model as applied to museum immersive experiences: human, earth, sky, and deity [1]. Both the fourthfold model and the framework treat four elements as a dynamic, interconnected relationship. Therefore, the four elements always function simultaneously and cannot be separated [2].

The "human" and the "earth", in this respect, belong to the hardware requirements. The visitors are the people who make up the "human", and the XR devices connecting them to the virtual world are referred to as the "earth". To provide people with the experience, the "earth" enables people to walk through virtual lands. If a virtual space has rich narration, it can elevate the "earth" and extend into the virtual world.

The "sky" and the "deity" are responsible for contributing to the richness of the narration and creating good results. XR technology creates extraordinary worlds in the "sky", fulfilling visitors' imaginations by making the impossible possible. What is most remarkable is that visitors will be able to interact with lost things, which will be reborn in the virtual through XR technology. Whereas visitors depend on interaction with the "earth" to create a presence, high-quality interaction design is essential in the "sky" to attract visitors. Then, the tough problem in the "sky" is persuading visitors to accept the virtual worldview and engage with it through a variety of virtual designs that contain storylines and communication. An effective "sky" design will cause emotional reflection and resonance, leading visitors into a so-called "deity".

This paper will primarily examine research on the "sky" and the "deity", specifically on how virtual content design can trigger emotional resonance and create an immersive experience in museums.

2.2. Flow effect: creating happiness for tourists

In the immersion paradigm of this paper, the channel between the "sky" and the "deity" will be the flow effect. It is essential that the psychological factors that are important to understanding the immersive experience of tourists are especially important for comprehending how to put visitors in a state of flow.

Aspects that construct happiness and lead to the flow effect require presence and sincerity. The presence creates credibility regarding the authenticity of virtual exhibits, and, eventually, this results in happiness that enhances the immersion in XR technology. In the context of museums applying XR technology, authenticity is a notion in which the content is not necessarily real, and immersion in reality is not the same as authenticity [3]. Authenticity is more likely to awaken visitors' psychological states. Such a feature may cause visitors not to think about the medium but to activate their intentions to obtain information. Thus, the presence that defines authenticity must have two features: space and interaction [4].

In the physical presence case, the tourists will already be in the virtual world, with sensory instructions at their fingertips on the virtual device, which is the simplest physical intervention on the immersion trajectory.

Social presence enables tourists' inclusion in the virtual environment, allowing them to engage with virtual products. A number of articles about XR technology have stated that the features of the experience, such as interactivity [5], will influence people's final experience, including the sense of immersion. As regards the way of interacting with virtual creatures, social presence enhances rationality and helps tourists identify with the virtual world. Providing interactive feedback makes tourists feel enthusiastic and authentic. Once presence shapes authenticity in that way, tourists are more likely to neglect the boundary between the virtual and real worlds and experience the flow effect of forgetting others [6]. Tourists will believe they are not just passing by, but invited to join the virtual activities. From the interrelated presence and authenticity, the paper concludes that interactive design is almost a mandatory "sky" design for the XR immersive experience to stimulate tourists' entry flow

3. Case analysis

3.1. Natural History Museum exhibition

The Visions of Nature is a VR experience project of the Natural History Museum that opens in 2025. From the moment visitors enter, watch the content, engage in virtual interaction, and experience emotional resonance, the Natural Landscape Exhibition perfectly embodies the importance of Heidegger's fourfold model and interactivity for immersive experiences.

The exhibition mainly explores the virtual nature of diverse environments and organisms. Visitors can experience not only the magnificent natural wonders but also the life in the ecological environment in an interactive way, to feel the diversity of life. Once entering the exhibition, visitors have already become part of the virtual natural environment (the "Human" and the "Earth"). From the visions of future organisms and environments presented in the exhibition, XR technology could reproduce the past and even construct and predict future scenes [7]. The vital thing is that the museum uses XR technology to create a natural environment experience and rare animals that are "impossible" to access in the present. Because the "Sky" element not only stimulates visitors' interest in the biological environment, but also leads them to the "Diety", that is, to evoke the visitors' awe of natural life and the prospect of fictional biological environments. With the

participation of the "Human" and the support of the "Earth" scenes, the four elements, including the "Sky" that breaks through the limitations of environment and biological genes, and the "Diety" that evokes natural feelings, can form a complete virtual ecological environment experience for visitors.

In terms of interactive design, the Vision of Nature is quite successful, and its interactivity is key to guiding visitors to a state of flow. Visitors can interact with some virtual organisms through gesture recognition. In different ecological environments, body temperature sensations change. For example, when visitors are in areas such as the Antarctic or the Arctic, the temperature will decrease. It is one method that the exhibition establishes a special connection between visitors and nature through VR technology. The strong sense of presence will make visitors feel as if they have come to an environment and are integrated with other organisms. Visitors are no longer just passively browsing the virtual nature as a visitor, but feel the authenticity of nature through the interaction feedback with organisms and the environment. According to Mihaly's statement, if visitors can temporarily forget reality and focus on natural life as all organisms do, they can acquire happiness from the current virtual environment [6]. It can also enhance the immersion.

3.2. Exhibition of the University of Tübingen museum

"Temple tax and dove Trader" is a VR educational application developed by a team from the University of Tübingen in Germany. It has been on tour at several university museums. This special exhibition has not only proved that the fourth model is the basic immersive framework but also that the rational use of XR technology to shape authenticity can lead visitors into a state of flow.

The special exhibition is primarily based on games, and visitors can see historical buildings of the old Western world and experience the religious culture. Among them, the main gameplay is simulating religious rituals. Visitors will interact with virtual characters to obtain resources. Different resources will lead to different outcomes, such as offering sacrifices or paying the temple tax [8]. The special exhibition has the "Human" who attends as a gamer and the "Earth" with a virtual environment of ancient temple ruins. On the establishment of these two elements, the temple scenes design and virtual NPC interactions constitute the "Sky" design. Although the building is a virtual model based on the existing ruins of the temple, for visitors to experience the past temple is meaningful, and it is also the significance of using XR technology. As always, the immersive framework of each museum should utilize the characteristics of the "Sky" to break the limitations of the exhibits. This special exhibition successfully made visitors "ignore" the rules of time and space and "travel" to the complete and prosperous temple. Furthermore, the interactive design of religious rituals and the detailed construction would make visitors feel the charm of religious culture and the technology and wisdom of the old civilization. At this point, the special exhibition has successfully utilized XR technology to create an immersive religious culture experience for visitors.

The design that brings happiness possesses the authenticity close to life. According to the user experience survey, the scene design is popular [8]. Taking the square around the virtual temple as an example, it is filled with virtual pilgrims. Visitors can join them to experience the pilgrimage. However, the virtual pilgrims have few interaction prompts. Instead, they act as real pilgrims: they would meditate and worship quietly and sincerely, which provides visitors with a fulfilling but not chaotic atmosphere and authenticity. The design of this exhibition is another immersive idea, and it also indicates that interaction is not necessary for authenticity to increase immersion. The pilgrim square, while conforming to reality, also leaves space for visitors' non-interaction. Visitors can find a position they like, do nothing, and meditate and worship like virtual pilgrims. By obtaining this comfortable, free sense of happiness, visitors can enter the state of flow.

4. Revelation

According to the previous theoretical analysis and case studies, the paper suggests that certain elements still have the potential to enhance immersion.

4.1. Tourists transform from participants to decision-makers

Interaction is one of the most important aspects of the museum's XR immersive experience, which has transformed how individuals visit museums [9]. The interaction is also very developable. Gestures like clicking, waving, and touching are among the most common ways tourists interact. Museums have the opportunity to create designs that address the problems of interaction between tourists and the virtual background in terms of integrity and meaning. This kind of interaction must, at the same time, generate a sense of presence and serve as a vital chokepoint in virtual content. Virtual content is typically unaffected by simple interactions within its structure and process. Interaction can be designed to enable tourists to make choices that will impact subsequent virtual content and, consequently, increase tourists' sense of presence and need to interact. This is the point at which tourists will cease to be mere participants, and their choices will lead to alternative situations, roles, and even storylines. The whole narration system is altered, as the tourists' choices are determined by their thinking. After all, there are branches of the narrative, and museums can create XR exhibitions that visitors can revisit several times and develop the storyline. In such a situation, visitors will be able to enjoy the exhibition at close quarters, and every effort can also introduce new experiences and ideas to the tourists.

4.2. The connection between the "diety" and the flow effect

From the results, both the "Diety" in the fourthfold model and the flow effect can lead tourists into a positive psychological state. They even reflect each other. Before entering the "Diety", the state of self-forgetfulness in the flow effect can be the preparation. Because the latter happiness will make tourists fully immerse themselves in the sacred connection with the exhibits. Even if the tourists have already entered the "Diety", it can still inspire tourists to enter the state of flow through emotional resonance. There is a special necessity between the "Diety" and the flow. Without the flow effect, tourists do not have enough attention and perception to reach the "Diety". A single flow state without the "Diety" only makes tourists self-satisfied. Tourists will not be able to achieve thought perception or emotional resonance. Thus, it can be known that the "Diety" and the flow effect can construct different dimensions of immersion. The combination of the two can raise immersion to a new level, that is, truly achieving the integration of education and entertainment. This combination is also the design that museums using XR technology should pursue.

4.3. "Blank" virtual content

The blankness of XR technology can also undermine immersion in the design of virtual content. Blank actually means to strip visitors of sensory stimulation, leaving them with room to imagine and comprehend, e.g., sound reduction, blurred smell induction, or a screen showing nothing.

There is also the concept of blank design, which can result in the flow effect. A part of an immersive experience is creating a fulfilling, harmonious atmosphere for visitors. In some cases, blank is far more palatable than more technical special effects. The fact that "blank does not oblige the visitors to catheterize themselves with a load of content at a time, enables the visitors to express themselves in any manner they wish. Even in the empty spaces, museums can afford to allow

visitors who have been exposed to some form of virtual content a time to relax. Visitors can also be prepared for the next virtual content after taking some time to breathe. For example, in an XR exhibition with a plot or a dramatic enactment, the museum is free to use a short area or play with sections that are rather calming in different spots after each plot, allowing the audience to reflect on the last plot or visualize the next. Naturally, tourists will have an opportunity to take a quick break to refresh their minds and senses and renew their strength. Such an appropriate "blank" may indicate the curators' attention and appreciation for the visitors' ideas.

Blank is advantageous in arousing visitors' interest and desire to explore, and in leading them into a state of flow. In the case of a museum exhibition, one-directional information dissemination is not allowed and cannot be accommodated [10]. The blank, therefore, is also an effective method of interaction, ensuring that visitors actively participate in the exhibition and enhancing their immersion. Insufficient or missing information can make people visiting the destination feel they have explored an unfamiliar space in a selective way through guided interactions. Not all visitors will be interested in all the content; some just want to scan it at once. Such visitors can be satisfied with either blank or selective interaction. After the interested visitors are guided and complete their interaction, they are not only informed about the answers but also surprised and happy. Thus, museums will be able to establish blank as a dominant goal, which is only present to visitors. The choice to pursue a potential goal of a sense of successful endeavour and happiness can also indicate whether tourists enter a state of flow during the moment of unanticipated exhibiting [5].

5. Conclusion

Through a review of the theoretical background, the paper will show that Heidegger's fourfold model can foster narrative-based, immersive meaning for tourists, thereby enhancing the bond between tourists and exhibits. The paper refers to the concept of the flow effect and to two cases of museum exhibitions when examining the Sky and the "deity" of the fourfold model. The Vision of Nature reveals that the immersive experience of XR technology could encourage tourists to engage with virtual beings and receive constructive feedback. According to the special exhibition at the University of Tuebingen Museum, it is possible to propose that XR in exhibition design can be balanced with interaction, authenticity, and scene design to create greater happiness. To conclude, Heidegger's fourfold model can serve as a guide for organizing any exhibition of XR technologies. The absence of a narrative and interactive virtual content prevents visitors from having an immersive experience. The XR technology requires not only constant breakthroughs but also radical designs and new ideas of the so-called Sky category. It is only when human beings continue to be creative in their imagination alongside technological advancement that the museum experience results in a deeper, more in-depth cognitive and emotional affiliation.

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