Research on Interaction Design of Immersive Exhibition Space

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Abstract: With the development of technology, human society has stepped into the information age. With the support of Internet technology, digital information has become an indispensable part of people's daily life, how to better integrate digital information into the display space design has become the focus of designers to explore. With the improvement of people's aesthetic sense and art appreciation level, immersive experience space is gradually loved by people. Immersive experience space is a kind of "immersion" very strong space type, in this space, the audience can through immersive experience, and exhibits produce more sensory communication and interaction. This new way of interaction has changed the simple "one-way" information transmission mode between the audience and the exhibits in the traditional display space design, allowing the audience to interact with the exhibits in a more in-depth way. In this paper, we will explore the immersive experience space display techniques and interaction, through the multi-technology integration of immersive experience design exploration, and combined with case studies for the display space design to provide some new ideas and methods.

1. Introduction

With the development of society, information technology is more and more closely related to people's lives, and people's spiritual and cultural needs continue to grow. With the development of the Internet and virtual reality technology, there are numerous digitalized exhibition spaces, which are constantly being updated. "Immersive" is a concept put forward in recent years, it refers to the advanced digital technology will space information, multimedia technology, virtual reality and other kinds of information interaction fusion together, so that the audience through the senses and thinking to participate in the exhibition content. Immersive display space is a kind of display space experience new way, it will show the content, space environment, technology means organic fusion in one, can bring to the audience all-round, immersive experience [1]. In the traditional exhibition space design, people are more through the exhibits, exhibits to pass information, few people will take the initiative to participate in it, the interactivity is weak. In recent years, with the development of science and technology, "immersive" display space gradually into people's horizons, through the combination of a variety of technical means to create an immersive visual, auditory, olfactory and other sensory experiences, so that the audience in which to obtain a better interactive experience.

2. Materials and methods

Through the innovation of the traditional exhibition space, an immersive exhibition space with more contemporary characteristics is developed. Under the immersive experience, viewers can better feel the emotion that the curators want to express, and the interactivity between the exhibits, and understand the story behind the exhibits and their meaning. Visitors can feel a different sense of participation in immersive exhibition spaces than in traditional exhibition spaces, and interactive exhibitions will be more developed. Whether in a public exhibition space or a museum, the purpose of immersive exhibitions is to give visitors a better experience of the exhibition, not just a passing glimpse of the exhibits. Therefore, in order to give visitors a better viewing experience, the design of immersive exhibition space has become more well-known to the public.

2.1. Background of the study area

Immersive display space design is a special display method based on virtual reality technology, which creates a different sensory experience from the traditional display space by interactively simulating the scene and the behavior of the participants in the space. Immersive exhibition space design through the use of virtual reality technology, augmented reality technology and other related technical means, the traditional exhibits into the audience can touch, feel, experience the entity, so that visitors and exhibits to produce interaction, so that the exhibition is more interactive and participatory, to achieve the best results.

In recent years, with the improvement of the level of technology, immersive display space design also presents a diversified development trend. Immersive display space design can be divided into the following stages: "no man" stage, "man" stage. Among them, the "no man" stage and the "semi-human" stage is mainly the use of VR technology to realize the interaction between people and objects in the space; and "human" stage is the use of virtual reality technology to realize the interactive experience in the space. In the "human" stage, virtual reality technology is used to realize the interactive experience in space. In domestic research, there are more interactive studies in the field of digital media technology, focusing on the technical level, such as the use of digital media technology for exhibitions in museums, so that exhibits appear in front of the public in the form of digital imaging. Through the research and application of technical means, visitors can better understand the historical background of the exhibits and realize the ideological experience in the context of the society at that time.(Figure 1)

Overseas research focuses on the exploration of interactive forms of art and design research at the sensory level. Through research in the fields of psychology and behavior, research is carried out from the personal experience of the crowd, and the experience brought to the viewer is different at different levels. In overseas research, it can be found that through the combination of art forms and the feelings of the crowd, an immersive experience can be brought in the form of interaction. For example, U.S. artist Usman Haque creates an immersive experience for visitors through sound interaction.(Figure 2)

Figure 1: Museum Digital Imaging

Figure 2: Sound Interactive Exhibition

3. The concept and relationship between immersive experience and exhibition space

Immersive experience was first proposed by Rolf A. Zwaan, who initially defined immersive experience as the crowd's pursuit of experience in the virtual environment, he believed that when the crowd is in the virtual environment, the mood and feelings will be subject to change. He believes that when people are in a virtual environment, their moods and feelings will be changed so that they can detach themselves from the real world to gain a sense of satisfaction, which is also known as the "state of mind flow". Immersive experience is a new type of interactive experience, which integrates information technology and art design, through the integration of "virtual" and "real", so that the audience can participate in the display space in the presence of the audience to feel a new experience of the exhibition. In the immersive mode, the viewers can be better integrated into the feelings expressed by the exhibits, which not only enhances the viewers' experience but also improves the crowd's sense of personal identification with the exhibition [2]. Immersive expression is mainly through the digital media technology and the crowd's sensory experience, multi-faceted and diversified to realize the "immersion" of immersion. The display and interaction methods in immersive experience are different from the traditional display methods, and they are inextricably linked with each other.

3.1. Exhibition Space

The exhibition space exists as a kind of public space open to the outside and plays the role of conveying information to the public. In the public exhibition space contains museums, exhibitions and other forms, these are through the interaction between the exhibits and the public to show the content of the message conveyed, to accept the meaning of the expression. Exhibition space is a kind of venue that brings the viewers' feelings through the design of space, lighting design and the design of interactive equipment in the venue. Due to the change of time, exhibition space can be divided into traditional exhibition space and innovative exhibition space according to the form[3]. Traditional exhibition space is the earliest form of design that appeared before the eyes of the public, displaying exhibits intuitively in front of the viewers through a single design technique. In the past, viewers could still have the opportunity to experience the exhibits, but with the increase in the number of visitors, taking into account the management of the situation, today's traditional exhibition space will use alternatives to carry out the exhibition. Innovative exhibition space is to

utilize the combination of scientific and technological means, to add diversified design techniques in the exhibition space, so that the exhibits appear in front of the viewers, but also to attract the public's interest in the exhibition in the form of newer design. This paper will be in the form of exhibitions exist in the exhibition space as a research object, including profit-making and non-profit exhibitions, focusing on innovative exhibition space research, the immersive experience under the application of the exhibition space design to explore.

3.2. The relationship between immersive experiences and exhibition spaces

"Immersion" is a kind of psychological state that allows people to experience a strong sense of reality and sense of presence, immersive display space is based on virtual reality technology, through virtual scenes, multi-media displays, digital modeling and other means to create a "real" virtual space. The virtual space is based on virtual reality technology. In the virtual space, visitors can interact with the exhibits, so that they have a sense of being there, feel the exhibits in the real world. Immersive display space is a kind of technology and art combined with a new form of display, can increase the effect of the display, so that visitors have emotional resonance. The purpose of immersion in the viewer can enter the designer designed by the target scene when the viewer can feel in the moment the designer wants to convey the information, so that the viewer to produce interactive, in the immersive scenario environment to feel happy and satisfied. The exhibition space gives "immersion" as the designed scenario environment, in which the viewers are put into the scenario designed by the designer from the real world, and the viewers resonate with the scenario, which also allows the viewers to get the corresponding information better. For example, in the Shenyang Taste Museum, the designer utilized the sensory level design to place taste stimulation devices in the exhibition space, and used the music bucket to make it easier for viewers to immerse themselves in the taste information that the designer wanted to convey (Figure 3).The entire display space is also well organized, the viewer can feel a shallow to deep levels of experience. Therefore, in the immersive experience and display space, the space is essential, immersive experience is inseparable from the support of the space, the combination of immersive space can also bring a sense of richness of experience, giving the viewer a deep sense of experience.(Figure 4)
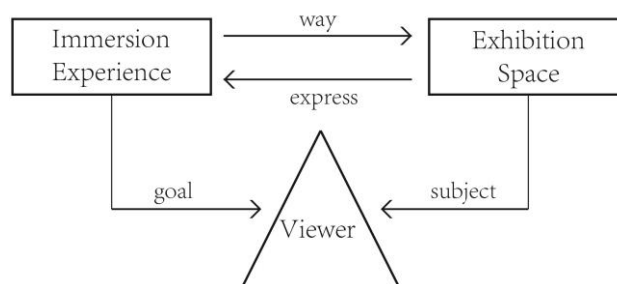

Figure 3: Shenyang Taste Museum

Figure 4: The relationship between immersive experiences and exhibition spaces

4. Immersive experience performance in exhibition space

Immersive design is a spatial design method based on user experience, so that the public can be immersed in a different from the reality of the spatial effect, immersive design is also inseparable from the "people-oriented" principle, in its design at the same time need to take into account the feelings of the public can be generated and the psychological, based on these aspects of thinking, to find the corresponding design approach, to bring visitors a different viewing experience, immersive design features include the use of spatial structural design to allow visitors to walk into the "exhibition" experience. The corresponding design approach to give visitors a different viewing experience, immersive design features include (1) the use of spatial structure design to allow visitors to walk into the "virtual" world.(2) the introduction of digital media technology into the design, and the public to generate interactivity.(3) the behavior of the visitors, sensory level to guide, so that they can feel the value of information brought by the designer to guide the behavior and sensory level of the viewer, so that he or she can feel the value of the information brought by the designer[6]. Immersion is intended to guide the viewer to feel the intention of the designer in the space, so that the viewer can be emotionally satisfied in a human-centered way. Under the characteristics of immersive design, we will take the exhibition space of TEAM LAB team in Japan as an example. TEAM LAB team has been devoted to researching the application of immersive interactive design since 2001, and we can find that in their design works, the team has started from the earliest use of digital media technology design to present the whole immersive experience, and then to the use of the original spatial atmosphere to enhance the immersive interactivity of the exhibition itself. In 2001, TEAM LAB designed "Message Tree", an exhibition focusing on data art, to demonstrate the immersive experience brought by digital media art.(Figure 5)In 2002, TEAM LAB designed "Digitized Nature", which utilizes the outdoor landscape space and intersects with each other, believing that the natural gesture of nature remains natural and becomes art.(Figure 6)In 2018, TEAM LAB designed the "Forest of Flowers and People" exhibition, in which the olfactory senses were added to the design, so that visitors could not only see the flowers and forests visually, but also smell the various flower scents in the exhibition.(Figure 7)The TEAM LAB team utilizes various immersive design techniques in their exhibition works, each exhibit brings a different visual feast to the viewers, allowing them to be completely immersed in the designers' exhibits.
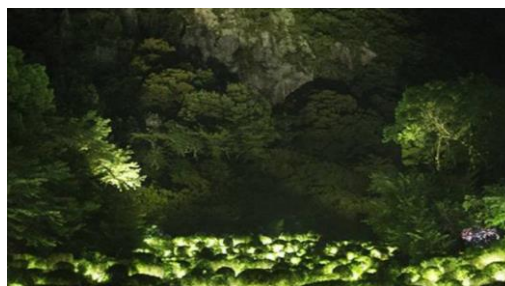

Figure 5: Message Tree

Figure 6: Digitized Nature

Figure 7: The Forest of Flowers and People

4.1. Immersive and Non-Immersive experiences

Table 1: Immersive versus non-immersive experiences

	way	Advantages	Disadvantages
Immersive Experience	Digital media technology, multi-sensory experience	Immersive exhibition, strong sense of experience, high interactivity, strong sense of immersion, high efficiency in receiving information, high degree of satisfaction	Requires technical support and a certain amount of space to set up.
Non-immersive experience	Exhibits, image text	Intuitive presentation and simple design	Low information acceptance, low interest in exhibition, no sense of immersion

Immersive experience space is a kind of display space that can bring people a strong sense of "immersion". Compared with traditional display space, immersive experience space has stronger interactivity, which allows the audience to better understand the content of the exhibits through interaction with the exhibits. Immersive experiential space and non-immersive experiential space has a big difference, because immersive experiential space in the display method and interaction on the traditional exhibition space design has a big change, so in the specific design should be combined with the content of the exhibition and the audience needs to carry out a different display method and interaction mode selection, so as to better play the role of immersive experiential space. Immersive experience will be supported by science and technology, through a variety of forms of expression, such as digital media technology, visual, olfactory, auditory and other aspects of the sensory design, as well as through a variety of art installations and visitors to interact. The advantage of immersive experience is that it can bring visitors a better exhibition experience, allowing them to quickly become involved and gain a sense of pleasure and satisfaction [5]. They can also interact with the exhibits in a diversified way and receive the information that the designers want to convey more efficiently. Non-immersive experience is mainly in the form of the exhibits themselves and graphic text in the exhibition, in an intuitive form to the visitors to convey the information of the exhibits, although the design of non-immersive experience is simpler and quicker in form, and involves fewer types of spatial design techniques, but the non-immersive experience is very difficult to let the visitors to realize the intention of the exhibits want to express, and cannot clearly understand the information of the exhibition that the designer wants to convey, so it will reduce the public's ability to view the exhibition, and therefore will reduce the public's ability to understand the information of the exhibition. The non-immersive experience will not allow visitors to realize the intention of the exhibits and understand clearly the message that the designer wants to

convey. (Table 1)

5. Immersive design principles

Immersive exhibition space is through technological means for the audience to bring immersive experience, it needs to focus the attention of the audience in a specific visual, auditory and tactile experience. It is composed of a number of sub-systems, such as multimedia information systems, projection systems, interactive systems, etc. These sub-systems interact with other sub-systems. These sub-systems are interconnected with other sub-systems to provide a sensory experience for the audience.

5.1. Immersive experience through the creation of spatial environments

Immersive experience space "immersion" is its biggest feature, in this space, the audience can get through the sensory experience of unprecedented immersion. In order to better realize this, the designer should make full use of the space environment to create an immersive atmosphere, so as to bring an immersive experience for the audience. Different from the traditional exhibition space, from the original static display as the main change into a static and dynamic combination of display forms, from passive to active interaction with the viewer [8]. The spatial environment constitutes one of the elements of the immersive experience. Through the creation of the spatial environment, the visitors are drawn into the world of the exhibits, bringing them a sense of immersion and satisfaction. In the construction of spatial environment, there are different forms of expression, through the specific spatial place construction can bring different spatial immersion experience, from the types of spatial design can be divided into narrative space, interactive space, etc., these two types of spatial environment is the most commonly used way of construction. Narrative spatial environment construction techniques can allow visitors in the exhibition of the whole process according to the storyline towards the exhibition, by the story to penetrate the entire display space, this way allows visitors to produce emotional resonance experience, enhance the sense of immersion. From the interaction between the story and the viewer to the interaction between the person and the space, in the narrative space environment, the viewer can give play to their imagination and the story for fusion, so as to achieve the story and the experience of the interaction between the sense of transformation, interlocking, and finally achieve the story - the person - the space of the interaction between the three experiences. Interactive spatial environment creation is the design of interactive technology in spatial venues, so that viewers can experience the immersion created by different spatial environments during the tour of the spatial route, as a way to express the background and information content conveyed by different exhibits. Utilizing interactive means to bring interactivity between exhibits and viewers.

5.2. Display design incorporating digital media technology

The application of digital media technology is mainly realized in the application of digitalization in display design, especially in the application of interactive display design. Through visual, auditory, tactile and other sensory stimulation, this interactive mode allows the audience to participate in it and create a rich emotional experience. Through the study of immersive experience space, it is found that digital media technology can maximize the transmission of information to the audience in the interactive mode. For example, in the VR immersive experience space, the audience can experience the customs of the ancient Silk Road through VR glasses; in the 5G digital exhibition hall, the audience can communicate with the staff on site in real time through the 5G network and get real-time updated information; in the AR technology application space, the

audience can feel the scenery of the tropical rainforest by wearing AR glasses. Through the virtual way to pull the public into the "virtual world" in which the virtual and reality combined to create a specific scenario, so that the public get a sense of generation, immersion experience [7]. The Landscape Digital Library created by the State of Utah in the United States demonstrates the application of digital media technology. The Landscape Digital Library presents virtual scenes from the history of landscapes, allowing the public to tour the landscapes of historical sites around the globe through VR goggles and virtual reality headsets, enhancing the public's sense of immersion.(Figure 8)The project was initially created to allow students to better learn the history of landscape, through immersive experience to enhance students' interest in learning, from the experience and sense of immersion level to bring students a different learning experience, but also to integrate technology into the learning life. At present, the Landscape Digital Library covers 24 different historical landscapes in the world, and opens a tour channel for the public, who can access the website through cell phones, computers, IPADs and other electronic devices, thus promoting the development of landscape.

Figure 8: The Digital Library of Landscape Architecture History

5.3. Enhance viewer engagement through visual experience

Participation is the core of immersive experience space design. Through visual, auditory, tactile and other sensory experiences, viewers can enhance their participation in the exhibits. Through visual experience, viewers can produce more sensory communication and interaction with the exhibits. In the design of the exhibition space, digital display technology, interactive devices, environmental atmosphere creation and other elements can be combined to enhance the audience's sense of participation in the immersive experience space. For example, in the design of the digital exhibition hall, you can 3D holographic projection technology, interactive projection technology, etc. into it, for visitors to create a sense of being there [4]. Immersive display space through human-computer interaction, virtual reality and other technical means, the use of virtual reality immersion, interactivity, to bring new visual and auditory experience to the audience. It is through the display space design of vision, hearing, touch and other senses together to create a visual effect, so that the audience from multiple perspectives to understand the display space. Immersive display space has the following characteristics: a strong sense of experience, enabling the audience to be there; show better, can interact effectively with the audience; the scene is more realistic, can truly reflect the reality. The annual Lantern Festival in Macao utilizes the design of visual experience to enhance the sense of participation of the audience. For example, the light display activity in Rua de Cunha is a combination of interactive projection technology and architectural façade, where the viewers can understand the theme and emotion that the designers want to express through the projected images

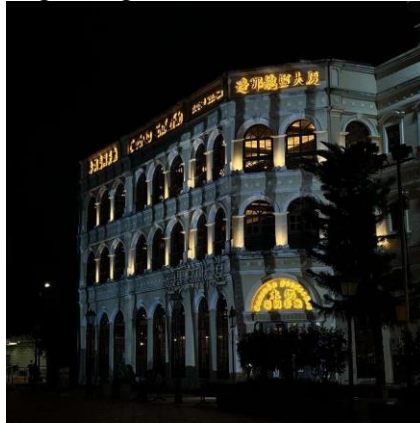on the façade of the featured buildings. (Figure 9)

Figure 9: Macau Lantern Festival

6. Exploring immersive exhibition spaces for multi-disciplinary integration

Immersive display space interaction design is a kind of user-centered design method, need to be explored through the wisdom and experience of the designer, need to be through the designer's understanding of the display space, analysis and research, will be the information and information conveyed to the user, the use of the user to participate in it and get a sense of satisfaction.

Immersive display space interaction design is a comprehensive design method, according to different types of display and display content and focus. From the user experience point of view, immersive display space interaction design includes interaction interface, interface elements, interaction process, users and the environment and other four aspects. Interaction interface refers to the interface between the user and the information [10]. Interface elements include text, image, color, shape, sound and other elements, the application of interface elements can be divided into direct application and indirect application of two kinds. The interaction process mainly consists of clicking, touching, sliding, dragging and other operation methods, and according to different operation methods to produce different interactive effects. There are two types of interaction between the user and the environment: physical interaction and virtual interaction.

6.1. Experience support for digital media technologies in the viewer experience

Digital media technology refers to the computer as the core, the use of multimedia, network communications and other technologies, sound, image, video and interactive information carriers for the integrated operation of the exhibition space for a series of technical means, so that the audience in the visit process to produce a rich experience. The application of digital media technology can not only improve the interactivity of the exhibition space, interesting, but also improve the experience of the audience. For example, in the exhibition area of "Digital Media Technology in the Information Society", visitors can feel the visual impact and auditory stimulation brought by "news" in the space through virtual reality equipment or augmented reality equipment, and the audience can experience more visual and auditory sensory stimulation. Visitors can experience more visual and auditory sensory stimulation. The exhibition area also allows visitors to experience the games and entertainment effects brought by virtual reality technology in a virtual environment. This digital gaming experience enables the audience to have a stronger feeling in multiple senses such as vision, hearing and touch. The addition of digital media technology, so that the exhibition space in the form of exhibition from the static into a dynamic, this form of change is inseparable from the support of technology. Digital media technology has brought diversified forms

of exhibition, VR technology, 3D holograms, interactive projection, etc., through the medium of the viewer into the virtual and real combination of the "world"[9]. Through the creation of spatial atmosphere or visual experience in the exhibition space, digital media technology enables the viewers to better receive the information conveyed by the exhibits, and drives the viewer's sense of experience, thus achieving the interactivity between the exhibits, the viewers, and the environment. Digital media technology is also a fusion of art and technology, utilizing expressions that the public can accept and understand to realize the creativity of art, which is also a means of integrating art into life. It is also a means of integrating art into life, so that the public can feel the sense of identity that art brings to life in the exhibition space.

6.2. Multi-sensory stimulation of participation

The experience of immersive exhibition space is realized through "perception-action-feedback". During the experience, the participant's sensory system, perception system, thinking system and motor system interact with each other and relate to other elements in the environment. In the exhibition space, participants need to actively explore and create new experiences through "sense-action-feedback".

In the immersive display space interaction design practice, the audience's perception and understanding of the experience is through the "sensory" and "action" levels to complete. Sensory level, including vision, hearing, touch, taste, etc., the user needs to experience the process through the visual, tactile and other ways to receive information; and in the action level, it is necessary for the user to think and make feedback through the movement, so that the information received into the content can be understood and remembered [11]. Immersive display space interaction design to be built on the sensory experience, which requires designers to user perception and behavior in-depth analysis, in order to establish the user's understanding of the content of the display space. In addition, also need to consider the interaction between people involved in display activities, realize the interaction between people, people and the environment. Immersive experience space is a multi-sensory stimulation of space type, the audience in multi-sensory participation, can experience a variety of different sensory stimulation. For example, in an immersive experience space, the audience can touch, shake, rotate and other actions and exhibits to produce interaction. Here, the audience can not only interact with the exhibits, but also through the interaction with the visitors to influence the behavior of the visitors. Through the exploration of multi-sensory stimulation of participation in the exhibition space, providing a new immersive experience for the audience, so that the audience get a more intense sensory experience.

7. Conclusions

Display space is an indispensable part of people's lives, and it is of great significance to people's lives and culture. With the development of the economy and the progress of the times, people on the display space requirements are getting higher and higher, pay more attention to the "immersive" experience. Immersive display space is a special way of interaction, not only can attract visitors to stop and watch, but also enable visitors to have the feeling of being there, it is easier to stimulate the interest of visitors to visit. Immersive display space interaction design is an emerging topic, based on the theory of interaction design combined with the characteristics of the display space and user behavioral psychology proposed immersive display space interaction design strategies and methods. Immersive display space interaction design as a new way of interaction, on the display space between people and information technology, people and communication has an important significance, but also for the future of the display space interaction design provides a new way of thinking. With the rapid development of digital technology, immersive experience space is more

and more popular, and its advantages have gradually emerged. Immersive experience space can make the audience better understand and remember the content of the display, and in the process of interaction with the exhibits to deepen the understanding of the content of the display. Immersive experience space in the design, you can integrate a variety of technologies, the use of a variety of new display techniques, new interactive methods, to enhance the sense of participation of the audience, improve the visiting experience. Future immersive experience space will be more diversified and intelligent, bringing the audience a more colorful experience.

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