

Research on the Application of Digital Design to Museum Design

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Abstract: The purpose of this study is to explore how digital design can revolutionize museum design concepts, display methods and visitor experiences, promote their modernization and enhance their educational functions. By analyzing the principles of digital technologies such as virtual reality (VR), augmented reality (AR) and interaction design and their specific applications in museums, combined with case studies, it is found that digital design significantly enhances the educational function and cultural value of museums, provides a more intuitive and in-depth interpretation of history and culture, and improves operational efficiency and audience satisfaction. The research conclusion shows that digital design is profoundly changing museums, which not only enriches the way of display, but also deepens the audience's participation and sense of experience, becoming an important trend in the future development of museums. However, how to balance the relationship between the traditional and the modern, the physical and the virtual, and how to deal with the challenges of continuous learning needs brought about by technological update, still need further research.

1. Introduction

With the prosperity of economy, people's demand for design not only stays in the functional satisfaction, but also begins to pay attention to the cultural connotation. As the carrier of spiritual civilization and material, museums play a role in the transmission of culture. However, in the process of transferring knowledge and culture, most museums in our country still adopt traditional and old-fashioned exhibition forms. The display techniques are old-fashioned, such as the display of objects in the history museum and the arrangement of screens in the digital museum. People have little understanding of their contents. At the same time, the lack of humanized, emotional and interactive design in the exhibition process makes people easy to feel boring.

In the process of the digital age, digital technology develops rapidly, especially in the context of interactive experience, the design concept and communication mode of museum display have

undergone fundamental changes, and the application of virtual reality technology, 3D technology, digital interactive technology and multimedia technology has become a new form of museum display design. This is a profound social change for the development of museums.

2. Overview of digital technology

2.1 Virtual Reality (VR)

Virtual reality (VR) is a cutting-edge technology that utilizes computer-generated environments to immerse users in human-constructed three-dimensional worlds. By wearing a VR headset or using other wearable devices, users can experience highly simulated visual, auditory and even tactile experiences as if they were in another reality. The key to this technology is its powerful graphics processing power and accurate motion tracking system, which together enable the response of the virtual environment to be synchronized with the user's actions in real time. In many fields such as games, education, psychotherapy and engineering design, VR is gradually showing its irreplaceable value. For example, in the game, the player can personally experience the perspective of the character, enjoy an unprecedented immersive experience; In the field of education, VR can simulate various complex scenes, such as the scene of historical events and the observation of biological structures, which greatly enriches the learning experience^[1].

Virtual reality (VR) technology is revolutionizing museum design by not only recreating historical scenes, but also allowing visitors to explore places that cannot be physically visited. With VR, museums can create a digital exhibition space that allows artwork, artifacts and even entire buildings to be recreated in 3D. Users wearing a VR headset can walk freely in the virtual environment, observe each exhibit up close, and even touch and interact. This immersive experience not only increases the fun and participation of the visit, but also solves the problems of physical museum space limitations and the protection of precious cultural relics. For example, for historic sites or damaged artworks, VR can restore their original appearance, so that historical stories are vividly reproduced, so that education and entertainment are perfectly combined.

2.2 Augmented Reality (AR)

Augmented reality (AR) is the superposition of virtual information on the field of view of the real world, this technology does not create a new environment like VR, but through mobile phone screens, smart glasses and other devices, the virtual elements into the user's current environment. Key technologies for AR include accurate location tracking and image recognition, which ensure that virtual information is accurately located and seamlessly integrated into the real world. The application scenarios of AR are very wide, from virtual fitting rooms and product previews in the commercial field, to interactive textbooks and virtual experiments in the educational field, to maintenance guidance, real-time navigation and other fields, AR can provide unique value to enhance user experience. For example, AR can provide consumers with a "try before you buy" shopping experience, or provide engineers with real-time guidance and assistance during complex mechanical repairs^[2].

Augmented reality (AR) is playing an innovative role in museum design, providing visitors with a richer and more personalized experience by overlaying virtual information on the real world. In museums, AR can be used to enhance the information display of the exhibits, and visitors can see the story behind the exhibits, the artist's creative process, or the historical background of the artifacts simply by using a smartphone or special AR glasses. In addition, AR can also be used to create interactive games that encourage visitors to actively participate and improve learning efficiency. For example, an exhibition about the age of dinosaurs can make static fossils "come

alive" through AR technology, showing the dynamic image of dinosaurs and the ecological environment, which greatly enhances the attraction and educational value of the exhibition.

2.3 Interaction design

Interaction design is the bridge between people and technology, focusing on designing the user interface of a product, system or service to ensure that users can interact with it easily and intuitively. It involves a deep understanding of users' needs, behaviors, and motivations, and creating interactive experiences that are both beautiful and functional through well-designed interfaces and operational processes. The core principles of interaction design include user-centered design, usability of the interface, timely feedback, and flexibility and control. The design process usually includes phases such as research and analysis, ideation and prototyping, testing and iteration to ensure that the final product can truly meet the needs of users and provide a smooth and efficient user experience. Whether it's a website, a mobile app, or a more complex system and service, interaction design is one of the key factors that determines its success. For example, when designing a mobile application, the interaction designer will consider how to optimize the user interface so that it is ergonomic and provides clear instructions to improve the user experience^[3].

Interaction design is crucial in museum design, and it focuses on how to enhance the overall experience of visitors through user-friendly interfaces and operational processes. In the museum's guided tour system, the role of interaction design is particularly obvious. Designers need to consider the needs of audiences of different ages and cultural backgrounds to ensure that the message is readable and easy to understand. Modern museums often use multimedia terminals, interactive booths or mobile applications as tour guides. Through interactive design, these tools can provide multilingual explanations, personalized route recommendations, in-depth interpretation of exhibits and other functions. For example, an interactive booth can allow users to select a guided tour of a specific topic, while providing a virtual tour service that automatically adjusts the presentation to the user's point of interest, making each visit a unique journey of discovery. Through these well-designed interactive elements, museums can not only better tell the story of their collections, but also stimulate visitors' curiosity and promote cultural inheritance and exchange.

Different types of museums have different types of interaction (Table 1).

Table 1. Interactive design of different types of museums

| Types of museums | Interactive mode | Interactive emphasis |
|------------------------|--|---|
| History | Historical reenactment and role play | An immersive historical experience |
| Arts | Creative interaction and art experience | Inspire artistic inspiration and imagination |
| Nature class | Popular science interaction and exploration learning | Enhance the interest of natural science knowledge |
| Science and technology | Interactive display and technology experience | Enhance the interest of natural science knowledge |

3. Overview of digital display design

3.1 Digital display design

Digital display design refers to the use of information technology auxiliary tools, such as computer technology, to digitize physical museum exhibits and combine them with display design

to achieve display purposes^[4]. With the application and promotion of digital information technology, traditional museum display methods are no longer accepted by the public, and people try to break the traditional display methods. Digital display experience design follows the trend of The Times and can meet the needs of the development of The Times. The amount of information conveyed by the existing digital information technology has far exceeded the traditional display, and it has features such as diversification, convenience, humanization and interactivity, which caters to the demands and characteristics of information intake in the digital age^[5].

3.2 Digital display design features

1. Show the humanization of the concept

Nowadays, most museums are faced with the problem of homogenization, a single way of exhibition, through the display of objects through the glass cabinet, through the introduction of objects through the panel, you can hardly distinguish between the content of the gap between museums, professional vocabulary, simple introduction, can not let us in-depth understanding of the connotation, in the face of a whole exhibition hall exhibits, It is easy for tourists to feel boring, and they cannot accept all the exhibition culture in a short time, and they only show for the sake of display, ignoring the visitors' visiting feelings. In order to arouse the enthusiasm and participation of users, the interactive experience design in the process of display has become particularly important.

The process of the digital age has promoted the development of emotion recognition system, which can constantly monitor the changes of users' emotions and provide designers with a large amount of data. In museum design, the changes of users' emotions are very important, and even the changes of users' emotions in the whole exhibition path need designers to think about. Through data feedback, design adjustments, etc. to achieve a better visiting experience, which also promotes personalized customized design.

2. Diversified display methods

The exhibition contents of the museum are all-inclusive, and the comprehensive knowledge of human history, food customs, and the natural world is accommodated, which makes the exhibition methods of the museum have diversified characteristics. It is the focus of modern museum design to mobilize users' participation, experience and interest through human sense vision, touch and smell.

(1) Emotional interactivity

Interaction, to some extent, can be called "interaction". The concept of interaction in museums includes the communication and interaction between people, space and exhibits, including human-computer interaction, the increasingly mature design of emotional interaction systems, the development of Internet technology, emotional computing, intelligent recognition technology, wireless network, micro sensors and physiological signal recording equipment, and the development of interactive systems. The gap between input and output of human-computer interaction is getting smaller and smaller^[6]. From a physiological point of view, the direct expression of human emotional experience is the sensory experience of objective things. Based on the five senses, the perception of things creates a rich emotional experience for the psychology. Interaction design aims to meet the emotional needs of users, which is crucial to the design of museums. And interactivity can enhance the audience's sense of experience, stimulate their desire to explore, meet their emotional needs, and more actively receive the information that the museum wants to display and convey.

(2) Virtual immersion

Based on the development of virtual reality technology, a virtual experience environment with "real" visual, auditory and tactile effects can be created, enabling viewers to "truly" place themselves in the artistic atmosphere created by designers for immersive interactive experience^[7].

The advancement of this technology can make the display content in the exhibition area more realistic and vivid expression, and can enhance the sensory experience of visitors to the exhibits. This static exhibition method, which breaks the traditional text display board and the explanation of the narrator in the exhibition area of the museum, makes the audience experience the feeling of being in the scene, and makes the originally boring and rigid museum come to life.

Through the design concept of combining virtuality and reality, the design of the museum can be more flexible, and the space expression can be more abundant and imaginative. At the same time, based on the innovation of technology, the emotional interaction system can provide statistical feedback on the data of users' preferences, which will enable personalized customization for visitors to enhance the sense of visiting experience.

(3) Game participation

Games have become an important part of our modern life. In an unfamiliar environment, games can enable us to quickly integrate into the environment, improve our social ability and enhance the interaction between people. Games can be said to be the most participatory activity, which infuses the information needed by museums into the process of games. It can enable people to accept and absorb more quickly, and at the same time, it also greatly increases people's sense of experience and enriches emotional changes^[8].

4. Application of digital display experience design in museum display

4.1 Scenario-based design

Scene design plays a core role in the museum's digital display experience. It enables the audience to feel the story and emotion behind the exhibits by constructing specific historical, cultural or artistic scenes, so as to obtain a deeper and richer visiting experience. The following are several application ways of scene design in digital display:

1. Interactive narrative scenes

Using multimedia technology and interactive installations, museums can create a series of interactive narrative scenes. For example, in an exhibition of ancient civilizations, visitors can talk to virtual characters through the touch screen to learn about the living customs, religious beliefs and social structures of the time. This interactive narrative not only provides rich historical information, but also stimulates the audience's curiosity and desire to explore.

2. Immersive virtual reality experience

Through virtual reality (VR) technology, museums can create immersive virtual reality experiences. Wearing a VR headset, visitors can enter a highly realistic virtual world, interact with exhibits, and even participate in historical events. For example, in an exhibition on war history, VR can allow viewers to experience the tension of the battlefield, deepening their understanding and empathy for historical events. The Panorama function of the Palace Museum in the wechat public account of the Palace Museum is a digital display of the Palace Museum through VR panorama technology, and visitors can visit the Palace Museum through their mobile phones (Figure 1).

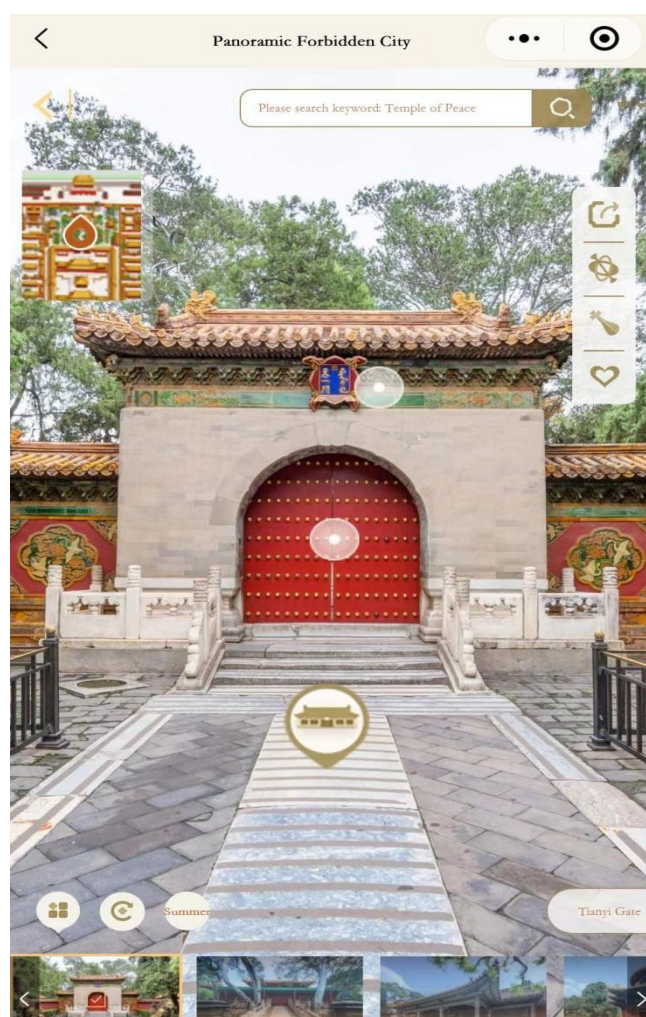


Figure 1. Panorama of the Palace Museum The Palace Museum

3. Augmented reality tour

Augmented reality (AR) technology has brought innovation to the museum's guided tour system. Using a smartphone or AR glasses, visitors can view detailed information about the exhibits, animated demonstrations of relevant historical events, and even videos of expert explanations in real time. This scenariographic design makes the visiting process more lively and interesting, and also provides a personalized learning experience^[9].

4.2 Multi-sensory experience

As an important place for cultural inheritance and education, museum exhibition design is gradually changing from traditional static display to immersive and interactive, aiming to deepen audience's emotional resonance and cognitive understanding by triggering multi-sensory experience. The core of this design concept is to comprehensively mobilize the audience's visual, auditory, olsmell, touch and taste systems to build a multi-dimensional perceptual environment, so as to achieve a richer and deeper cultural experience^[10]. Specifically, the process can be broken down into the following four main aspects:

1. Visual experience

Interactive experience design displayed by museums is first and foremost a visual art. Museums attach great importance to the pursuit of artistic effects of visual experience in interactive design, in

which the two visual elements of modeling and color are the focus of designers^[11]. As the first observation factor when people enter the space, vision is very important to get the feeling and experience. Through carefully arranged visual elements such as lighting, color, shape and moving images, designers are able to create vivid and layered visual landscapes that guide the viewer's eye and stimulate their interest and curiosity in the exhibits. The design of visual experience should take into account the line of sight of the audience, ensure the effective transmission of information, and create an atmosphere that fits with the theme to enhance the artistry and appeal of the exhibition.

2. Auditory experience

In the interactive exhibition design of the museum, sound, music, interpretation and other means add depth to the visual information to help the audience better understand and feel the exhibition content. High-quality audio equipment and precise sound field layout are key to achieving a good listening experience. The selection of background music, the simulation of environmental sound effects, and the recording of professional explanations should all be closely related to the theme of the exhibition, aiming to create an immersive feeling and strengthen the emotional investment of the audience.

3. Olfactory experience

Smell is an emerging way of sensory interaction in museum design. Some exhibits themselves contain flavor, but in today's exhibition hall, exhibits are stored in a closed space, making it impossible for people to personally experience their connotation. Smell is very special for the existence of emotional memory, such as ancient spices, natural flowers and plants, and the smell of soot in the industrial era. It can activate the audience's memory and association, so that they have a more intuitive feeling of a specific historical period or geographical area. The olfactory experience needs to be carefully designed to avoid overly strong or incongruous odors that interfere with the overall experience.

4. Tactile experience

Tactile experience refers to the way in which the body skin receives external stimuli such as vibration, squeeze, temperature, humidity and so on to obtain corresponding emotional changes, which can directly affect people's psychological activities and behaviors. Nowadays, most museums will post "Do not touch" next to exhibits, and the appeal of tactile experience will completely break the display form of museums in the past. The audience can enjoy the exhibits in an all-round way through the combination of touch screen and three-dimensional modeling, considering that the most objective touch is the feeling of materials, and based on the concept of protecting cultural relics, The materials used in the exhibition can be created by modern techniques, providing visitors with a way to understand the materials.

5. Conclusion

Research on the application of digital design to museum design reveals how technological advances have profoundly changed the way museums display, their educational functions, and the audience experience. The introduction of virtual reality (VR), augmented reality (AR) and interaction design has created unprecedented opportunities for museums. VR technology provides an immersive experience by recreating historical scenes and works of art, allowing the viewer to feel as if traveling through time and have a direct dialogue with the exhibits. By superimposing virtual information on the real exhibits, AR technology enriches the visitors' access to knowledge, while enhancing the interactivity and interest, making the learning process more vivid and interesting. Interaction design focuses on optimizing the tour system, ensuring legibility and personalization of information, and providing a customized visit experience through multimedia terminals and mobile applications to meet the needs of different audiences.

To sum up, digital design not only breaks through the physical limitations of traditional museums, but also greatly broadens the boundaries of cultural education. It promotes the participation of the audience, enhances the educational efficiency of the museum, and realizes the digital sharing of cultural resources. However, with the rapid development of technology, museums are also faced with the challenge of continuously updating technical facilities, protecting the privacy of visitors, and balancing online and offline experiences. In the future, museums should actively explore new applications of digital design, pay attention to humanistic care and technical ethics, and use the power of science and technology to revitalize cultural heritage, connect the past and the future, and stimulate the cultural confidence and creativity of society.

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