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Innovative Research on the Design of Exhibition Space Empowered by Digital Media Technology

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Abstract: ***This paper aims to deeply analyze how digital technology can bring innovative changes to exhibition design and its key role in cultural communication. Through literature review, case analysis and field research, this paper analyzes the current application status of digital technology in exhibition design, proposes strategies for digital technology to empower exhibition design from the perspectives of technology integration, user experience optimization, and display form, and looks forward to future development trends.***

Keywords: Digital Technology; Exhibition Design; Cultural Communication.

1. INTRODUCTION

With the rapid development of digital technology, the field of exhibition design is ushering in an unprecedented change. Virtual reality (VR) allows the audience to be completely immersed in it, augmented reality (AR) combines virtuality with reality, artificial intelligence accurately understands the audience's preferences, and big data provides a solid backing for exhibition planning. These technologies have not only completely subverted the static mode of traditional exhibitions, but also opened a new era of dynamic interaction and opened up a new world for cultural communication. However, current research is far from enough. Most of the existing literature only lists the application cases of digital technology in exhibitions, but rarely explores in depth how these technologies can systematically empower exhibition design. It is based on these shortcomings that this article will systematically analyze the innovative application of digital technology in exhibition design. Closely combining theory with practice, exploring new ideas for exhibition design, and providing reference and inspiration for future related research.

2. APPLICATION OF DIGITAL MEDIA TECHNOLOGY IN EXHIBITION SPACE DESIGN

Digital technology refers to a technical system that uses certain equipment to calculate, process, store, transmit, disseminate, and restore various information such as images, text, sound, and images [1]. In the field of exhibition design, the digital technologies used mainly include virtual reality (VR), augmented reality (AR), multimedia interactive devices, and big data analysis. These technologies have brought unprecedented innovation space to exhibition design by simulating real scenes, enhancing reality experience, providing interactive functions, and optimizing exhibition content.

2.1 Virtual Reality (VR) and Augmented Reality (AR) Technology

Introducing virtual reality (VR) and augmented reality (AR) technology into exhibition design can effectively enhance visitors' experience and sense of interaction. VR technology can create a virtual environment for visitors, allowing them to experience the exhibition content in an immersive way. The 2024 Beijing Grand Canal Museum's "Adventures in Sanxingdui" VR immersive exploration exhibition uses the most cutting-edge VR technology. Visitors can go boating in the virtual world, follow the flying of the divine bird, and observe the details of Sanxingdui cultural relics up close, allowing them to experience the magnificence and exquisiteness of Sanxingdui cultural relics and ancient Shu civilization up close. In the context of the information age, diversified communication methods and constantly innovative technological environments have greatly promoted the creativity and vitality of museum cultural communication, making the pace of museum digitalization present a huge breakthrough. Applying AI+AR technology to museum exhibits can expand the display content, enable visitors to interact with exhibits, provide visitors with a new interactive experience, effectively enhance the user

experience, enable visitors to understand the exhibits more immersively and deeply, and improve the efficiency of users in obtaining information, so as to give full play to the museum's cultural heritage, education of the public and other functions.

Figure 1: "Adventures in Sanxingdui" VR Immersive Exploration Exhibition - Scene 4 "Searching for Hometown" (Pictures from the Internet)

2.2 Multimedia Interactive Device

Multimedia interactive installations can enable visitors to interact with exhibition content in real time through touch screens, sensors, voice recognition and other devices, increasing interactivity and visitors' sense of participation [2]. For example, Fragments is an interactive art installation by Random International. The installation consists of nearly two hundred identical small mirrors arranged in a grid to form a flat, homogeneous surface. As visitors slowly approach the artwork, the orderly array of small mirrors will track the audience's face and turn around, moving with the visitor's movement. The surface of the mirror will form different three-dimensional forms, perhaps waves, curves, or circles. The reflection of the mirror will become fragmented with movement, making the originally static object seem to have life and show an organic dynamic. This interaction creates a physically interconnected dialogue between humans and non-living things.

Figure 2: Fragments interactive installation (Pictures from the Internet)

2.3 Digital Display Space

Digital exhibition space is an important innovative direction for digital technology to empower exhibition design. The key to digital exhibition space is to embed digital media technology into physical space and make it present a flexible and changeable exhibition environment according to different needs. The exhibition with the theme of "Future City" in Shenzhen Contemporary Art and Urban Planning Exhibition Hall uses projection mapping technology to transform the exhibition hall into an immersive digital space, where visitors can see the scene of the future city and related life forms. This is a design that breaks through the concept of traditional exhibition space, aiming to immerse visitors in the exhibition in a virtual space and achieve a deeper interactive effect. The innovation of digital exhibition space brings more possibilities to exhibition design and provides a new carrier for cultural communication.

Figure 3: Shenzhen Contemporary Art and Urban Planning Exhibition Hall - Imagine the Future Space (Pictures from the Internet)

3. FUTURE DEVELOPMENT TREND OF DIGITAL TECHNOLOGY EMPOWERING EXHIBITION SPACE DESIGN

Under the influence of digital media, exhibition space design has abandoned the rigid design model and started to develop in the direction of intelligence and personalization, cross-domain integration, combination of globalization and localization, and sustainable development [3].

3.1 Intelligence and Personalization: In-depth Insight into Audience Needs

The rapid development of artificial intelligence is pushing exhibition design into a more intelligent and personalized world. Facial recognition technology can identify visitors' information and call up their historical visit data; emotion recognition technology can analyze visitors' facial expressions and body language, accurately understand their current emotional state and explore their interests and preferences. For example, in the intelligent guide system, deep learning algorithms can be used to match visitors' behavioral characteristics and historical records with the huge exhibition library data, thereby achieving one-to-one personalized recommendations [4]. This precise customization greatly improves the visitor's visiting experience and achieves a deep fit between the exhibition and the audience's needs.

3.2 Cross-domain Integration: Expanding the Diverse Boundaries of Exhibitions

In the future, exhibition design will be deeply integrated with multiple fields, opening a new chapter of interdisciplinary innovative cooperation. Relying on cutting-edge technologies such as virtual reality (VR), augmented reality (AR) and holographic projection, a venue for cultural experience is constructed, allowing people to be immersed in an immersive environment that blends the virtual and the real without being limited to a single sensory stimulation. This method dilutes the boundary between learning and traveling, and stimulates the unlimited potential of innovative technology in cultural presentation [5]; AR technology adds knowledge pop-ups to exhibits, promotes popular science education, and combines with tourism to develop special cultural tourism routes to attract tourists to experience the site and guide visitors to visit the site. For example, the "Digital Forbidden City" project jointly launched by the Palace Museum and Tencent integrates multiple fields. The online and offline cultural influence of the Forbidden City has reached hundreds of millions of people around the world, expanding the breadth and depth of exhibition content and opening up new paths for cultural communication.

3.3 Combining Globalization and Localization: Promoting Cultural Coexistence and Prosperity

In the context of globalization, exhibition design is committed to the organic integration of global vision and local culture. On the one hand, based on digital information, cultural treasures from all over the world are introduced to the local area through online exhibitions, virtual exhibitions and other forms to promote cultural exchanges. For example, the online platform displays the collections of the Louvre, allowing local audiences to appreciate the charm of world art without leaving home. On the other hand, digital means are used to activate and display local cultural heritage through 3D modeling, animation restoration, etc. For example, the Dunhuang Research Institute uses digital technology to dynamically present the Mogao Grottoes murals to the audience. In addition to strengthening cultural identity, it has broadened the channels for the protection and inheritance of local cultural heritage and promoted the prosperity of global cultural diversity.

3.4 Sustainable Development: Practicing the Concept of Green Exhibition

Embed green and sustainable concepts in the design of exhibitions. When building exhibition spaces, digital technology can be used to pre-plan the space application of the exhibition through digital virtual technology before layout, and then the space planning inside the exhibition hall can be carried out according to the pre-arranged arrangements [6]. In terms of material selection, green ecological materials should be selected to ensure that the materials are renewable and easy to decompose. During the use stage of the exhibition, the big data application model is used to control the layout of the exhibition space inside the exhibition, further reducing the energy consumption of the air conditioning system and lighting system in the exhibition hall. This low-carbon green model not only meets the requirements of environmental protection concepts, but also is the fundamental guarantee for the development of the exhibition industry.

4. DIGITAL TECHNOLOGY EMPOWERS EXHIBITION SPACE DESIGN STRATEGIES

While digital technology empowers exhibition space design and enhances the vitality of space, it also presents problems such as formalization, entertainment, and universalization. Therefore, corresponding effective measures are proposed to address the above problems.

4.1 Focus on User Experience and Create a Personalized Immersive Journey

The principle of people-oriented is the core starting point for promoting the development of digital technology in the field of exhibition design. In the entire process of exhibition design, how to provide the audience with a better and more intimate experience is always a crucial consideration [7]. Through intelligent information capture methods, the audience's movement data in the exhibition hall is captured, and the audience browsing data on the website is combined to establish a data file of the audience's interest level. In this way, the "big data" intelligent guide can provide each audience with a reasonable and targeted tour route planning. That is, art lovers are given more guidance on the tour of art exhibits such as calligraphy, painting, and sculpture, and some introductions to art appreciation are made accordingly; technology lovers choose some tour routes related to technological development, the latest inventions, and science and technology. The adaptability design of different devices uses a responsive layout mode, so that different devices such as mobile phones, tablets, and computers can have a good browsing experience and tactile design, bringing a more satisfactory experience [8].

4.2 Deeply Integrate Culture and Technology and Innovate Cultural Communication Paths

The core of the exhibition lies in culture, which can be achieved by closely integrating with digital technology to innovate exhibition design, which has become the key path to improve the exhibition effect. Digital technology has revolutionized the way of cultural dissemination, allowing cultural content to be displayed and widely disseminated in a variety of forms. With the help of virtual reality (VR) technology, combined with meticulous model construction and realistic scene reproduction, it can make the experiencer feel as if they are experiencing it in person and immerse themselves in specific situations of history and culture, such as experiencing the trade activities of the ancient Silk Road. Using augmented reality (AR) technology, visitors can instantly unlock the rich historical context and stories behind the exhibits by simply scanning the exhibits with their mobile devices, making the static exhibits present dynamic vitality. Holographic projection technology combines virtual images with physical exhibits to produce a novel visual experience, effectively enhancing the depth and speed of cultural dissemination.

The “Night Tour of the Imperial Cats in the Forbidden City” exhibition at the Palace Museum is an outstanding case in the industry. Through the AR technology of mobile terminals, with the physical buildings of the Forbidden City as the background, a virtual imperial cat character was constructed, which moved freely in the scene, triggered historical stories, provided audio explanations and picture information, and spread historical and cultural knowledge in this way. Since the launch of this exhibition project, it has attracted more than one million visitors, and the number of views of related social media topics has reached an astonishing 500 million times, successfully realizing the digital reuse of cultural heritage and greatly promoting the popularization and inheritance of traditional culture.

4.3 Innovate Display Forms and Expand Unlimited Possibilities of Exhibitions

Exploring new display forms and technological applications has become a core element in promoting innovation in exhibition design. Digital technology has broken through the shackles of traditional exhibitions in terms of space and expression. For example, the 360-degree immersive surround screen system creates an immersive visual space through panoramic projection. Whether it is the vast universe or the ancient forest scene, it can bring the audience closer in a realistic way; the ground screen interactive system relies on infrared sensing technology, so that every step the audience takes triggers changes in the picture, adding a lot of fun; in the interactive experience, the application of touch screens, somatosensory devices and voice recognition technology is becoming more and more in-depth, allowing people to have richer and more diverse interactive modes to operate the exhibits. This trend of diversified participation is constantly reshaping the audience’s on-site perception.

The Shenzhen Contemporary Art and Urban Planning Exhibition Hall uses holographic projection and VR technology to create a future city experience area. Visitors can wear VR equipment to enter the virtual block and walk around. Three-dimensional landscape images including smart transportation and ecological buildings unfold in front of them. At the same time, they can feel the dynamic evolution of the planning blueprint through holographic projection. This ingenious method has attracted many visitors, and the number of spontaneous shares on social media has reached more than 5,000 times per month. This achievement shows the extraordinary creative nature of new technologies in giving the public cultural cognitive experience.

5. CONCLUSION

Digital technology has brought profound changes to exhibition design. This article discusses the three aspects of technology application, empowerment strategy and future trends, revealing its innovative value and potential. At the application level, the introduction of VR, AR technology, multimedia interactive devices and digital display space has enriched the form and content of exhibitions, brought immersive and interactive experience to the audience, and broken through the limitations of traditional exhibitions. From the perspective of empowerment strategy, focusing on user experience, integrating culture and technology, and innovating display forms have improved audience participation and satisfaction, and helped cultural communication. In the future, intelligence and personalization, cross-domain integration, globalization and localization, and sustainable development will become important trends, expanding the boundaries and value of exhibitions. The exhibition design innovation enabled by digital technology provides strong support for audiences and cultural heritage. In the future, we need to continue to explore the integration of technology and design, promote exhibition design to a higher level, and make greater contributions to cultural development.

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