Discussion on the Application of Virtual Technology in Museum Display Design

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Abstract. In recent years, more and more technologies have been introduced into museums, bringing new opportunities and challenges to museums' study and research. In the context of the digital age, the use of virtual reality and other emerging technologies to innovate the exhibition design of the museum can bring a new visual experience and exhibition experience to the audience. This paper focuses on combing the literature on the application of virtual technology in museum display design at home and abroad, and analyzes the research results of the application of virtual technology in the field of museums and the effects and achievements of the application of virtual technology in museum display design, to provide a reference for researchers in the field of museum display design.

Keywords: Virtual technology · museum · display design · user experience

1 Introduction

The rapid development of science and technology provides more possibilities for the carrier of information dissemination. Under this background, the value of virtual technology is becoming more and more prominent. Traditional museums have been unable to meet the experience needs of modern users, more and more museums bid farewell to the traditional model, using 3D, VR, and other new technologies, and museums are gradually digitized. From the point of view of users' experience, the museum's visual display design based on virtual technology presents the display information to people in a multi-sensory, multi-level, and three-dimensional way, which makes users seem to be in the virtual museum scene. Feel the immersive mood (Shi Xiaodong 2014) [1]. At present, virtual technology has become an important means for the public to recognize and learn about cultural heritage. For example, the Louvre Virtual Museum, the British Virtual Museum, and the Imperial Palace Museum have all adopted virtual technology to provide visitors with a full range of visiting experiences. Loved by the public. Therefore, how to spread museum culture through new technology has become one of the key research directions. The focus of this paper is to sort out the current literature on the use of virtual technology in museum display design at home and abroad and to show the effects and achievements of the current application of virtual technology in museum display design.

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2 Related Research

2.1 The Development of Museum Exhibition Design

From the Middle Ages to the European Renaissance to the early days of modern museums, collection and preservation have always been the first function of museums. During this period, there is no outline on display in the museum, but there are some activities close to display-such as taking the collection off the storage shelf for observation, appreciation, and research. This kind of activity has no display plan and no clear utilitarian purpose, so there is no way to produce the concepts of "display" and "display design". Until the 18th century, the occurrence of the bourgeois revolution in Europe prompted temples and court collections to gradually open to the public (Bi Wendi 2011). As mankind enters the 21st century, the development of museums will also experience the transformation from exhibit display to audience understanding and appreciation of exhibits, from "do not touch" to "welcome to participate". Based on simple display space, people point out that the significance of modern museums is no longer limited to collection, museums are not only treasures but also places for historical and cultural presentation, social exchanges, and learning. Therefore, to better and more convenient for the public to accept the content of the display, the way of the display will also develop from oneness to diversification. At this time, the rapid development of science and technology, the continuous emergence of a variety of high and new technologies, and the increasing cultural demand, also provide a huge development space for the display design of modern museums and provide strong technical support for the diversity of museum display designs.

2.2 Virtual Reality Technology

Virtual reality (VR) technology originated in the United States in the 1980s, which was put forward by Jaron Lanier Ranil. Virtual reality technology is an important direction of simulation technology, which is the collection of simulation technology and computer graphics, man-machine interface technology, multimedia technology, sensor technology, network technology, and so on. American scientists Burdea G. And Philippe Coiffet put forward a "triangle of virtual reality technology" in the article "Virtual Reality Systems and Applications" published at the World Electronics Annual meeting in 1993, which concisely expressed the three most prominent features of virtual reality: interactivity, immersion and imagination, that is, the "3i" characteristic of virtual reality, which is a highly comprehensive and interdisciplinary field of science and technology (Zou Xiangjun, Sun Jian, He Hanwu,2004) [2]. Virtual reality technology mainly includes simulated environment, perception, natural skills, sensing equipment, and so on. The simulation environment is a real-time dynamic three-dimensional realistic image generated by a computer. Perception means that the ideal VR should have the perception that all people have. In addition to the visual perception generated by computer graphics technology, there are also hearing, touch, force, movement, and other perceptions, and even smell and taste, also known as multi-perception. Natural skills refer to the rotation of the head, eyes, gestures, or other human actions. The computer processes the data adapted to the participant's actions, responds to the user's input in real-time, and feeds back to the user's facial features respectively. In recent years, virtual reality technology

Table 1. Development schedule of AR

Time	The inventor	Technology
1968	IvanSutherland	The Sword of Damocles
1992	T.P.C audell and D.W.M izell	The concept of Augmented Reality was first proposed.
1997	RonaldAzuma	A widely accepted definition of augmented reality is proposed for the first time.
1999	Koichi kato	Develop the first AR open source framework - ARToolKit.
2000	Lumus	Geometric waveguide.
2005	TapaniLevola	Diffracted light guide technology.
2012	Google	Launched Google Glass, the first AR glasses
2017	Apple inc.	Launched AR development platform ARKit.
2019	Microsoft corp.	Announced HoloLens 2, the next generation of its augmented reality device.

has been applied to many fields, such as education, medicine, architecture, military, and so on.

2.3 Augmented Reality Technology

Augmented reality (AR) is a new technology developed based on virtual reality. Augmented reality technology is based on computer display and interaction, network tracking and positioning, and other technologies, the virtual information formed by the computer is superimposed on the real scene to supplement the real world so that people in vision, hearing, touch, and other aspects to enhance the experience of the real world (Wang Cunyou, Cheng Tong 2016) [3]. Augmented reality has three characteristics, namely, the combination of virtual reality, real-time interaction, and three-dimensional registration (Jiang Zhongwang 2012) [4]. Augmented reality has three ways of presentation and display, which can be divided into head-mounted (head-attached), handheld and spatial display according to the distance from the eye. Augmented reality has a wide range of applications (Table 1). For example, augmented reality can present holograms, virtual experiments, and virtual environments for students in the field of education; in tourism, augmented reality can help tourists to visit scenic spots by themselves, explaining the general situation of scenic spots, development history, cultural landscape and other contents for tourists in the form of virtual images. Augmented reality shows a good application prospect in industrial, medical, military, municipal, television, games, exhibitions, and other fields (Table 2).

2.4 Augmented Reality Technology

VR is different from AR in appearance. VR needs to be covered like a helmet so that people have a sense of immersion. There are rubber or sponge products in full contact

Table 2. Development schedule of VR

Time	The inventor	Technology
1957	Morton Heilig	Immersive experience machine: Sensorama.
1960	Morton Heilig	The first head-mounted virtual reality display.
1961	American Flying Brother company	Motion tracking technology patent.
1963	Hugo RN Snack	Teleyeglasses
1965	Ivan Sutherland	Ultimate display: Swordof DamocIes 1.
1985	NASA	VIVID VR program.
1987	Jaron Lanier, the father of virtual reality	Virtual reality headset
1998	SONY corp.	Personal head-mounted display.
2012	SONY corp.	An MHz-t1 3D head-mounted display

with the face to make the face fit closely with the equipment to prevent light leakage. The eye lens is usually a circular convex lens. AR is relatively portable, which brings the user into the preset virtual space and realizes the visual image stimulation through the virtual space experience, to achieve the purpose of the application of three-dimensional imaging technology. AR devices are usually presented in the form of glasses. For example, in Google glass, the eye lens is usually a square prism. After the user wears AR glasses, the image is projected on the prism through the miniature projector in the lens frame, and then reflected close to the human eye through the prism. Through the prism, the human eye can see the display superimposed on the real scene.

On the other hand, AR and VR have different visual effects. AR users are in the real world, and the observed content is superimposed on the real world, which makes the image information transition from two-dimensional spatial structure to three-dimensional spatial structure, to form a perfect image processing system and enable users to achieve the best image perception experience. VR virtual reality scene is interactive rather than one-way, and the visual effect is 3D, but it is not the same concept as 3D movies. When users perceive the stimulation of the virtual world, including touch, taste, smell, motion, etc., the immersion of VR will produce thinking resonance, cause psychological immersion, and feel like entering the real world.

3 A Summary of the Application of Virtual Technology in Museum Visual Display Design

The earliest research on the display of virtual technology in museums comes from cultural units, university research institutes, and art institutions in Europe and the United States, and other countries. In 2009, Exploring the relationship between presence and enjoyment in a virtual museum (exploring the Virtual Museum: presence and enjoyment) by Stella Sylaioua, Katerina Mania, Athanasius Karoulisa, and Martin Martin White introduced

a feasibility study. The purpose is to explore the relationship between the “sense of presence”, enjoyment, and real museum visits experienced by participants in virtual museum exhibitions (Stella Sylaioua, Katerina Maniab, Athanasis Karoulisa 2010) [5]. Also published in 2009 were Sylaiou Styliani, Liarokapis Fotis, Kotsakis Kostas, Virtual museums, a survey, and some issues for consideration by Patrias Petros (Virtual Museum: a Survey and questions to think about). This paper mainly investigates the field of virtual museums (virtual reality technology, augmented reality technology, web 3D technology). While exploring various existing virtual museums, this paper discusses the new and old display methods of VR and the advantages and limitations of development tools [6]. In 2010, Beyond virtual museums: Experiencing immersive virtual reality in real museums, written by Marcelo Marcello Carrozzino and Massimo Massimo Bergamasco, was published. The author makes an in-depth investigation of VR technology and its application in the cultural environment, summarizes the current situation of museum VR and the possibility of the next future, lists the main problems that prevent the real popularization of VR technology, and summarizes some suggestions on how to use virtual reality for cultural purposes more widely and effectively.

Domestically, in 2007, Xian Feng, a teacher at Tsinghua University, put forward in his article “Virtual Museum”: “Virtual Museum, also known as Digital Museum, reproduces the functions of traditional physical museums on the Internet through digital technology, modern communications, and network technology. And in the technology and implementation means to greatly expand the traditional museum exhibition, demonstration, archiving, management, and other functions [7]. “ The “Digital Collection of National Science and Technology Program Technology Compendium” defines a virtual museum as: “to digitize all kinds of objects, specimens, documents, and other collection materials." digitized and stored with high-resolution scanning, digital shooting, virtual production of three-dimensional models and other technologies, and through the network to fully present the display, collection, education, and research functions that physical museums should have. " In 2015, Yang Xin, Liu Shuhan, and Zhang Tianmeng proposed that augmented reality technology should be applied to museum exhibitions to enable cold exhibits to be displayed freshly, enhance "interaction" and "participation", and play a role in teaching and entertaining. For the first time, it gives a brief overview of augmented reality technology and museum education, focusing on the relationship between them. Finally, it is considered that the application of augmented reality technology to museum exhibitions not only increases the interest and entertainment of the exhibition, but also effectively disseminates information and knowledge [8]. In 2017, Lu Ping, Yang Pengfei, and Li Xu discussed the interactive design of the immersive virtual museum because of the characteristics of virtual reality technology in "interaction Design of Virtual Museum based on VR Technology". At the same time, it is pointed out that diverse interaction design will be the development direction of the immersive virtual museum in the future, and play a vital role in the promotion of virtual museums [9]. Qi Yanan’s “Analysis of the Application of VR Interactive Technology in Museum” pointed out that the application of VR and other new media technology in museum display design can make social development more Internet and intelligent, and the individual needs of cognition can be more highlighted [10]. In Bai Liqun’s “Countermeasures for the C”onstruction of large and medium-sized Museums based on VR and AR Technology--

also on the practice of museums in Guangxi Zhuang Autonomous Region", it is pointed out that VR and AR technology play an important role in the exhibition of museums and the research and development of cultural and creative products, effectively combining the educational function of museums with leisure and entertainment. Improve visitors' perception of historical knowledge in the process of interaction between virtual and real environments [11]. Li Tingting and Wang Xianghai's "Research on the Interactive Application of Museum Exhibition based on AR-VR Hybrid Technology" (2017) analyzes the key technologies involved in the mixing of augmented reality and virtual reality and puts forward a method of developing a museum interactive display system based on AR-VR. The experimental results show that compared with the traditional interactive technology, the combination of virtual reality technology and augmented reality technology can make the visualization effect more realistic, arouse the enthusiasm of visitors and dynamically display exhibit information in the process of the visit. Inspire visitors to observe and think, so that visitors in the exchange of interaction deepen memory, to achieve a deeper interactive experience [12]. Zhang Qing, "the Interactive expression and language Transformation of China Museum using Virtual Reality Technology in the Exhibition-- taking the development and application of VR shadow game" Tianji Horse Racing "as an example" (2020) points out that the traditional art under the influence of VR has become a dynamic process of perception, communication, creation and learning in the virtual world of human-computer interaction or human-machine-human interaction. In this sense, virtual reality opens a new mechanism for the link and function between art and tradition, art and reality, and opens up an imaginative experiment of cultural and artistic interaction in the display of Chinese cultural relics [13].

4 Conclusions

Through the discussion and analysis of the above research results, we find that virtual technology is more humanized in museum exhibition design, and can deeply meet the individual needs of different people. The information of culture itself is static and intuitive, and the content of its virtual technology interpretation is dynamic, diversified, and interactive. The application of virtual technology can make the excellent Chinese traditional culture and art form regain its former glory, and even exude greater artistic charm. In the context of today's epidemic, the combination of virtual technology and museum culture brings us more possibilities. It should be noted that due to the limitation of time and space, this study can only select representative papers from the level of journals and the number of citations for review and analysis, and the coverage and comprehensiveness of the analysis need to be further improved.

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