Application of Virtual Reality Technology in Public Art Design

Kaichen Zhang

{zhkc888666@163.com}

School of Design, Xianyang Normal University, Xianyang, Shaanxi, China

Abstract: Modern exhibition art is gradually developing corresponding public art with the progress of the times. Nowadays, people's pursuit of contact with information is constantly improving. In the modern era of advanced information technology, public art is gradually changing the traditional habit of artistic expression with its unique charm and competitive advantage. This article takes the application of virtual reality technology in public art as the research goal, integrates virtual reality technology into public art, and studies the form and function of its expression. Through the sorting out of modern public art expression and its current situation, it is proposed to combine virtual reality technology with public art, change the expression of public art with the latest plans and technology, and explore new ways of public art innovation. This article studies the virtual reality technology and public art in detail, and specifically understands what virtual reality technology is and combines it with public art. Public art Public art has an unusual significance in the city's street landscape. It plays a vital role in the artistic atmosphere and atmosphere rendering of a city. It not only allows visitors to the city to experience the atmosphere of the city, but also Played a special role in undertaking culture. Experimental analysis and research show that the market scale of the delicate reality derived from the development trend of virtual reality and the type of service structure analyzed in this article broke through the tens of billions mark in 2018, and the future market scale is still Continuous growth. Among them, the types of services are divided into 7 parts. Among them, the service packaging part accounts for the largest market share, which accounts for 28.9% of the total market service share.

Keywords: Virtual Reality, Public Art, Scene Realization, Design Display

1. Introduction

With the progress of human society, people are applying more and more mature science and technology to their lives and work, and this includes the technology of virtual reality, which uses corresponding technology to construct a mini-reality multi-dimensional space. Its purpose is to study how to maximize the realistic experience of users in the virtual world.

Many scholars have conducted research on how to apply virtual reality technology

ICSETPSD 2023, November 17-18, Coimbatore, India

DOI 10.4108/eai.17-11-2023.2342804

to public art and achieved good results. For example, Zhang Pei once proposed to study the application value of virtual reality technology in public art, and first briefly describe virtual reality technology. It also analyzes the necessity of virtual reality technology for public art design, and discusses the innovative application of virtual reality technology for public art design display. In practical applications, virtual reality technology can provide artists with a more free and convenient creative space, and bring a new visual experience and interactive experience to the public [1]. Zhang Shengnan proposed that the change in technology and design is an important manifestation of this change. New multimedia interactive installations are being used more and more in the creation of public art, and landscape design based on computer technology is slowly coming onto the stage. Through the various characteristics of multimedia technology, science and technology are better used in landscape design, continuously improving the interactive experience between people and design, and enhancing the fun and artistry of design. It also integrates high-tech landscape design solutions. Will become the mainstream of landscape design in the future [2]. Virtual reality will become an indispensable part of people in the future.

This article lays the foundation for the research of combining virtual reality technology with public art. Constraints on space, time, angle, etc., comprehensively and in-depth thinking about the key issues in the development of public art, detailed classification and summary of the art creation process, methods and traditional art projection technology, and proposed virtualization recommendations. The importance, role and methods of augmented reality technology in public art design define the principles of application of new technologies in public art, and review new technical solutions in all aspects of public art, broadening the way of thinking in public art[3] .

2. Virtual Reality Technology and Public Art

2.1 Virtual Reality Technology

Virtual reality technology is also called VR (Virtual Reality) technology. Virtual's explanation is illusory. "Reality" The explanation is realistic and practical. In short, combining means virtual reality. Generally speaking, virtual reality refers to a high-performance computer that acts on users through visual, auditory, tactile and other information dissemination methods to make them physically present. An interactive information simulation technology to improve the environment. The reality that the human body feels is actually formed by the transmission of various sensory stimuli from the human body to the brain through nerves, and its essence is the reality formed in the mind through external stimuli from the human body. Images can be virtual. When the five senses provided to the user are real, and any interactions created by the user are real-time and natural, the user cannot distinguish between virtual and reality. It was first proposed by Lanier in the 1980s. In short, virtual reality technology is based on a virtual environment created by a variety of testing equipment and computers, allowing participants to create aesthetic interest and artistic sense of computer through human-computer interaction. Realize the maximum efficiency of information transmission [4].

2.2 Features of Virtual Reality

(1) The reality of virtual reality technology

Virtual reality technology is a multi-dimensional virtual space composed of computers based on various human sensory and psychological characteristics. It has true representation. Virtual reality space is a simulation of actual space, and users can experience the most realistic sensory experience.

(2) Virtual reality technology interactivity

The interactivity in virtual reality is different from traditional multimedia technology. Since the invention of computers, traditional human-computer interaction is mainly one-dimensional and two-dimensional keyboard and mouse interaction, while virtual reality technology emphasizes the natural communication between people. Through natural methods, users use special hardware in virtual reality technology. Devices (such as data gloves, power feedback devices, etc.) realize the virtual world interaction, thereby generating the same perception, in the real space, as a real user, do not know the existence of the computer [5].

The interactivity of virtual reality technology has the following characteristics:

1) Human participation and feedback in the virtual environment,

The real-time feedback provided by people is one of the important factors in the virtual reality system, and it is the direction and premise of all Suni reality progress. It is precisely because of human participation and feedback that the real-time interaction of the virtual environment will produce various requirements and changes.

2) Real-time human-computer interaction

Real-time performance means that virtual reality can provide immediate feedback on user interactions. For example, after the user turns his head, he can immediately make corresponding changes to the scene and give corresponding feedback. If the real-time human-computer interaction is lost, the virtual environment will lose its sense of reality and immersion [6].

(3) Conception of virtual reality

Conceptualism refers to how to practice the attractive features of human creativity and imagination in virtual reality technology. People are the subject of creative behavior. The realization of the virtual reality system is expected to be the parallel operation of the virtual reality technology and the designer. This essentially determines that it is not continuous but creative. In virtual reality technology, there will be no passive information retrieval behavior, so presentation will not be defined as linear, deterministic, and organized reservations, but emphasizes the active perception of people and the dynamic creation of participating activities[7] .

2.3 Advantages and Disadvantages of Virtual Reality

Virtual reality combines a variety of digital technologies. Integrating 3D computer graphics technology, computer simulation technology, artificial intelligence technology, sensing technology, display technology and other technologies into one, a computer delicate simulation system is formed. Therefore, the scope of application is very wide. Currently, the fields involved include architectural design, industrial design, screen design, animation and game design. Although virtual reality has its advantages

over other technical methods, it also faces some pressing problems, which need to be solved according to current trends [8].

(1) Focus on technology but not art

Because virtual reality technology is so complicated, users are required to be more familiar with computer languages and have higher control over computers. Therefore, computer professionals often emphasize their rational thinking in invention, design, and use.

(2) Poor ease of use

Virtual reality technology is currently under development. It has high hardware requirements, and the user's computer hardware conditions are uneven, causing inconvenience during use, and it is difficult to achieve large-scale promotion.

(3) Poor flexibility

Since this technology industry has not yet formed a single industry standard, different additives must be installed in advance according to different requirements, otherwise they cannot be used, and many options are incompatible with each other. This phenomenon bothers designers and users. It has also become the reason that affects its development [9].

3. Public Art in Virtual Reality

3.1 Development of Public Art at Home and Abroad

The design and implementation of public art is very important to the construction of modern cities. It is a process of analyzing, reorganizing and innovating the culture of the city. Public thinking and inspiration is an important artistic style that belongs to the people and public collectives, and represents the cultural value of a country's houses and cities. Most countries and cities in the world attach great importance to public art. On the one hand, we use public art to inherit and carry forward the cultural spirit of the city and the country. On the other hand, we hope to influence the aesthetic concept and culture of residents in this way. Value, thereby promoting urban culture to the world. Therefore, since the 1950s, many countries have implemented various policies and bills that are conducive to the development of public art. Percentage art law, public cultural policy, and the establishment of art communities to promote the values guided by public art, thinking about the direction of improvement in the development of public art in our country [10].

With the acceleration of domestic urbanization, public art has taken root in China. After nearly 30 years of development, public art keeps pace with the times and is renewed again and again, with a wide variety of art forms like spring flowers, blooming in every corner of the city. The concept of public art has gradually changed from public curiosity to acceptance to understanding to willingness to participate. Public art is playing an increasingly necessary role in the daily lives of residents. The role of substitution not only makes the beauty vivid, but also makes the environment more interesting and charming.

However, the development of public art in China also has many shortcomings, especially the common problems of urban art appearing in second- and third-tier cities. Without effective planning, not paying attention to urban culture, and not paying attention to spatial planning, builders do not take urban construction and development as their own responsibility, and often come together for the benefit of [11].

By cultivating the cultural innovation and cultural conscious development of the city, public art can create a good social and cultural atmosphere, reflect the good character of the city, enhance the city's reputation, and meet the public's artistic aesthetic needs. And dedicated to the artistic construction of this city is a manifestation of the social nature of education. Emphasize the leading and long-term spiritual influence of art on urban development. Excellent presentation is not just a simple construction of urban public space. The material form is not the ultimate goal. It is an effective and reasonable urban cultural and artistic construction law and effective method that can be developed reasonably through the long-term development of public art. Develop urban cultural resources and extensively absorb talents and projects that are conducive to urban cultural construction. Event space system, build a city brand, highlight the charm of the city. A suitable role in the process of settling in China with a long history and culture has a special role and value for the sustainable development of urban economy, politics, culture and society.

3.2 Virtual Reality and Public Art

The essence of virtual reality is that everything serves the needs of users. Sensation is the timely reflection of the brain to the individual characteristic objects acting on the sensory organs. The five main senses of the human body are: sight, hearing, taste, touch, and smell. Among them, the sense, hearing and touch are the most important receptive sensations in current human-computer interaction. From a purely technical point of view, virtual reality can be described as "a multi-dimensional, real-time computer simulation environment based on user behavior. Real-time presentation of current images and audio requires a very powerful computer processor and huge storage capacity. Today, Most virtual all quasi-real systems are realized through special designs. Like all technologies, virtual reality uses its own innovative ways to show existence, reveal and hide. Like any previous technology, it gave me They provide a complete field in which there are new possibilities and new dangers [12].

In thousands of years of art and technology history, they have always been closely integrated. In the doctrine of virtual quasi-reality, art and technology have undergone a new integration and return to their original identity. The way that virtual reality returns to its roots today is also a form of artistic expression. Artistic visualization, through the use of computer reality, sensors and other tools to simulate human vision, hearing, touch, etc. Through the simulation of sensory functions, people are immersed in the virtual world created by computers and user behaviors, using gestures and other natural senses and behaviors to interact with them to create a multi-dimensional humanized virtual space. Users can perceive the real material environment through the virtual reality environment, feel the real limitations of time and space such as the authenticity and penetration of riveting, and enjoy an experience that cannot be obtained in the real world; virtualization technology makes the use of graphics to a certain extent 了 extended. Provide an interactive experience like the real world for artistic creation.

3.3 Use of Public Art and Virtual Reality Technology

One of the most important characteristics of public art is "publicity". Propaganda means communication and exchange. And virtual reality technology makes it possible to turn this "propaganda" into "sharing". It can do the free participation and interaction of the public. As far as public social interaction is concerned, even today, virtual reality is mainly regarded as an entertainment technology. Interesting, but the outside world does not regard it as a social application. The interaction in public art creation: 1. For art works with technical functions such as sound and light in the design, there can be more bold creations and fullness in the creation of the virtual world. Performance; 2. The author can create works and can design to switch between day and night under different conditions of day and night. The labor ratio issue. 4. Provide a variety of creative materials and creative methods, so that something can be actually completed in the virtual world, and the creation can also be completed in virtual reality instead of in reality. 5. The creator can change the process of the work arbitrarily during the creation. The size can be controlled intuitively. 6. You can independently choose the existing creative environment in the content, or you can enter the real environment of the environment through panoramic shooting. Interaction in the display or experience of public art works: 1. For some large-scale works of art, experts may enter the field of public art, walk in the space, and feel the space; 2. Through the interactive action of the handle, you can imitate the touch of the sculpture in the virtual space , The viewer can also experience the change of space and the form of the sculpture; 3. The viewer can watch the work from different angles; 4. By activating the voice, text or video input 5. By zooming in on the important details of the work, you can observe in more detail the work, which is considered to be public communist art, will be liberated. The art space with public experience created by virtual reality will supplement and replace the existing public art in the real space.

3.4 Visual Rendering of Virtual Reality

The rendering of the final virtual reality image is generated using ray tracing. The brightness of the image is approximated by the average value of a series of samples, and each sample is obtained by tracing a line of sight from the eye to the scene through a pixel. The returned brightness value is the brightness of the emitted light along the direction of the line of sight at the point where the line of sight intersects with a certain mirror surface for the first time. The classic rendering formula is as follows:

$$L_s(x,\psi_r) = L_e(x,\psi_r) + \int_{\Omega} f_r(x,\psi_i;\psi_r) L_i(x,\psi_i) \cos\theta_i d\omega_i \tag{1}$$

Among them, L_e is the radiation energy emitted by the surface, L_i is the energy incident in the direction L_i, f_r is a function, Ω is the spherical surface of the incident direction, L_e can be obtained directly, and L_i needs to rely on the radiation energy in the scene. The L_r can be decomposed into a formula. The specific formula is as follows:

$$L_r = \int_{\Omega} f_r L_{i,l} \cos\theta_i d\omega_i + \int_{\Omega} f_{r,s}(L_{i,c} + L_{i,d}) \cos\theta_i d\omega_i + \int_{\Omega} f_{r,d} L_{i,c} \cos\theta_i d\omega_i + \int_{\Omega} f_{r,d} L_{i,d} \cos\theta_i d\omega_i \quad (2)$$

In the decomposed formula of $f_r = f_{r,s} + f_{r,d}$ and $L_i = L_{i,l} + L_{i,c} + L_{i,d}$, the energy contribution directly decomposed by the light source after incident is $L_{i,l}$, $L_{i,c}$ represents the energy of the specular reflection, and $L_{i,d}$ is the energy contribution of the light source after at least one diffuse reflection. $f_{r,d}$ is the diffuse reflection part of the specular surface, and $f_{r,s}$ is the specular reflection part.

4. The Development Trend of Virtual Reality Technology

4.1. Analysis of the Development of Virtual Reality

As shown in Table 1, according to the analysis of development opportunities for the virtual reality industry released by the Institute, China's virtual reality market size opportunity reached 5.28 billion yuan in 2017. And with the gradual maturity of virtual reality technology, funds will gradually be injected into the virtual reality market. With the promotion of merchants, the market scale will be further expanded. As of 2018, China's virtual reality market has exceeded the scale of tens of billions.

TABLE I. VIRTUAL REALITY MARKET SIZE ANALYSIS TABLE

Time	2016	2017	2018	2019	2020
Market size (100 million yuan)	32.7	52.8	105.7	225.5	300.8

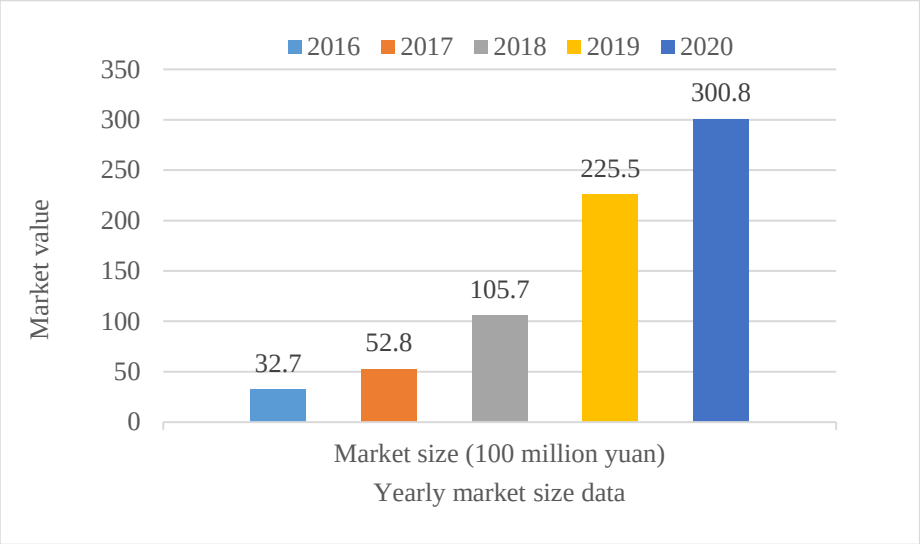

Fig 1. Market data scale diagram

As shown in Figure 1, the scale of my country's virtual reality market was only 3.27 billion yuan in 2016. However, as the technology becomes more mature, businesses are propagating more and more, and more and more capital is injected. We are optimistic about this There are more and more skilled people, and the market scale is growing faster and faster. In 2018, it has already exceeded the tens of billions mark.

4.2. Market Data of Virtual Reality Service Types

As shown in Table 2, the current market structure of virtual reality service types in China is divided into 7 parts: service packaging, raw material processing, product research and development, installation and construction, service consulting, quality supervision, and design consulting. Among them, packaging services accounted for as high as 28.9%.

TABLE II. VIRTUAL REALITY MARKET SERVICE STRUCTURE TABLE

Service type	Packaging service	Raw material processing	Product development	Installation and construction	consulting service	Quality supervision	Design Consultation
Occupy ratio%	28.9	25.9	18.9	13.6	10.8	8.1	4.6

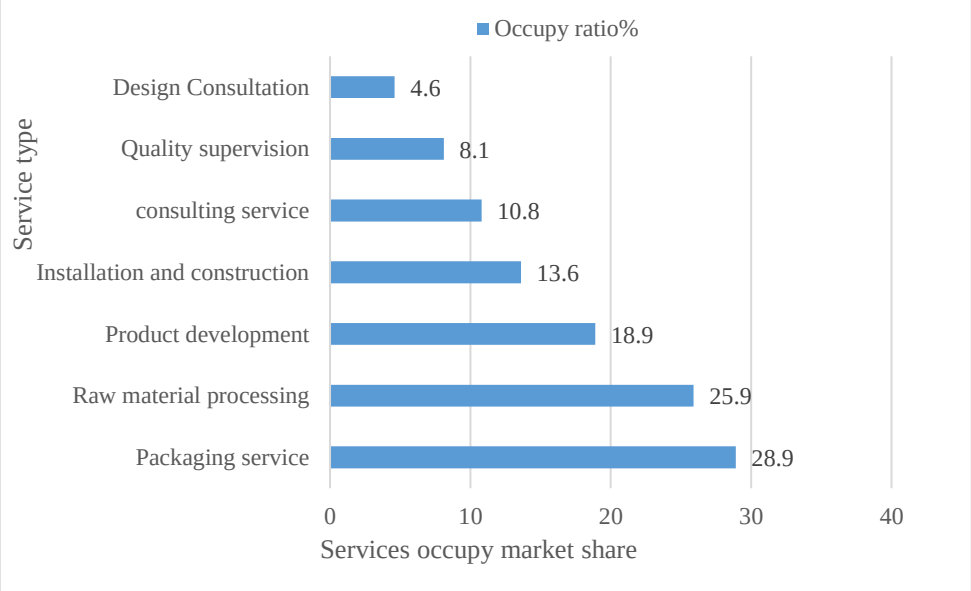

Fig 2. Market share of virtual reality services

As shown in Figure 2, the virtual reality industry has had a huge impact on my country. Product R&D refers to the 18.9% market share, which is far lower than the service packaging, which accounts for the highest proportion, and is 10% lower.

5. Conclusions

This article obtains data from references and the Internet, and analyzes the development prospects of virtual reality and the proportion of market service structure, combines it with public art, visualizes art, and creates an illusory multidimensional world through virtual reality technology. Users can experience the real world of spatial simulation and the real penetration of multi-dimensional space through computers or other information perception tools.

References

[1] Zhang Pei. Research on the Application of Virtual Reality Technology in Public Art Design and Exhibition. Industrial Design, 2019, No. 159(10):138-139.

[2] Zhang Shengnan. A preliminary study on the application of modern multimedia technology in landscape design. Artwork Jian, 2017, 000(11X): P.65-66.

[3] Li S, Fang Z, Song WF, et al. Bidirectional Optimization Coupled Ligh tweight Networks for Efficient and Robust Multi-Person 2D Pose Estimation. Journal of Computer Science and Technology: English Edition, 2019, 034(003) :522-536.

[4] Bae S B, Han K S. A Study on the Conservation of New Media Art - Focusing on collections of domestic museums. The Korean Society of Science & Art, 2018, 33:137-147.

[5] Lu Le. The application of virtual reality technology in the teaching of art history. Journal of Jiamusi Education College, 2017, 000(012):226-227.
[6] Huang W, Xiang H, Li S H. Study on Multimedia Visual Design of Intangible Cultural Heritage in Lingnan. Frontiers of Educational Research: Chinese and English Edition, 2019, 009(002): P.37-41.
[7] Machidon O M,Duguleana M,Carrozzino M . Virtual humans in cultural heritage ICT applications: A review. Journal of Cultural Heritage, 2018:249-260.
[8] Hou B. The Application and Prospect of Virtual Reality Technology in the Future Architecture Design. Frontier Research of Architecture and Engineering (English), 2018, 001(003): P.76-79.
[9] Zhu Qin. Public Art Design for Urban Mass Innovation Space. Journal of Changzhou Institute of Technology, 2017, 030(004):42-47.
[10] Chen Junru. ARCHITECTURAL DESIGN AND ANALYSIS OF A PUBLIC ART MUSEUM% The architectural structure design analysis of a public art museum. Architecture Technology, 2018, 049(002):152-154.
[11] Cranz G. Designing and Building the Visual Pathway as Public Art: Some Pros and Cons of Design-Build Pedagogy for Higher Education. Studies in Health Technology and Informatics, 2018, 256:780-790.
[12] Li Lei. The Possibility of Bringing Public Art into Beijing Sub-City Design. Sculpture, 2017, 000(004):71-73.