Applications of VR and AR in Architectural Design

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ABSTRACT: The arrival of the information and data era has greatly promoted the development of information technology. VR and AR technologies, which connect the virtual world and the real world, were born as a new way of information display and transmission, and brought great cognitive changes to modern new technologies. Augmented reality and virtual reality technology can not only focus on enhancing the interaction strength between information technology and the real environment, but also further promote the continuous growth of the demand for immersive digital applications. VR and AR technologies are gradually mature, and the industry chain behind them is also gradually improved. In this period of development, integration with other fields is inevitable. For example, in the application process of virtual reality and augmented reality technology, further improving the relevant functions of digital technology museums and museums can not only better combine relevant human-computer interaction equipment to further improve the overall quality of visitors, but also improve the speed of visitors' feedback on relevant preventive measures and practical problems, so as to better reduce the investment cost of human resources in this regard. The related virtual reality and augmented reality technologies can also be applied to the related fields of medicine. They can not only conduct more diversified and realistic case analysis for difficult and complicated diseases with fewer cases, but also better build a virtual operating table, which will play a greater role in improving doctors' surgical experience. In addition, relevant technical means have also been widely used in telemedicine cooperation and rehabilitation treatment, playing a positive role in the development of domestic medical care and the optimization of treatment forms. This paper will focus on the application and benefits of virtual reality technology and augmented reality technology in the field of architectural design, and clarify their important role in promoting architectural design

Keyword: VR, AR, Architecture design, Optimal solution.

1 INTRODUCTION

Virtual reality (VR) technology is a new application technology developed since the 20th century. It is a scientific and technological means to build a completely virtual computer world. VR includes simulation technology, computer data processing and real-time distribution technology, 3D view construction, etc. In this computer created world, people can have a series of sensory experiences, such as realistic three-dimensional perspective, smell, hearing, etc. It is difficult to judge whether it is fictitious without prior notice. As the movie The Matrix said, people in the movie live in a virtual world that they do not know themselves. With the development of science and technology, VR are no longer guesses in science fiction, but gradually enter our lives, such as virtual games, virtual travel, VR engineering and VR games.

VR has experienced three booms. The first time was in the 1960s, when the principle of VR technology was established. Secondly, in the 1990s, VR tried to commercialize but failed. For the third time in 2014, Facebook acquired Oculus for 2 billion dollars, starting the third wave of VR technology and commercial promotion of VR technology. Since the 1990s, China began to research and apply virtual reality technology. Due to the limitations of technology and cost, it was initially only applicable to high-end applications, such as military and commercial applications. In the past few years, product chips, displays and human-computer interaction technologies suitable for ordinary consumers have gradually entered the market. According to the data, the virtual reality market with a GDP of only 1.52 billion RMB in 2015 reached 6.74 billion dollars in 2016, a number of times over last year [1]. It can be seen that VR hardware involves too many fields. Once it is applied in any field on a large scale, it will generate huge market increment. It can be said that China's virtual reality industry is developing at a high speed [2]. As far as augmented reality technology is concerned, it is a technology that skillfully combines virtual information with the real world. It is widely used in multimedia, 3D modeling, real-time tracking and registration, intelligent interaction, sensing and other technical means, simulating computer generated virtual information and applying to the real world. These two kinds of information complement each other, thus realizing the "enhancement" of the real world. From a certain point of view, both VR and augmented reality technology are based on reality, but both are higher than reality.

Architectural design refers to that before building construction, the designer reasonably designs the structure of the building according to the requirements, looks for solutions to problems that may exist in the construction process, and controls the consumption of manpower and material resources. As a subject of comprehensive planning and imagination, modern architectural design has higher and higher requirements for designers. In ancient times, the building may be a house made of stone and straw which is too simple. With the discovery of more and more available building materials and ingenious building methods, the content of architecture and the problems to be solved have become more and more complex, involving more and more related disciplines, and the original everything has gradually become inappropriate. In order to seek a more efficient and convenient design method, a branch discipline that combines architectural design with VR technology and augmented reality technology has gradually developed from the mainstream of architectural design. This paper will start with the advantages of VR technology and augmented reality technology in architectural design, and analyze their feasibility and development possibilities. After 1990, contemporary architecture has put more emphasis on sustainable green architecture. In this process, other new synthetic materials such as composite metal and traditional materials such as wood and bamboo have been more widely used. The development of technology and computer has brought more possibilities to architecture. Digital and parametric design is widely used in contemporary architectural design. Assembly, building information model, 3D printing technology are also applied in architecture [3].

2 APPLICATIONS OF VR AND AR

2.1 VR and AR can avoid unnecessary losses

The application of VR and AR can avoid the waste of human, material and financial resources, judge the feasibility and safety of the project in advance, and facilitate modification and

improvement. It is helpful for analysis and can find the best solution within the budget. For example, in a project similar to a large building complex in urban planning. The national landscape roaming function can view the urban planning content at any time and conduct 3D visual browsing [4]. Reviewing the urban planning scheme, summarizing the loopholes in the design, and timely revising and optimizing will help to improve the efficiency of urban planning and improve the effect of urban planning. Reviewers can complete the scheme review by browsing the dynamic landscape. Interactive is the outstanding advantage of the urban planning 3D design system designed based on VR technology, which realizes the interactive roaming of the urban planning dynamic landscape through interactive control. The system sets free roaming, picking objects, controlling objects and other functions to complete human-computer interactive roaming [5]. When roaming in the urban planning scene, users can carefully view the details of urban buildings, roads, landforms and landscapes, and use the keyboard and mouse to control the camera angle to achieve the conversion of front and back perspectives [6]. If only one design scheme is adopted in theory, it is inevitable that the mistakes of the design team will lead to unreasonable urban structure or excessive costs. These problems will not be found until the construction phase of the project has started, and there will be unnecessary losses and contradictions. Use VR and AR to simulate operation in advance, and experiment whether the current scheme is feasible and the problem is concrete in the virtual world. This behavior itself has no cost and belongs to an attempt which gains ten thousand percent. Moreover, VR and AR are not limited to large projects, they can also be used in small projects of interior decoration or layout design. For most people who do not know much about interior decoration, using these convenient technologies can enable them to participate in their own room design, rather than browsing the designer's design drawings hastily. Because of the limitation of knowledge, it is difficult to find the dissatisfaction in the design of professionals. Even the field survey is only a theoretical discussion, which can easily fail to meet the expectations of consumers. VR and AR technology can solve the communication and understanding difficulties between the two sides, and as with urban planning, they can quickly find and solve the problems. At the same time, such a way can stimulate the enthusiasm of the client to participate and greatly improve the design fit. In this regard, VR focuses on creating immersive building simulations, while AR focuses on visualizing virtual objects directly built on the site. On the other hand, we can also use VR interaction to quickly implement actions that cannot be completed immediately in real access [7]. For example, if the owner wants to try the layout effect of different furniture in the space when roaming, he can also use "replace interaction" to replace various furniture and furnishings through the handle operation to experience the decorative layout effect of different spaces. These two interaction modes are very effective VR enhanced interaction functions for experiencing architectural decoration professional projects, and have innovative significance. In short, VR is more inclined to the overall situation and the whole, and AR is more inclined to the details.

2.2 VR and AR can improve teaching quality

The market potential of the education industry is huge. According to the data in the Analysis Report on Market Outlook and Investment Forecast of China's Online Education Industry, the total value of China's education and training market in 2009 was about 680 billion yuan, and it is expected to reach 960 billion yuan by 2012, with an annual growth rate of 12%. It can be seen that the future development of the education industry will be better and better, and the resulting market profits and value-added space will gradually increase [8]. As time goes by, the traditional

teaching mode is rigid, the process is boring, and the interaction is not strong. The teaching practice of architectural design needs the support of mathematics, mechanics, professional basic courses and other courses. But in the past, the courses mainly relied on blackboard writing or a single broadcast of PPT. The teaching process was too boring, the students' learning efficiency was greatly reduced, and their attention was not easy to focus, leading to low efficiency in class. The engineering practice in the course is mostly presented in the form of visits, which, on the one hand, will lead to students' lack of initiative in professional practice with the purpose of playing in the whole practice process, and students' ability to find problems, raise problems, explore and innovate and solve problems has not been improved. On the other hand, the engineering practice site of civil engineering major is mainly the construction site. Affected by objective factors, students in some dangerous areas cannot enter the site for learning, and students' understanding of this part can only stay in the textbook or video level. The assessment method is similar. The proportion of final examination is much higher than that of time in most cases. Under the imperceptible influence, the idea of emphasizing theory over practice is deeply rooted in the students' minds, which will lead to the students not paying attention to the practice part and putting their own learning focus on theory. VR/AR technology, as one of the mainstream technologies in the 21st century, brings visual experience to the experiencer that cannot be achieved by the current traditional media. It is certain that integrating VR/AR technology into civil engineering teaching practice will certainly bring unprecedented experience. VR/AR learning environment brings us not only a working platform, but also a new teaching mode or teaching means in a great probability. For example, the architectural design course can use VR to let students experience all the possibilities of architecture in a highly interactive way. Teachers can personally demonstrate the design process and construction of buildings, rather than simply reading slides. Students can also master classroom theoretical knowledge and accumulate certain experience through practice in the virtual world. At the same time, teachers can also simulate some dangerous situations in the virtual world, which can correct students' understanding in a timely manner. Under the condition of ensuring students' safety, let students realize the minefields and their dangers in architectural design. Virtual education (combined with VR/AR technology), like artificial intelligence and big data, is known as the three major fields that affect future scientific and technological innovation. Therefore, the application of VR/AR technology undoubtedly provides a good opportunity for traditional architectural design teaching in China.

2.3 VR and AR can improve engineering construction efficiency

VR/AR technology can make advance planning for people, machines and materials during construction through 3D simulation, provide accurate construction information and processes for construction personnel, and reduce various problems that may occur during construction. In traditional construction, project managers generally refer to the construction drawings issued by CAD to arrange construction, which requires the project party to have a strong ability to read drawings. At the same time, CAD drawings are two-dimensional display drawings, and many locations and equipment are represented by special symbols. If the review is not in place, it is easy to miss in construction. Compared with CAD, VR/AR technology can provide more specific and real construction data. Constructors do not need to have strong map reading ability to understand drawings. They can mark important information, reduce construction errors, and improve construction efficiency. Before the construction, combined with the characteristics of VR technology, we can use drones to collect on-site construction pictures, import these pictures

into the background database, and turn them into specific "virtual models". Technicians can make 3D models of each small link in the construction. The construction drawings obtained in this way are not only accurate, but also easy to present, so that every constructor can understand them. The connection between virtual technology and BIM is also increasing. During construction, the project party can form a relevant database of construction equipment and construction process, use BIM technology to conduct 4D virtual construction, and inspect the construction process, equipment, materials, etc. through visual rehearsal and construction process simulation, so as to optimize the organization of the construction plan and reduce rework. At present, BIM+VR technology has been applied more and more in some large-scale, large-scale and dangerous projects, providing convenient and intuitive simulation and detailed and accurate analysis results. Next, it should also be actively promoted in ordinary construction projects to achieve real "smart construction".

2.4 VR and AR can ensure construction safety

Building safety is one of the clearest use cases for AR and VR. AR can be used for hazard identification and safety inspection to provide a safer working environment, and VR can support safety education. Fortunately, they have been widely used in emergency drills to enable people of different posts to perform in the same virtual scene through human interaction technology. It breaks through the traditional training mode to let trainees know how to make decisions quickly and respond reasonably in the face of disasters, so as to ensure the safety of themselves and others. The promotion of VR and AR has solved the tedious and purely theoretical problems of safety education in the past. In the past 20 to 30 years, most construction sites have issued a thick safety instruction and organized several drills with little effect. But they perfectly solve this situation. Nothing makes workers realize the importance of safety better than personal experience. Let them personally experience the hazards caused by mistakes can urge their safety awareness. This is in itself a responsible act towards their families and colleagues. At the same time, VR and AR have improved the coordination of various departments, which enables people to unite as one when facing problems, rather than working independently like a group of headless flies, and ultimately, nothing can be done. They also improve the efficiency of safety education, which can be conducted by multiple people at the same time. As in the past, it is not enough to rely only on the experience of the new and old generations and the inheritance of skills. It is always one-sided to single out a faction.

3 CONCLUSION

In recent years, VR/AR technology has been continuously improved and developed, and has rapidly been widely used in various fields and industries, enabling people to have more fresh experience. VR/AR technology is developing better and better, and people's demand points are also increasing. People's expectations for the development of virtual technology have also become greater and greater. Virtual technology is also constantly integrated into people's lives, which also makes the future life more colorful with its penetration in industrial, educational, medical and other industries. VR/AR technology started late in China. Although they are different in technical approaches, they are interlinked in essence. The main core meaning lies in the combination of "integration of real world and virtual information", "three-dimensional scale space" and "human-computer interaction", and one of the three is indispensable. VR/AR

application market still has a large space to expand. The simplest point is to reduce the use cost and improve the usability to expand the scope of promotion. Both software and hardware can become mainstream only when the product is easily accepted by users. Although the price of VR/AR related products has been reduced, people's awareness of use has not been widely accepted, and users do not particularly understand the technology. Most people should not buy relatively expensive technology products for the sake of freshness. The product range can become more open and undergo a gradual price adjustment process. On the other hand, virtual technology has not developed perfectly. Although there have been technologies similar to VR chat or VR painting, they still have great limitations and immature nature. For example, VR is a virtual technology that emphasizes immersion. Then a series of problems, such as how to strengthen the immersion experience, how to build a virtual reality that is more similar to reality, and how to ensure the safety of VR use process, need to be solved urgently. They may be to capture sound through a new omnidirectional microphone, or to establish a VR use base station. Facts have proved that there are more ways than difficulties. With the flow of time, problems will eventually be solved, and virtual technology can also achieve perfection.

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