

# Research on the Application Strategy of Virtual Reality Technology in the Historic Building Protection Courses

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## ABSTRACT

More and more attention is paid to the protection of historical buildings around the world, and more attention should be paid to the training of relevant professionals. Virtual reality technology currently has a good trend of development in various industries, and has obvious advantages that can be used in the teaching of historical building protection courses. This article analyzes the current situation of historical building protection courses and teaching bottlenecks. Combined with the current application examples of virtual reality (VR) technology in the field of education, it summarizes the advantages of VR technology in historical building protection courses. Finally, it reflects on the problems that may occur in the application of VR technology in the course, and contemplates a preliminary solution, which will provide a certain theoretical basis for the practical application of VR technology in the historical building protection courses.

**Keywords:** virtual reality (VR), building protection, teaching strategy

## I. INTRODUCTION

With the rapid development of society, the situation of many historical buildings in China has become increasingly difficult, and effective protection measures for precious historical buildings are extremely urgent. At present, colleges and universities are paying more and more attention to the cultivation of professionals in the protection of historical buildings. Meanwhile, some colleges in this direction have become independent undergraduate majors in China. At the same time, related courses have also been set up in the majors of architectural engineering, architecture, environmental art design, etc. The focus of teaching has also gradually expanded from the physical protection of historical buildings and cultural relics to the protection of non-material levels such as traditional culture and spirit. Virtual reality (abbreviated as VR) technology has more and more successful applications in recent years. Its real-time three-dimensional space performance, human-computer interaction and real immersion characteristics have brought great convenience to the exploration of the micro and macro worlds. The use of these characteristics to protect historical and cultural buildings has been widely recognized in relevant professional fields in China and foreign countries. Adding VR technology to the teaching of historical building protection courses, combining the products of the two eras, will also form the future development trend of the course education.

## II. HISTORIC BUILDING PROTECTION EDUCATION

The protection of historical buildings is a multi-disciplinary course, and it is also a major course for other architectural related majors. At the graduate level, the protection of historical buildings has become the research direction of the students. This course is based on the basic theory and skills of architecture, focusing on the theory and methods of protection and regeneration of historical buildings and historical environmental. In recent years, with the increasing awareness of the protection of historical and cultural heritage in various countries, more and more attention has been paid to the cultivation of relevant professionals. In some western developed countries, the protection of historical buildings has become a relatively independent research field, and it has implemented professional education which is adapted this field. The protection of historical buildings has become an important part of the sustainable development of human society, and this has formed a broad international consensus.

Although China has a large number of historical and cultural buildings, the research on the protection of traditional buildings is not as good as some Western countries. In 1962, the Università Degli Studi Di Roma opened an architectural protection course in cooperation with the International Cultural Relics Protection and Restoration Research Center. In recent years, the education of the protection of historical buildings in

Italy, Russia and other countries has had a profound impact on the protection of world heritage. In the United Kingdom, the registered architect system clearly requires attention to the degree of understanding of the protection of historical buildings. In China, related majors have been gradually established from Tongji University, such as the architectural heritage protection major of Southeast University, the architectural heritage protection major of the University of Hong Kong, and so on. The education of the protection of historical buildings involves cognition of traditional building structure and structure, cognition of architectural design and historical culture, etc. To cultivate talents with the ability to work in the protection of historical buildings, it is in need of a more complete and scientific in-depth training.

Facing the needs of the traditional inheritance and protection of the traditional architecture and the future development trend, there are still some areas for improvement in the construction of its educational course. The first is that the traditional education model cannot forge students' practical ability. Due to the peculiarities of historical buildings and their protective operations are irreversible, this course has extremely high requirements for students' practical ability. However, in the current education model, students have almost no chance of practice. Secondly, the major currently stays in the literature research on technological process, lacking innovative talents. China's traditional construction resources are very rich, and many related construction records are kept, such as "Construction Method" and "Ministry of Industry Regulations", etc. These materials are certainly very precious, but in the face of current material and technology updates, it is also necessary to make a combination to carry out innovative research. Finally, at present, the coordinated education of this major and other disciplines is weak. The protection of traditional buildings requires a multi-disciplinary and comprehensive role. However, due to the limited teaching space and time, most traditional building protection education classrooms are difficult to achieve multi-discipline coordination. In summary, the education of traditional building protection needs to be implemented in the cultivation of quality and ability through the in-depth optimization of the contemporary education system.

### **III. APPLICATION OF VR TECHNOLOGY IN EDUCATION**

#### *A. Technical overview*

Virtual reality (referred to as VR) technology originated in the 1960s. After decades of development, the technology has been continuously upgraded and gradually integrated into people's daily life. Its core is to rely on external technical means and equipment to

simulate the real world and form a multi-sensory virtual world. After 2016, the actual application research of VR technology has exploded, and mainstream electronic information industry manufacturers such as Facebook, Google, HTC, Samsung, etc., have all launched VR products. In addition, VR technology has also been involved in education, medical, military and other fields. In 2017, the scale of China's virtual reality industry market has reached 16 billion yuan, and it is expected to exceed 90 billion yuan in 2020. The continuous expansion of the market will also further promote the combined development of VR technology and various industries.

#### *B. The combined application of VR and education and teaching*

With the rapid development of VR technology, its practical value in various industries has also been continuously recognized. In the "Thirteenth Five-Year Plan for National Education Development" promulgated by the National Development and Reform Commission in 2017, it also mentioned supporting schools to build smart campuses and comprehensively using the Internet, big data, artificial intelligence and virtual reality technologies to explore new models of education and teaching. The relevant guidance emphasizes the available value of VR technology in the field of teaching. Combining VR technology with teaching is to open up new teaching methods for traditional teaching.

Some electronic information industry manufacturers are also committed to the research and development of VR education products, such as the investigation teaching tool launched by Google, which can simulate the content that cannot be completely displayed in the textbook through VR technology. After that, it launched Cardboard, although its effect is not the best of all products, but its low price makes the virtual reality experience more popular and reduces the cost of its trial value. In addition, many schools have begun to try to introduce VR technology into the classroom. For example, the G-Magic Virtual Reality Laboratory, a collaboration between East China University of Science and Technology and Manheng Digital, is based on the G-Magic deformable large-scale immersive virtual simulation system. Equipped with DVS3D virtual reality collaborative design work platform, G-Motion optical position tracking system and other virtual reality products, it aimed at carrying out VR technology in the field of art engineering research. Zhejiang University cooperated with Harvard University to launch a history class assisted by VR technology — "Giza Pyramids: Technology, Archaeology and History". Through VR technology, students can see the appearance of pyramids in history after wearing VR glasses, including some internal reliefs, murals, etc. Students can also choose an object to pop up and display it individually

for detailed observation from all angles. In the future, virtual reality technology will continue to improve and upgrade. The way students learn in the future will also be affected by it, and huge changes will take place.

#### **IV. APPLICATION ADVANTAGES OF VR TECHNOLOGY IN HISTORICAL BUILDING PROTECTION COURSES**

At present, there are many practical cases of applying VR technology to teaching classrooms, and almost all of them make full use of the 3I characteristics of VR technology, namely Immersion, Interaction and Imagination. The main advantages of VR technology are also reflected through these three points: Immersion refers to the use of computer technology to simulate the real world to create a virtual environment comparable to the real world; Interaction means that in this virtual environment, using some sensing devices, people can interact with some objects in the scene; Imagination means that in a virtual environment, people can make up the things in their minds, thereby inspiring people's creative thinking.

In view of some problems of the current historical building protection course, combining the three characteristics of the above VR technology, applying VR technology to the traditional building protection course has the following advantages: first of all, VR technology can create a multi-perceived virtual historical environment space. Within the scope of space, students can try a variety of protection schemes and continue to deepen conceptual ideas, thereby greatly improving students' practical ability; secondly, the virtual space created by VR technology is extremely realistic and pays great attention to the performance of environmental effects. Whether it is the control of material details or the detailed explanation of the construction process, the distance between students and actual work can be minimized; finally, the virtual space created by VR technology can add a variety of interactions. On the one hand, it has greatly facilitated the introduction of other disciplines and coordinated the cooperation of multiple majors. On the other hand, students are no longer restricted by space and time. They can communicate with teachers anytime, anywhere, and observe the original historical buildings in detail, which is convenient for students' in-depth study.

#### **V. TEACHING MODEL OF HISTORICAL BUILDING PROTECTION COURSE SUPPORTED BY VR TECHNOLOGY**

##### *A. Desktop virtual reality mode*

This mode mainly uses a graphical display as a visual window, and enters data input through traditional

tools such as a mouse and keyboard, thereby reacting with the virtual world. People can input the historical building style gallery, internal anatomical model, classic structured process flow video and other comprehensive input, and then add hidden / display, semi-transparent / opaque, whether it is unique, etc., so that students can more easily understand some of traditional buildings basic concept. This is a software-only virtual reality model. Students are independent of the virtual environment, and the immersion is not strong, but teachers are easier to control the overall teaching rhythm and more convenient to popularize and use. It can be improved based on the existing computer room teaching equipment.

##### *B. Immersive virtual reality mode*

This mode further utilizes the immersion of VR technology, and students are within the control of the device. People can enter the planned virtual environment by wearing a helmet display or a VR all-in-one machine, and use the handheld handle to interact with the device, which will trigger the preset interaction actions. Under this mode, students can carry out the disassembly and assembly of historical buildings and the simulation of technological processes, so as to have a deeper understanding of the structure and construction of historical buildings. In addition, students can also conduct simple historical environment modeling in the virtual environment, and experience the spatial scale and modeling proportion of historical buildings. However, this model has certain requirements for the size of the space, and requires the investment of related equipment, which has certain restrictions on the teaching scale.

##### *C. Holographic naked-eye mode*

This mode relies on a certain medium to suspend the two-dimensional image in the real space, has a strong three-dimensional sense, and is no longer bound by helmets and other equipment, which means that people can feel the phantom of the historical space with naked eyes. It is mainly used to display the details of traditional building structures and the overall environment. Although this model has certain limitations in terms of resolution and viewing distance, the traditional architectural phantoms displayed on it as teaching aids not only intuitive and stereoscopic but also stimulate students' curiosity and improve students' autonomous learning. In addition, there are many choices of holographic projection equipment, such as 3D holographic mobile phone projectors, 3D holographic display cabinets, and 3D floating holographic projectors. Different kinds of equipment have different prices and meet different requirements. Schools can make appropriate choices based on the size of the teaching space and the number of students.

## VI. TEACHING CHALLENGE OF HISTORICAL BUILDING PROTECTION COURSES SUPPORTED BY VR TECHNOLOGY

### A. Technical support issues

For schools, to popularize the application of VR in courses, a large number of VR equipment needs to be provided, which will increase the capital investment in teaching equipment. And with the continuous development of VR technology, schools also need to communicate with various VR equipment manufacturers to choose hardware devices that are stable in operation, good in experience, and better in price. For teachers, VR technology is a new auxiliary teaching tool that requires unified related learning and training in order to better play in the classroom. At the same time, teachers can also provide feedback on actual use, and promote manufacturers to optimize the technology of VR + education, so as to continuously adapt to changes in education requirements and scientific and technological updates.

### B. The problems of technology application

As with other new technologies, the application of VR technology to the course of historical architecture will surely raise practical and acceptable concerns. Judging from the current VR experience feedback, most people will experience physical discomfort, such as dizziness. What's more, the extension of VR technology to the senses will affect the conversion of the real world to a certain extent. These are likely to happen to students and teachers. The relevant technical personnel have been constantly studying and improving to avoid these negative effects. In the current stage of teaching, the guide also needs to observe the experiencers to avoid the impact of abuse. Secondly, when using it, teachers should also grasp the degree of use of the technology. In essence, VR technology is only an auxiliary tool for teaching, and the focus needs to be implemented to the teaching of professional knowledge.

## VII. CONCLUSION

China's historical building resources are very rich, and more and more attention is paid to the protection of historical buildings. However, China's modern architectural education originates from the West and has a short development history. The relevant system is also in the trial stage. Western architectural theories and practices have undergone tremendous changes after World War II. The courses and teaching models of related majors are far from traditional forms, while the mode of cultivating relevant professional talents in China is still not much different from the early days. It takes ten years to grow a tree and a hundred years to bring up a generation of good men. Both the research on the education model and the cultivation of talents for

the protection of traditional buildings will affect the level of China's future urban development and construction. With the emergence of new technologies, it is a must to naturally grasp and implement them in a timely manner. At present, more and more colleges and universities are paying attention to this point. While introducing new technical support, it is also necessary to focus on personnel training. The advantages of VR technology can solve some problems in the current historical building protection courses. On the premise of teaching purpose, the support of VR technology is added to allow students to learn interactively in the VR virtual environment and evaluate in an objective way, so as to gain professional knowledge. But at the same time, science and technology is also a double-edged sword. In the actual teaching activities, it is of great significance to pay attention to avoid the negative effects of VR technology and give full play to the advantages of VR + education.

## References

- [1] Fang Zhiguo, Zhang Danyin, Xiong Liang, Teaching Practice of "One Heart Multi-faceted" Course Based on Walking Perception Method — A Case Study of "Rraditional Building Reconstruction and Renewal" of Environmental Design Course [J]. *Hua Zhong Architecture*, 2019, 37(03): 100-103. (in Chinese)
- [2] Wu Huisi, On the Development of Virtual Reality Technology in the Field of Education in China [J]. *Communication and Copyright*, 2019(01): 166-168. (in Chinese)
- [3] Xia Yibo, Innovative Application of Traditional Architectural Expressions in China from the Perspective of Virtual Reality [J]. *Think Tank Era*, 2019(01): 164-165. (in Chinese)
- [4] Yang Zhouyang, The Application and Research of VR Technology in the Teaching of Art Design [D]. *Jilin University*, 2018. (in Chinese)
- [5] Xie Songmin, The Design of Virtual Lab for Electronic Circuit Based on LabVIEW and Multisim [D]. *Hunan Normal University*, 2015. (in Chinese)
- [6] Zhang Jie, Chen Hengxin, Wang Jiahui, Application of Virtual Reality in Chinese Ancient Architecture Education: Design and Implementation of Experiential Teaching Soft of Bucket Arch Culture [J]. *Journal of Architectural Education in Institutions of Higher Learning*, 2019, 28(04): 139-146. (in Chinese)