Research on The Design of VR-based Architecture Teaching System

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Abstract. Architecture is a discipline about space, and space is the first characteristic of VR, which is fundamental to the sense of "scene". In architecture teaching design, it is easy for teachers to draw an architectural drawing, but in the process of explanation, how to explain more clearly and how to make students understand more clearly is one of the difficulties of current architecture teaching. Bringing VR technology into architectural design teaching breaks the boringness of architectural design plane teaching and stimulates students' enthusiasm for learning. In this paper, we first analyze AR technology, and then research and design an architecture teaching system that is more in line with the actual architecture teaching based on AR technology and the characteristics of architecture teaching. The system makes it easier to start architecture teaching, students can better understand the teaching content and improve the efficiency of architecture teaching.

Keywords: AR technology, system design, architectural design, teaching system

1 INTRODUCTION

The VR classroom is the main place used by schools to carry out daily teaching and various class activities, and is the main space for students to learn and move around at school [1]. Ordinary classrooms should make full use of multimedia equipment, network access and other information technology tools to support classroom teaching interaction, optimize classroom teaching resources and improve classroom teaching models. VR classrooms provide teachers and students with content-rich teaching resource data packages through hardware and software platforms, and use VR technology to create interactive and interesting learning situations for students to explore knowledge through themselves, stimulate interest in learning and accelerate their knowledge understanding. The application of virtual reality technology in the construction field has been in a slow progress, mainly because this technology is not mature enough at present, plus the construction field itself is a traditional industry with strong practicality. Therefore, the application of virtual reality technology in the field of architecture needs to advance slowly in research and practice [2]. VR technology is immersive, interactive and imaginative. VR technology has surpassed the 2D drawings and 3D animations commonly used by the architect community before the building was built to give a realistic spatial experience. The virtual architectural space it creates can easily allow people to visualize and evaluate the architectural space of architectural projects [3]. Therefore, combined with the current situation of architecture teaching, this paper researches and designs a more realistic architecture teaching system based

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on VR technology to explore and provide ideas for teaching architecture space based on VR technology [4].

2 VR TECHNOLOGY ANALYSIS

Virtual Reality (VR) is a computer-based virtual simulation system that allows users to experience a virtual environment and interact with them in a virtual space through the processing of complex information and visualization of information [5]. The space created by the virtual reality technology in the computer is called "spirit world". This is why virtual reality technology is also called "spirit world technology".

Virtual reality technology is a virtual environment built in the computer, through the visual, auditory, haptic and other senses to achieve a variety of real-time interactive means for the establishment of virtual environments [6]. For users by using virtual reality technology can effectively reduce the user's operational burden and improve the efficiency of work.

2.1 Composition of VR technology system

The three main characteristics of VR technology are: Immersion, Interaction, and Imagination, that is, the "3I" characteristics, as shown in Figure 1.

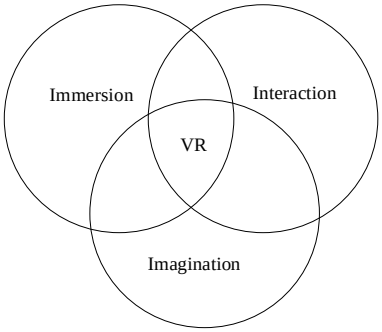

Figure 1 "3I" characteristics of VR technology

Immersion, also known as immersion, refers specifically to the realism of the scene felt by the user in the virtual environment, the size of the realism is used as a benchmark for judging the performance of VR technology [7]. By wearing a headset display, body sensory feedback and other hardware equipment, you can be in the virtual environment and become a physical and mental participant in the virtual scene. Motion capture system, processing control system and display system are the components of a typical immersive VR system, the three complement each other, one is indispensable. The composition of an immersive VR system is shown in Figure 2.

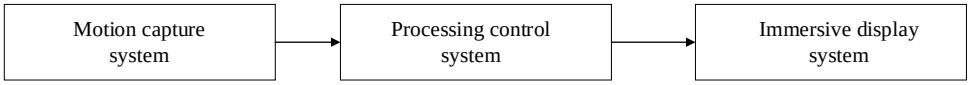

Figure 2 Composition of an immersive VR system

The traditional human-computer interaction mainly refers to the interaction between the user and the computer through mouse and keyboard input and the image displayed on the monitor [8]. the interaction referred to by VR technology means that the user can interact with the virtual scene not only through the mouse and keyboard, but also through their own natural behavior. The main hardware devices to achieve this interactive effect are helmet-type displays and body-sensing devices .

Imagination refers to the user's immersion in a multi-sensory three-dimensional space, relying on their own perception and awareness to give full play to their subjective initiative to obtain knowledge, find answers, improve perceptual and rational understanding, so that users deepen the concept and develop new associations, which means that VR can inspire creative thinking .

2.2 Application of VR technology

Immersive VR technology has been applied earlier in the foreign architectural community, mainly in the direction of virtual city system research before. For example, the virtual city simulation system in Los Angeles is considered to be one of the most successful virtual city simulation systems in the world.

The application of VR technology in the field of education is also a leap forward, it creates a self-directed learning environment, from the traditional full classroom learning style to a new type of independent learning, with interactive features. In the application in universities, many universities have built virtual reality research rooms one after another. For example, Beijing University of Aeronautics and Astronautics has set up applications in distributed flight simulation, Zhejiang University is doing virtual planning and virtual design in architecture, and Tsinghua University is doing virtual research on proximity. Immersive VR technology can provide students with a more realistic learning environment than the boring theory in books, in the immersive virtual space to feel the light, scale, space will be more interesting and vivid, while faster to grasp the theoretical knowledge learned, apply it to practice.

3 COMPOSITION AND ANALYSIS OF VIRTUAL TEACHING SCENARIOS

3.1 Virtual teaching scene composition

A virtual scene is an environment built in a virtual world by computer software with the support of virtual reality technology in order to realize virtual reality technology. As an important part of virtual reality technology, virtual scenes are realized through high-performance computers that build scenes in a virtual environment. Virtual reality technology is to bring the user to the set scenario to realize the experience from a first-person perspective. Unlike traditional virtual scenes, virtual scenes in virtual reality technology are a series of user-centered virtual environments built to imitate reality, so that virtual scenes are generally the same as real scenes, and all elements of the real environment can be reflected in the virtual scenes. In general, the virtual scene is composed of three major modules: static environment module, dynamic module and human-computer interaction design module. The virtual scene composition is shown in Figure 3.

3.2 Construction of an architecture teaching platform based on VR technology

The content of this paper mainly discusses the teaching of architectural design should be specific, according to the current market application prospect and the richness of supporting software and other influencing factors, choose to use Autodesk Revit as the main core modeling software, building space performance analysis software to Ecotect as the main.

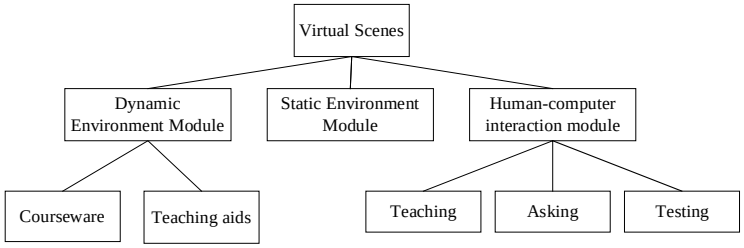

Figure 3 Virtual teaching scene composition

VR common build: Mars by the domestic company Glory City released a effects, animation production software, open VR function can be real-time rendering of the scene. The software simulates a person walking is achieved by constantly changing the position in the scene, press the control handle, the handle in the scene will shoot a blue parabola, the final point of the parabola is the next time to stand, but due to the limitations of the helmet display connected to the wire, can only walk within a certain range. To sum up, the choice of Mars released by the City of Light for VR scene building software.The model format saved natively by Revit software is RVT, which supports exporting models in FBX and DWG formats for interactive design, while the model formats supported by Mars software are SKP and FBX, so the FBX format was chosen as the model conversion format for both software.

Due to the limitations of software and hardware development, Mars only supports importing models with no more than 2 million faces at this stage, so the FBX format model exported by Revit needs to be collapsed in 3D MAX to streamline the number of faces of the model, as follows.

Step 1: In the 3D view interface of the Revit software, open the Revit 3D model directly in 3Dmax by means of a scene file through the Suit workflow, which ensures that the materials of the model created by Revit are retained. Step 2: Process the model through the Quick Collapse plug-in to reduce the number of model faces. Step 3: Export the model in FBX format.

4 THE SPECIFIC APPLICATION OF VR TECHNOLOGY IN ARCHITECTURE TEACHING

VR technology mainly intervenes in the scheme design from two aspects: general plan layout and building form design.

Building orientation design is mainly based on sunlight analysis, solar radiation analysis and ventilation analysis. The best building orientation should not only meet the requirements of sun shading and sun protection in summer, but also ensure a long sunshine period in winter, and

should consider the dominant wind direction in winter and summer, so as to reduce the penetration of cold wind in winter and reasonably organize the use of "through wind" in summer. The choice of building orientation should also consider the reasonable use of the surrounding landscape resources, the use of VR technology, the building orientation of the surrounding environment faced by an intuitive display, to avoid the building facing a bad landscape.

Building spacing design is mainly based on sunlight analysis and ventilation analysis. The optimal spacing should ensure that the buildings are not blocking each other while saving land; it should also ensure a good outdoor wind environment, such as increasing the building spacing along the airflow direction or changing the layout to obtain a larger wind incidence angle. VR technology can be used to visualize the shadow blocking situation between buildings. In addition to meeting the requirements of sunlight and ventilation, the spacing should also take into account the psychological feeling of people, too much spacing will cause a sense of emptiness, and too little spacing will cause a sense of oppression and visual interference, because the psychological feeling can not be quantified, can not be described by specific values, so the spacing of buildings can be judged reasonably by experiencing in VR scenes, as shown in Figure 4.

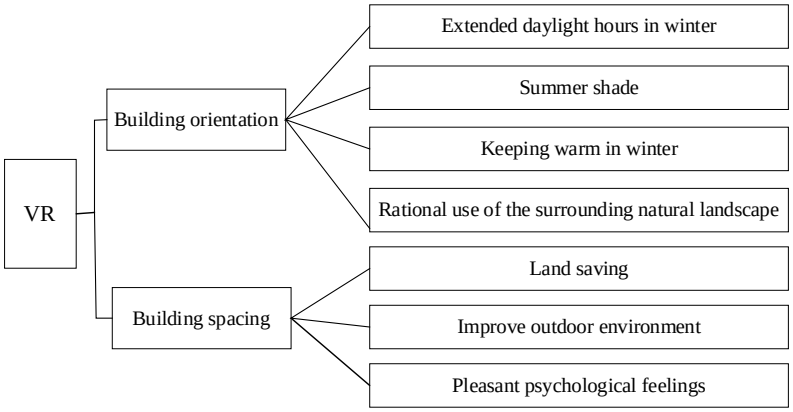

Figure 4 Application of VR technology in general layout design

The outdoor wind environment and indoor natural ventilation of the building is one of the important considerations in the process of green building design. The building shape has an important influence on the indoor and outdoor wind environment of the building under the condition that the surrounding building environment is determined, which can be said to be a key factor in determining the indoor and outdoor wind environment of the building; at the same time, the building shape design also affects the overall energy consumption of the building, and BIM technology can be used to further simulate the analysis and select the optimal shape design.

In the Revit software work interface, architects can observe the 3D model from any angle, whether it is a local detail or the whole, so it is easy to control the overall effect. The application of VR technology can more intuitively show the rationality of the building shape in the project's surroundings, such as whether it has a "sense of oppression" on the surrounding buildings. The 3D building model is shown in Figure 5. Figure 6 shows a building designed from a VR perspective.

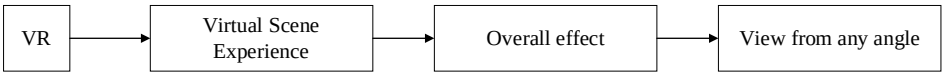

Figure 5 Application of VR technology in the design of architectural forms

Figure 6 3D view of architectural design display

5 CONCLUSION

Virtual reality technology can play its key technical value in architectural design teaching, which can improve the teaching mode of architectural design, solve the problems of unclear positioning in architectural design, setting classes according to people and detaching from practice, and realize the integration of "art" and "architecture". The integration of "art" and "architecture" allows students to understand the characteristics of products from a more comprehensive perspective in the virtual space, realizing a more real-time and efficient teaching mode and reducing the cost of practice. Through the actual operation of students in the virtual environment, teachers can also have a clearer understanding of students' learning status and learning effect, and have a more intuitive understanding of the teaching results. The construction of virtual environment is a big project and requires certain professional skills and talents to support, so more efforts are needed to apply virtual reality technology to industrial design teaching.

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