Experiment Research and Realization Core Exploration of Multimedia Teaching System Based on VR Technology

Siqi Tang^(✉)

Chongqing College of Architecture and Technology, Chongqing, China
1760217461@qq.com

Abstract. At this stage, in the actual experimental teaching process, due to the limitations of school funds, learning venues and other aspects, students cannot practice multiple times, and some experimental venues cannot realistically restore reality, which will directly affect the efficiency of experimental teaching. The use of VR technology to construct virtual experimental scenes can effectively solve the problems existing in experimental teaching. In this research process, it is necessary to study the main points of multimedia experimental teaching design from the application status of VR technology. In the design, it is necessary to consider the design of the hardware system and software system with VR technology as the core, and at the same time, it is necessary to give full play to the advantages of the computer and information platform, build the experimental scene of the multimedia teaching system, complete the design and implementation of the experimental scene and interactive function, and carry out the experiment. Teaching lays a solid foundation.

Keywords: VR technology · multimedia teaching · experimental system · core technology VR

1 Introduction

Virtual reality technology has unique advantages, in the real environment can use multimedia system to complete virtual experience, bring users real feelings. This characteristic determines that the virtual reality technology can be fully assessed in the multimedia experimental teaching system. In the actual teaching process, because of the restrictions of school funds, learning venues and other aspects, students can not fully practice, and some experimental sites can not realistically restore the reality. In this case, it will directly affect the efficiency of experimental teaching. Using VR technology to construct virtual experimental scenarios can effectively solve the problems existing in experimental teaching. In the process of this research, the specific application of the experimental teaching system was mainly analyzed, and the experimental scene of the multimedia teaching system was constructed while mastering the characteristics of VR technology, which laid a solid foundation for the experimental teaching.

2   Overview of VR Technology

Virtual reality technology (VR technology) is a new type of technology that applies computer technology. VR technology can generate a realistic visual, auditory and tactile integrated virtual environment during use. Objects in the virtual environment interact with each other, so that users can have realistic feelings and experiences. With the continuous development of computer technology and network speed, the development of VR technology is becoming more and more mature, and the application of VR technology is gradually developing towards the whole field. In education and teaching, the application of VR technology can provide a wider space for teaching, especially in the process of experimental teaching using VR technology to build a virtual experimental teaching platform, which can realistically build experimental spaces and scenes, and conduct interactive operations for students possible. VR technology can enable people to explore more unknown worlds across time and space, and enable humans to acquire the sense of vital signs. From this aspect, VR technology can not only expand the space of human physiological activities, but also promote human knowledge innovation. [1].

At present, in the process of applying VR technology, its main application types in the experimental teaching system include the following: First, roaming applications. This application is mainly used to browse virtual scenes. The extensibility, mobility and reusability of virtual scene roaming are relatively strong, and the roaming process has strong authenticity, which is its main feature. However, the interaction with virtual objects in the environment is relatively weak [2]. Generally, the virtual scene roaming mainly includes two types: virtual virtual scene roaming and virtual reality roaming. Among them, the main feature of virtual virtual scene roaming is that a relatively large group of 3D models needs to be created during browsing. In order to ensure the fidelity, the technical requirements for the actual scene, texture, scale and modeling are relatively high. The advantage is that it is more flexible and simple to control the scene, can complete collision detection, and can interact with virtual objects at the same time. The current application is also relatively common. Second, display applications. This application mainly refers to the display method of panoramic objects simulating a single object, and the displayed objects are divided based on the angle of creating the model, mainly including virtual objects and virtual virtual objects. In the process of virtual physical research, it can be regarded as objects that can be observed or photographed by human eyes, such as experimental instruments, stationery, computer equipment, tables, chairs and benches. These are all virtual objects; and virtual objects are actual existences that cannot be observed by the human eye, or objects constructed through modeling, which cannot be photographed and recorded, such as the molecular structure of certain chemical elements, macrocosmic galaxies, Biological viscera. Under normal circumstances, virtual objects cannot be moved. Once they move or deform, they need to be driven by external forces. While virtual objects can move or remain stationary, such as dynamic atomic models and simulation of outer electrons' operation. Third, operational applications. This is the main type used in the construction of experimental scenarios for multimedia teaching systems. The operational type needs to be designed based on the knowledge of the experimental operational type in the design process. In the operation-type design process, it is necessary to complete the design of the operation panel device, and to ensure the authenticity of the operation process and the operation panel in the

virtual environment. The operation panel especially emphasizes the fidelity of virtual design, and has high requirements on interactivity. Operational applications can simulate real-world operations [3].

The key technologies of virtual reality include dynamic environment modeling technology, obtaining three-dimensional data of the actual environment to build a virtual environment, and building a virtual environment model according to actual needs. For example, before room decoration and design, the virtual environment model can be used to build a house structure and decoration effect model, so that designers can have a more specific understanding of the room decoration scheme. In addition, designers can use the virtual environment model to design a virtual room, change the position in the room, and observe the decoration effects from different angles. Design time can be solved, and the use of virtual environment models can save the cost of making physical models. The real-time 3D graphics generation technology should ensure that the refresh rate of the graphics is not lower than 15 frames/second, and the optimized 3D graphics generation technology should preferably be higher than 30 frames/second. With the development of stereoscopic display and sensor technology, the interaction ability of virtual reality has been improved. At this stage, it is necessary to conduct more in-depth research on mechanics and tactile sensing devices, and continuously enhance the tracking accuracy and tracking range of virtual reality equipment. System development tools to find suitable occasions and objects, improve production efficiency, and research virtual reality development tools to practically upgrade product quality. The system integration technology in virtual reality technology can integrate a large amount of perception information and models, including information synchronization, model calibration, data conversion management model, identification and synthesis technology.

3   Status Quo of Multimedia Experiment Teaching

Experimental teaching mainly uses experimental methods to intuitively understand new things and new knowledge. As a relatively special teaching form, in the process of experimental teaching, more emphasis is placed on cultivating students' practical ability. Especially in the process of recognizing and understanding new knowledge and new things, teachers need to use experimental means to enable students to experience and feel, and to improve students' understanding of knowledge and things. In the specific experimental teaching process, teachers generally use experimental demonstrations to concretize and visualize abstract knowledge. Students can master new knowledge more quickly through their own operations and integrate knowledge into practice. So as to cultivate students' ability to use the knowledge they have learned to solve practical problems. However, in the actual teaching process, due to certain limitations in other conditions, it is impossible for students to complete the experimental operation multiple times, which will affect the efficiency and quality of experimental teaching to a certain extent [4].

The multimedia teaching system experiment is an important part of the current development of modern educational technology. The equipment of the multimedia system is relatively expensive. In addition, important equipment such as video booths are fragile objects. Frequent improper operation may lead to failures and affect the performance

of the equipment. Use effect, and will lead to increased investment costs. Therefore, in the process of carrying out the experiment of the multimedia teaching system, many schools conduct it in groups, which directly limits the time for students to operate the equipment. The experimental operation level of some students is not high, which affects the experimental teaching level of the multimedia teaching system [5].

4 Main Points of Multimedia Experimental Teaching Design Based on VR Technology

In the process of carrying out multimedia experimental teaching based on VR technology, it is necessary to ensure that all participants in the experiment can share the experimental scene and experimental rules, and at the same time participate in the experimental process through the network, so as to increase the frequency of students' practice and operation, and prolong the students' experiments. time of operation. The virtual laboratory based on VR technology needs to ensure the design effect from the following perspectives: First, the design of the information base system needs to be completed to ensure that the information base system can store the simulation information presentation conditions, boundary conditions and experimental result information. Second, to ensure that the designed server can handle a large number of simulation operations and information [6]. Third, in the design of processing software, it is necessary to ensure that it has the functions of information processing and analysis and storage, and to visualize different information processing links to ensure the reliability of the simulation software system.

At this stage, the web-based operation management mode can provide a platform for the development and design of the virtual laboratory. The browser computing mode based on the web server is the main mode for realizing the functions of the virtual laboratory. During the construction of the laboratory system, it is necessary to The virtual experiment software is embedded in the Web page, and the client can directly access the page content of the browser Web server. The specific design structure is shown in Fig. 1.

In the system design process, its main core is the software design process of the server-side computer virtual research experiment system, which mainly includes I/O interface module, conversion driver module, advanced application module and other centralized software modules. It mainly manages various operations in the experimental process. As the core link of the entire virtual laboratory system, software plays a vital role in the construction of the virtual experiment system and the processing of experimental results. It is also the key content that must be paid attention to in the design process of the virtual experiment system. In the design process of the hardware part, it is mainly to complete the hardware design work of instruments, measurement units, information acquisition cards and so on. The design of these hardware requires in-depth analysis of the virtual experiment mode, collecting the information of the measured unit or instrument to the computer, and using the hardware to feed back the instructions issued by the computer to the instrument of the measured unit, so that the corresponding operation requirements can be realized. [7]. The application layer is the client of the virtual learning platform. Through the virtual learning environment constructed based on VR technology, with the
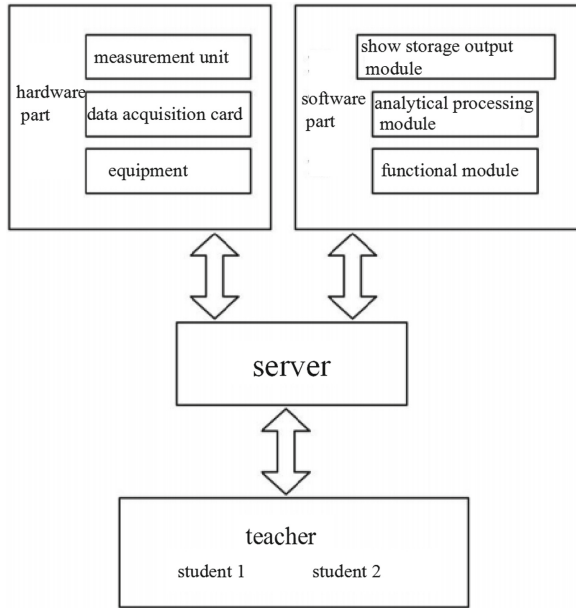
Fig. 1. The structure of the virtual research laboratory

help of the device terminal, students can interact with the virtual elements in the learning environment in real time.

The application layer of VR virtual learning platform includes basic theoretical platform, practical training platform and material management, so that knowledge and technology can be learned intuitively in a virtual learning environment, and a network experiment environment is built to help students conduct practical training operations and track records. Material management platform Help teachers manage network devices and update knowledge bases. The convergence layer of the VR virtual learning platform can provide business interfaces, feedback training data, access related network projects through various project interfaces, connect system data and VR systems through VR sensor interfaces, provide platform directory services, and realize real-time data processing and other functions. The data layer of the VR virtual learning platform can store and manage data, including user data, training data, knowledge base, network equipment, and student operation data. For example, in the teaching of "Web3D in Teaching", teachers use VR virtual Technology leads students to understand the dynamic process of molecular, atomic and mechanical motion, helps students experience the space of three-dimensional imaging, and uses CAI to focus on learning key and difficult knowledge, creating an interactive teaching environment with students as the main body.

In the software design process of the virtual research experiment system, the software is mainly based on the modular and hierarchical structure, and plays different roles in the system.

First, the main function of the driver conversion module is to manage operations and computer resources, and to complete functions such as memory DNA transfer and CPU

interruption. In order to minimize the initialization time in the experimental system and improve initialization efficiency, it is necessary to The application effect of the driver replacement module is comprehensively analyzed to enhance the compatibility and matching degree of different parts in the system. At the same time, it is necessary to ensure that the resources of different hardware instruments in the experiment can fully play their roles and improve the comprehensive utilization efficiency of each functional hardware. The production conversion driver module generally provides the function conversion and driving of the instrument to the user to ensure that the general functions and specific functions can function normally [8].

Second, the interface I/O module is the continuation module in the design process of the virtual research experiment system, and is an important bridge connecting control and command transmission. The main function is to realize the information communication between the experimental instrument and the computer module. The main direction of virtual instrument in the development process is to improve the information dissemination speed of the interface hardware to ensure its reliability, security and stability. Therefore, in the design process of the interface module, it is necessary to ensure that it can work efficiently and stably, so as to ensure that the software and the upper-layer application module and the lower-layer conversion driver module can be effectively connected. This is an important part of the research process of virtual research experiment system.

For the conversion drive module and the interface module, the advanced application module generally stays in the computer and is directly called by the computer. This module is directly oriented to designers and specific users of experimental projects. The advanced application module can generally directly use software programming to realize a certain function of the experimental instrument, or directly replace the function of an original experimental instrument in the virtual experiment system. In order to facilitate the acquisition of the corresponding experimental results, the interface can be used to collect signals and information from the unit under test of the original instrument and enter the computer, and conduct in-depth analysis and processing of these information and signals. mode storage or direct display output. Using logical design and structured design, a relatively complete experimental project system can be formed.

5   Experimental Function Design of Multimedia Teaching System Based on VR Technology

5.1   Development of Virtual Experiment Scenarios

The VR technology-based multimedia teaching system experiment is mainly aimed at students of different majors in the public course of educational technology at the basic stage of the university in the design process. The virtual experiment scene needs to be as close as possible to the actual experimental teaching site during the design process. A consistent environment can improve the efficiency of students' learning. In the process of this experiment, it is necessary to complete the construction of the experimental teaching of the multimedia system, the teaching venue and the laboratory scene of the public course of teaching technology based on the experimental scene.

In general, the main modeling methods in the virtual scene construction process include the following two: First, manual code establishment. This method directly utilizes the modeling statements in the programming language to model the specific location of the model in the entity space. In the specific modeling process, it is necessary to use three-dimensional coordinate points to accurately label the mutual positional relationship of objects in the virtual space [9]. This modeling method requires the designer to have an accurate and comprehensive understanding of the programming language, and at the same time to have a comprehensive scientific grasp of the spatial position of the object, in order to ensure the modeling effect. Because the programming language is directly used for modeling, the virtual scene established is relatively simple and short, and the running speed of the scene is relatively fast, which is suitable for use in some relatively simple rule object modeling. At present, in the process of modeling directly using programming language, there are special basic geometric nodes in VRML to construct three-dimensional shapes, and at the same time, the appearance and material of the shapes can be designed in a targeted manner. In the process of constructing the virtual classroom, the design is mainly based on this modeling method. Second, the modeling work is carried out through professional modeling software, such as 3Dmax, which can obtain scene models according to the specific needs of the design. Under normal circumstances, when using professional modeling software for modeling, it is possible to build more complex three-dimensional objects, mainly because the software has corresponding plug-in support for exporting to virtual reality software, which can export three-dimensional geometry in different formats. For example, 3D max has a plug-in output in VRML format during use, and a plug-in can also be installed in the software to output the X3D file format, which is convenient for using professional virtual reality software to carry out the preparation work. The amount of 3D volume data generated by this method is relatively large, and the model body is also more complex. Therefore, it is necessary to complete the data work to ensure the smooth operation of the model. In the process of establishing the virtual experiment scene model, its overall structure is shown in Fig. 2.

5.2 Experimental Interaction Design

In the process of experimental interactive function design, the design needs to be carried out from the following perspectives: First, to meet the interactive function requirements of the video display stand, the lens and double walls of the food display stand can be active in a specific area, mainly with fixed The rotation axis point is the basis for activities, or the rotation angle is determined within a fixed range. The design of interactive functions is mainly realized by using VRML, and 3DMAx can also be used for virtual design. In addition, there is VRML language modeling. It is necessary to clarify the three-dimensional coordinates of the video display platform in space. In addition to the spatial position coordinates, there are also the transformation coordinates of the spatial rotation direction. Therefore, the code for realizing the interactive capability of the video display stand for VRML is more complicated, and it is easy to jump. Using the technical animation design function of 3DMax, you can set the animation of the active point in 3DMax to build the motion function at a specific time, and then import it into the VRML software to complete the interactive function design. This can ensure that the animation
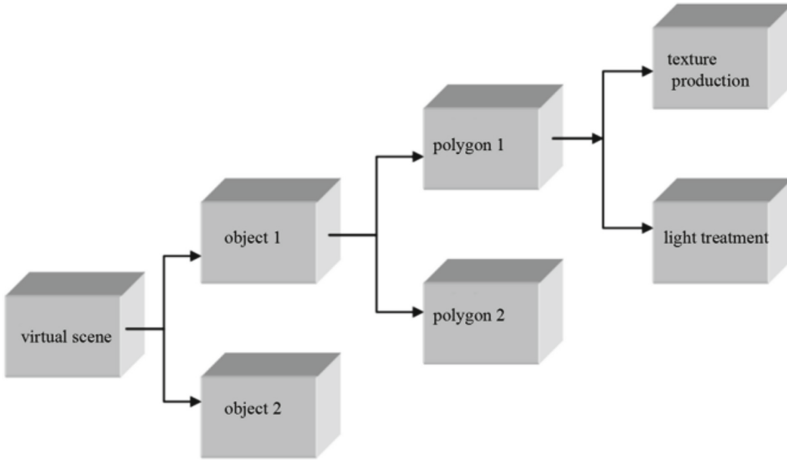
Fig. 2. The process of establishing the virtual experiment scene model

runs in a specific situation, and the animation can be performed after clicking to ensure the intuitiveness of the picture [10].

The key code in the implementation process is as follows:

DEF CylinderO1-TIMER TimeSensor {loop TRUE enabled FALSE

cycleInterval 3.333}

The main function of TimeSensor is to play the role of time sensor to control the speed of movement of objects.

DEF xiabie-POS-INTERP PositionInterpolator{

Key[0, 0.3, 0.33, 0.51, 0.54… 0.57, 0.6,]

keyValue[38.47 3.899-3.493…14.93 3.899-37.74]},

DEF xiabie-ROT-INTERP OrientationInterpolator{

Key[0, 0.3, 0.33,… 0.51, 0.54, 0.57, 0.6,]

keyValue[1 0 0 0, 1 0 0 0,… 0 -1 0 -1.129,]}

Second, meet and realize the interactive function design of video display platform lighting. Usually, in the design process of the video display stand, light bulbs should be set on the bottom plate and both arms. If the image projected by the object on the video display stand is relatively dark, you can directly turn on the double-wall light to improve the brightness of the display stand. The light bulbs on the bottom plate of the display stand are generally used in slide switching, which can improve the clarity of the slide images. Use the buttons on the control panel to complete the light bulb control work. After turning on the light bulb, you can keep the light bulbs on both arms off, turn on the bottom light, and press again to complete the two lights off.

6   Conclusions

All in all, in the application process of the experimental teaching system, a deep grasp of the application status and specific application value of VR technology can improve the overall application level of the experimental teaching system to a certain extent.

However, it should be noted that in the process of experimental teaching design of the current multimedia teaching system, VR technology also has some deficiencies. Only by fully grasping the application points of the type can give full play to the application value of VR technology in the multimedia experimental teaching system.

References

1. Liu Yang. (2019). Experimental Research and Implementation of Multimedia Teaching System Based on VR Technology. Journal of Xi'an University: Natural Science Edition, 22(3):5.
2. Chen Yuanzhang. (2017). Lu Haijun. Experimental Research on Multimedia Teaching System Based on VR Technology. Modern Vocational Education, 000(004):306.
3. Zhang Yuanyuan. (2012). Design and implementation of experimental teaching system for colleges and universities based on virtual reality. University of Electronic Science and Technology of China, 2012.
4. Song Wen. (2020). Design and application of teaching APP based on VR technology. Modern Education Forum, 3(7):19-21.
5. Gao Shuhan. (2018). Reflections on the application of virtual teaching based on VR technology. Audiovisual, (1):2.
6. Wu Weili. (2016). Research on the Teaching Mode of Power System Analysis Based on VR Technology and Knowledge Scenario. Curriculum Education Research: Research on Learning and Teaching Methods, (13):4.
7. Yang Heng, Zhang Xiaoru. (2021). Design of Algorithmic Immersion Teaching System Based on VR Technology. Journal of Jiujiang Vocational and Technical College, (2):3.
8. Wu Yongchun. (2018) The application of VR technology in animation practice teaching. Information Recording Materials, 19(1):2.
9. Huang Yongfu, (2020). Ji Liuxiang. Exploration on the construction of virtual simulation experimental teaching center for logistics management based on VR technology. Experimental Technology and Management, 37(8):5.
10. Wang Zhao. (2020). Research on the optimization design of college network teaching system based on VR technology. Comparative Research on Cultural Innovation, v. 4; No. 139(31):146-148.