Research on Intelligent Campus System Design Based on BIM & VR/AR Technology

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Abstract. With the new form of social development dominated by Internet technology innovation, more and more domestic colleges and universities are applying virtual reality and augmented reality (VR & AR) technology with smart campuses has realized campus The goal of informatization, intelligence and visualization.

1. Introduction
The construction of campus culture with characteristics of universities not only plays a unique role in cultivating talents, but also an important aspect of developing ideology and politics in universities. We can realize the visualized sightseeing of the campus in the virtual environment. Through this project, the virtual campus simulation teaching experiment, the construction of campus safety, the teaching in the field of special education and the visualized sightseeing browsing platform of the campus constructed by using BIM, VR and AR technology. At the same time, this project also involves the construction of campus safety in colleges and universities and teaching in the field of special education, opening up new learning methods for children in the field of special education. The design content closely follows the pace of development of the times, so that college students also keep in mind the importance of campus safety in their daily lives.

2. Overview of Related Theoretical Knowledge

2.1. VR technique
VR technology refers to virtual reality technology, which is fusion, interactive, and immersive. It uses computer-generated simulated environments to stimulate human’s senses of hearing, vision, touch, etc, and uses interactive 3D dynamic views and applications through multi-source information fusion System simulation of physical actions creates a simulation environment for users to engage.

2.2. AR technique
AR technology refers to augmented reality technology. This technology has the characteristics of integration, interactivity, and the addition of virtual objects in three-dimensional space. It applies virtual information to the real world, so that the real world and virtual images overlap and interact each other.

2.3. BIM technique
BIM (Building Information Modeling), also known as building information modeling, is a digital tool that integrates engineering design, construction, and management. The technology has the
characteristics of visualization, coordination, optimization, etc., through the integration of building data information to build a BIM model, strategy, maintenance, communication and sharing of life cycle information to achieve the purpose of improving efficiency and reducing costs[1].

2.4. Smart campus
Smart campus has the characteristics of personalized, cooperative, network-based and intelligent Internet of Things. In other words, it's a more advanced digital campus. Early use of BIM & VR technology for campus modeling, and later the use of VR & AR technology to show the architectural model. Smart campus is a perfect blend of education, scientific research, management and campus life.

3. Virtual Campus Simulation Experimental Teaching
In the face of the epidemic, the concern of countries, society and enterprises for virtual reality is rising rapidly. As the world has changed dramatically, the Ministry of Education has agreed to set up virtual reality majors in universities. This not only shows the unprecedented importance of virtual reality, but also shows that with the help of national policies and trend of the times, the development of virtual reality in China will usher in rapid improvement. What’s more, from the perspective of future development trends, the Ministry of Education's measures for the long-term development of the industry to provide strong support, but also to the VR & AR industry a lot of confidence.

3.1. The construction process of virtual simulation experimental teaching space
The intelligent campus virtual simulation experiment teaching platform uses BIM, AR, VR, database and other technologies to assist the management of virtual simulation experiment teaching, virtualization experiment application, experimental data sharing, etc. to realize the public sharing purpose of virtual simulation education resources. During the epidemic, students have more space to learn and can learn at home. This platform uses Unity3D and other developed software and small programs to realize the design and construction of virtual simulation experimental teaching space. On the basis of the building plan of our school (Tianjin University Renai College), we obtained the data of campus building information by measuring, flying drone records, etc., made a three-dimensional model using the modeling software Revit, then rendered it using the luminion software, and finally added the ground in Unity3D, adding the previously built 3D building model to Unity3D for scenario fusion and adding detailed lighting.
3.2. Virtual Simulation Experiment Teaches the Realization of Space Roaming Technology

You can convert perspectives and scenes with a mouse or keyboard during virtual campus roaming. The characters are animated separately in the 3DMax modeling software, and then the action model is imported into the Unity3D project. Virtual characters can change the direction and rotation angle of the characters with the mouse, and the keyboard controls the movement of the characters from front to back[2]. Among them, the VR virtual campus will merge the scene into a real scene after completion. In addition, the purpose of augmenting the real world through AR technology and equipment is to improve students' cognitive ability and experience in the experimental teaching space, and more, can also realize the roaming technology of the experimental teaching space.

Figure 1. Virtual campus simulation experimental teaching flow chart.

Figure 2. Virtual campus roaming figure map.
4. Campus Security Construction

The project uses VR technology to simulate the fire scene, and the experiencer can intuitively understand the fire emergency escape scene through the virtual reality system, so that the experiencer can train the escape ability, self-rescue ability and emergency survival ability in the fire disaster. VR & AR technology make smart campus systems more realistic and simulate fire scenes, allowing experiencers to learn about fire prevention safety in a relaxed environment.

4.1. Fire simulation system design

4.1.1. Disaster escape plot design. The system uses 3Dmax to create a scene map of the fire, based on Tianjin University Renai College’s experimental building. While the user experiences the fire scene in virtual reality technology, he can also produce the awareness of fire prevention and control in the consciousness of self-control. However, from a 3D point of view, users should not use 3D products for too long, otherwise it will produce vertigo, heavy harm to human health, so in virtual reality technology, the experiencer should randomly produce a starting point.

4.1.2. The action design of the character. Make the character's movements fuller and the design moves more diverse, making the scenes observed outside more realistic and immersive. In terms of character models, 3D Max's existing models are used to skin bones after they are added to them. The animation aspect is processed using motion capture technology and mixed space, and finally, the crafted character is rendered realistic in the technology, making it conform to the character's animation and imported into the engine.

![Figure 3. Fire simulation effect map.](image)

4.2. The fire simulation system is realized

Virtual reality technology to fire simulation to UE4 engine-based, the use of 3D Max for real-world scene modeling, the scene of the various materials using UE4 construction, its code development part of the use of the blueprint programming carried out in the C++ language.
4.2.1. *Scene construction.* The construction of the scene is modeled by the experimental building in the Tianjin University Renai College, and the basic basis of 3D MAX is constructed and then detailed, so as to achieve the effect of fine and consistent with the experimental building of the school. Technically, the 3D Max model will be exported into an FBX format file, then imported into Unreal Engine[3], and finally refined with C++ technology, so that the animation blueprint and blueprint programming to achieve the best results.

4.2.2. *Implementation of the role blueprint.* Let the characters in the experimental building be interacted through the character blueprint. The character blueprint is based on a state machine that sets six states, such as walking, squatting, squatting, standing, jumping, and running, and animates according to the different states. Compared to the state machine of the system, this virtual technology gives the dynamic state machine to the role blueprint and runs from the beginning of the mechanism generation. Change the state of the character from what occurs to the experiencer.

4.2.3. *The implementation of the interaction.* In order for the character to reach the position to play the animation, the Boolean-type properties are designed so that the animation can only be played when the character reaches the position of the trigger. Animation playback is part of the same process as perspective switching, and when it reaches a specified location, its perspective is switched to a preset new perspective through Set View Target with Blend, and finally the bone animation to be played through the Set Visibility node is set to visible and played.

5. *Visual Campus Operations Management*

The application of visual campus is the use of 4D model technology in the field of construction, refers to the campus facilities, dormitories and other buildings, BIM model and construction plan matching the campus facilities, teaching buildings, dormitories and other construction processes through animation, BIM technology to meet the information design into a three-dimensional model and display, but also to meet the digital management of design information.
5.1. Campus operations management
Campus operation and maintenance management is divided into daily operation and regular maintenance management, aiming to ensure that campus infrastructure equipment (such as multimedia equipment, elevators, etc.) in the daily use and management can meet the standards of normal use, to ensure that the surrounding environment and teachers and students are not affected, to provide a satisfactory working environment. Operation refers to maintaining the normal work of campus multimedia and other equipment and completing the expected goals, maintenance refers to the completion of the campus basic equipment within the expected service life of the work. Regular predictive, preventive maintenance activities to ensure that consumables such as campus equipment can be up and running until the end of life is called operations management.

5.2. Operations management
The purpose of operation and maintenance management in BIM mode is to reduce the possibility of failure of multimedia and other equipment through scientific management of campus equipment. Through the Internet of Things and other technologies to BIM model, operation and maintenance management system integration, to achieve the operation and management of equipment on campus. In the campus equipment management mainly includes the campus multimedia equipment, elevators and other equipment monitoring and maintenance. We use BIM technology to enhance the combination of digital management and operations management, managers through BIM technology 3D positioning and high-capacity data storage technology to develop a more reasonable maintenance plan, thereby greatly reducing the failure rate of campus equipment.

5.3. Campus operations management in BIM mode
Using BIM technology, campus equipment operation and operation management, management methods gradually changed into a network integrated management system, the main management objectives have also changed to improve services in the operation and operation process, simplify the process, improve efficiency. Modern campus application management system has changed the traditional management mode, saving people, things, money and other resources, but the problem also comes out, multi-sector cross-management leads to the lack of some information, resulting in the decline of accuracy in the process of information transmission, so that the campus equipment is not running well, maintenance is not timely. Using BIM technology for para methylation modeling, integrating the attributes, life, loss and other information of the equipment to support campus operations management to improve the efficiency of information transmission and store the information of the campus equipment[4]. In campus device management, troubleshooting can be done better by using device loss data in BIM technology.
We need to fully apply BIM-based operation and maintenance management system to improve the efficiency of monitoring equipment on campus, rational use of space, energy conservation, multidimensional management.

6. Teaching in the field of Special
Autism is actually a psychological problem, and the vast majority of people with autism are unable to socialize like normal people and often do not communicate with others for long periods of time. At first some scholars believed that autism was caused by parental education, but as society conducted various tests and more in-depth research on autism, this view was gradually ruled out by the general public, the results of the current study is a neurological disorder in the brain, different areas of the brain can not work together leading to autism.

6.1. Traditional treatments
The traditional treatment of autism is divided into two parts, which are divided into classical behavioral theory and applied behavior analysis, which are mainly based on analyzing the reactions of autistic people after doing things, and extracting data from these reactions as the basis for treating autistic people.

6.2. The feasibility of virtual reality technology to treat autism
There are many benefits of using VR and AR technology to treat autism, first of all, virtual environment can be controlled artificially, according to the skills of daily life to provide a relatively safe environment, so that children through guided learning to explore their own behavior characteristics. VR technology can also be a good way to apply the early childhood experience of autism to everyday situations, because virtual environments can provide an alternative environment in which children can think of early training scenarios in their daily lives. Autism can have some social disorders, but AR technology can be a good emphasis on visual and auditory responses to better deliver messages through the senses. VR and AR technologies can also be customized with personalized treatments that can better engage children with devices for a better sense of immersion\[5\].

Figure 6. BIM Smart Operations Management Platform.
6.3. Virtual reality technology to treat the autistic
Autistic children are interested in virtual reality systems and can improve problems that autistic people are afraid to share with others, according to research. Virtual reality systems divide tasks into different levels, and computers can better exercise children's social skills by setting up virtual characters to better interact with autistic children, a technology that not only restores the environment in everyday life, but also controls the environment to create a harmonious atmosphere to ease the anxiety of autistic children.

7. Summary
In this period of big data, the construction of intelligent campus has promoted the development of China's education, more benefit to campus planning and construction, improve the efficiency and scientific management of campus. To build a three-dimensional digital campus smart campus, and with AR, VR technology combined to achieve a new era in the background of digital campus to smart campus transformation.

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