Review of Digital Campus Construction Led by Virtual Reality Technology

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Abstract: In recent years, the government has issued a series of documents to promote the construction of digital campuses. This initiative serves to encourage the deep integration of information technology and intelligent technology education and digital reform, the combination of virtual reality and campus management is the need for innovative thinking and economic and social development, and then better change our learning style and living environment. The construction of the digital campus is based on virtual reality technology, BIM, GIS, and three-dimensional modeling technology to provide an immersive platform for students, promote the integration of virtual reality technology and education, help teachers, students, and parents to understand all kinds of education information and resources, to achieve their interoperability. From the off-campus environment to the school teaching equipment, teachers to teaching quality certification, and learning, to extracurricular entertainment, opening ceremonies to graduation parties, to bring more efficient, convenient, and safe campus life for teachers, students, and staff in school, and break the traditional information restrictions.

Keywords: Digital campus; Virtual reality technology; BIM; GIS; 3D modeling

1. Introduction

1.1. The background and significance of the thesis topic selection

1.1.1. Background of thesis topic selection

The construction of digital campus is an important task for colleges and universities in recent years. It constantly improves the investment in basic teaching facilities, provides a strong guarantee for improving the quality of education and teaching and management level of schools, and is also an important part of college operation and scientific research personnel training [1]. The combination of virtual reality and campus management is the need for innovative thinking and economic and social development so that everyone can truly enjoy the convenience brought by a digital campus.

1.1.2. Significance of thesis topic selection

The integration of virtual reality (VR), Building Information Modeling (BIM), Geographic Information Systems (GIS), and three-dimensional modeling into campus management transforms educational institutions

by creating immersive learning environments, enhancing resource and information sharing, and streamlining administrative processes. This digital upgrade facilitates flexible, blended learning models, enabling seamless transitions between online and offline modes and cross-platform data sharing, which inform decision-making and improve teaching quality. Additionally, advanced digital systems enhance campus safety and security, while virtual events foster community engagement. Overall, this integration promises a more efficient, convenient, and immersive campus life, breaking traditional information barriers and promoting a connected, inclusive educational environment [2].

1.2. Research status at home and abroad

Virtual reality (VR) technology is a pivotal component of information technology. Initially, VR was primarily utilized in military and industrial applications. However, with the advancement of Internet technology, VR has progressively entered the education sector. Today, VR is widely employed not only in education but also in medical diagnosis, smart cities, and other fields. Its profound sense of immersion and interactivity broadens its application prospects, making it a versatile tool with diverse potential uses [3].

1.2.1. Domestic research status

Compared with European and American countries, domestic research on virtual reality technology started late. With the development of computer technology, somatosensory hardware equipment is gradually updated, and relevant government departments in China actively introduce policies, domestic virtual reality technology research is highly accepted, and some key university laboratories and related enterprises and companies actively participate in the research team [4].

1.2.2. Research status of VR in education

Compared to European and American countries, domestic research on VR technology in China started relatively late. However, with the advancement of computer technology and continuous updates in somatosensory hardware, China has made significant strides in this field. Relevant government departments have actively introduced supportive policies, leading to high acceptance and rapid development of domestic VR technology research. Key university laboratories, along with related enterprises and companies, are now actively participating in VR research, contributing to the growing prominence and innovation in this sector.

1.2.3. Research status in foreign countries

Virtual reality traces its origins to the United States, where Morton Heilig pioneered the Sensorama, the world's first virtual reality hardware device. Initially encompassing hearing, vision, touch, and even taste, virtual reality expanded sensory functions. Later, Heilig patented VR glasses, paving the way for further innovation. In 1968, American scientist Ivan Sutherland designed and created the inaugural head-mounted display, marking a significant milestone in virtual reality's evolution [5].

1.3. Research content
1.3.1. Campus map

Three-dimensional modeling technology can be used to create a comprehensive campus map that details campus locations, surrounding areas, business support, and educational resources. This map marks school buildings and teaching places, providing brief introductions to facilitate understanding of the layout and functions for teachers, students, and visitors. Such a detailed map helps new arrivals accurately find their way around the campus, enhancing navigation and the overall campus experience [6].

1.3.2. Intelligent analysis of campus data

Analyzing consumption data from the canteen can provide valuable insights into students' dietary preferences, allowing for informed recommendations to improve the canteen's offerings. Similarly, examining access control system records can help identify abnormal situations involving students, enabling timely early warning measures and enhancing overall campus management [7].

1.3.3. Campus educational administration management ecology

The educational administration management system showcases the college's achievements and related patents, displaying real-time dynamics on a large screen to provide a comprehensive view of the school's educational status and facilitate effective teaching management. By presenting teaching outcomes, the system highlights the scale of the school, the faculty's size, and student development. Additionally, the platform allows for the submission of project progress, scientific research updates, and college announcements, synchronizing this information with the campus platform for easy access by teachers and students, thereby enhancing the browsing and dissemination of campus information [8].

1.3.4. Campus emergency control platform

The integration of Internet of Things (IoT) technology, big data, and artificial intelligence (AI) can effectively address campus security risks by building a comprehensive emergency management and control platform. This system collects video surveillance data from across the campus and employs intelligent monitoring to detect and promptly alert authorities of any abnormal behavior. It is compatible with dormitory administration and security systems, supporting remote management, rapid response, and the maintenance of extensive monitoring data. This enhances the overall campus security management system, ensuring a safer environment for all.

2. Related research
2.1. Virtual technology in campus management

Combining VR technology with the real school environment revolutionizes traditional recruitment efforts, creating a novel approach to school publicity. A VR panorama allows parents and students to "walk into" the campus virtually, providing an accurate and immersive understanding of the campus scenery and background. By embedding multimedia elements into the panorama, information about the campus, faculty, and club activities can be displayed through graphics, audio, and video, offering a comprehensive and engaging overview of the school.

2.1.1. Immersion

Immersion is the virtual environment created for users in virtual reality technology. As one of its most important features and functions, immersion can directly reflect the level of virtual reality technology.

2.1.2. Interactivity

Interactivity is the degree to which users manipulate objects in the virtual environment, with a more interactive feeling. The most important function of virtual reality technology is the observation degree of the object operation environment, the real-time effect, and the enhancement of user experience.

2.1.3. Multimedia function

Virtual reality technology can distribute virtual environments in diverse formats. These environments feature

three-dimensional elements for interactive experiences and incorporate dynamic audio and graphics for heightened immersion.

2.2. Visual display of campus

Three-dimensional modeling technology is employed to create a campus map, identifying campus locations, road networks, and traffic conditions comprehensively. This map highlights school buildings and teaching areas, providing brief introductions to aid teachers, students, and visitors in understanding the layout and function of the school buildings.

2.2.1. BIM technology

Three-dimensional modeling technology is employed to create a campus map, identifying campus locations, road networks, and traffic conditions comprehensively. This map also highlights school buildings and teaching areas, providing brief descriptions to aid teachers, students, and visitors in understanding the layout and functions of the campus buildings [10-11].

2.2.2. GIS technology

GIS is a data management system utilizing computer hardware and software to facilitate the measurement, collection, storage, analysis, and manipulation of spatial geographic information data [12].

2.3. Digital campus construction

By breaking away from traditional campus life, digitalization presents the campus in a convenient digital format for teachers and students. This transformation involves converting complex and dynamic information into measurable numerical data, visually showcasing campus situations and data through three-dimensional digital images, and enabling quick access to information.

A digital campus streamlines cross-departmental operations, bypassing tedious processes and offering convenient access services and management channels. It establishes data-sharing mechanisms among various departments, eliminating "data islands" and enhancing the utilization of school data.

3. Research status dilemma

3.1. Research status

Virtual reality technology combined with BIM, GIS, and 3D modeling technology has introduced groundbreaking advancements in digital campus construction, yielding notable research outcomes and application progress, including virtual classrooms, libraries, and distance education. However, further exploration and enhancement are necessary [13].

While 3D modeling technology has reached a level of maturity, improvements are still needed to generate high-quality, complex models in real time, enhance refresh rates, and provide users with smooth, convenient, and immersive experiences. To meet the demanding performance standards of VR devices, new technologies for 3D graphics generation and display are under development [14].

3.2. Research difficulties
3.2.1. Technology integration is difficult

Integrating BIM, GIS, and 3D modeling technologies with VR in campus construction is pivotal for achieving a cohesive and immersive campus experience. This integration requires careful attention to ensure the

compatibility and stability of each software platform. Additionally, factors such as data format and interactive information circulation must be considered. Harmonizing these technologies involves facilitating seamless data exchange and interaction within the VR environment, allowing for the optimized utilization of their unique advantages and application scenarios. By addressing these considerations, a new model of campus experience can be created, enriching education and enhancing the overall campus environment [15].

3.2.2. Complexity of data acquisition and processing

Building a digital campus requires extensive data collection, processing, and management, which can be challenging. Professional equipment and technology are needed for data collection, cleaning, integration, and modeling. Maintaining real-time updates adds further complexity. Establishing an efficient and convenient data management and update mechanism is crucial to address these challenges and ensure the accuracy and relevance of the data used in the digital campus environment.

3.2.3. High requirements for hardware equipment and network infrastructure

Establishing a digital campus involves various stages, including preparation, data collection, processing, modeling, platform building, and maintenance. Each step requires high-performance hardware support and a stable, high-speed network. The basic design requirements are demanding, and the update and maintenance of hardware equipment pose significant challenges throughout the process.

3.2.4. User acceptance and usage habits

Encouraging quick acceptance and use of virtual reality in the digital campus requires comprehensive user training, engaging demonstrations, and gradual integration into campus activities. Providing support, addressing concerns, and showcasing the benefits help users embrace this innovative technology for enhanced learning and engagement [16].

3.2.5. Security and privacy protection issues

In the construction of a digital campus, the protection of user privacy can not be ignored. A large amount of user data is generated in the process of model establishment and user use. How to ensure that the data is not illegally obtained and abused, it is necessary to establish an effective security protection mechanism and privacy protection when designing the program.

4. Research and innovation

With the vigorous development of the metaverse, digital campus construction combined with virtual reality technology, BIM, GIS, and 3D modeling technology presents an unprecedented innovative prospect [17]. This innovation not only brings intelligent and efficient changes to campus management but also provides users with an immersive experience.

In digital campus construction, safeguarding user privacy is paramount. The generation of substantial user data during model establishment and usage necessitates measures to prevent illegal acquisition and abuse. Establishing an effective security protection mechanism and privacy protection protocols within the program design is essential to ensure data integrity and user confidentiality [18].

5. Conclusion

Virtual reality technology holds significant importance in education informatization and aligns with the current development trends. Through the integration of virtual reality, BIM, and GIS into digital campuses, intelligent management and development can be achieved, enhancing efficiency and quality in school management. This integration saves resources and provides convenience for teachers and students, ultimately ensuring more efficient campus construction. While virtual reality technology brings convenience, it also presents challenges such as data security and privacy protection. Therefore, ongoing optimization efforts, strengthened data confidentiality measures, and continued promotion of its development are essential.

Disclosure statement

The authors declare no conflict of interest.

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