Performance and Application of Virtual Reality Technology (VR) in Digital Protection of Buildings

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Abstract. With the rapid development and continuous improvement of computer technology, more and more computer technology has become an indispensable element in social life, especially the emergence of virtual reality technology (VR), which has a very comprehensive digital performance and is involved in all major industries. VR has a very broad prospect. It can be used to perform digital performance through 3d model mode or 2d panoramic picture mode, and it can also be used in many industries through the characteristics of virtual reality technology itself. This paper mainly narrates the architecture and environment of ancient buildings and ancient villages, as well as the digital performance and application of virtual reality technology, to show the trend and number of the arrival of digital era of virtual reality technology in the near future.

1. Introduction
In recent years, computer technology has provided a new mode of digital protection for ancient buildings, sites and ancient villages. In particular, the emergence of virtual reality technology has put digital protection into interactive mode, and the application of virtual reality in the restoration of historic sites and ancient villages has been widely concerned.

2. Preliminary preparation for digital protection of buildings

2.1. Determination of the scope of digital protection of buildings
As for the scope of digital protection of buildings, a questionnaire was conducted on the Koguryo Ruins. The respondents were mainly young and middle-aged, because they are the main force of tourism. The scope of digital protection was determined according to their interest in the architectures in Koguryo period.
Through the questionnaire, 47% of the people are interested in Wandu mountain city, so this paper identifies Wandu mountain city as the subject of the digital protection of ancient buildings in Koguryo period.

Marudu mountain city is a city built on the top of the mountain by the Koguryo people. It is not only the military garrison city of the internal city, but also the king's capital in the middle period of Koguryo. The heritage site is widely distributed, rich in cultural and folk values, and records a little-known history. In 2004, Koguryo capital city, Marudu mountain city and royal mausoleum were added to the world heritage list.

2.2. Basis of digital protection of buildings
For the ruins of Wandu mountain city, after thousands of years, most of them are broken walls and rammed earth. The lack of historical data makes it difficult for digital protection, which takes a lot of time to solve this problem. This papers aims to conduct the study through literatures and existing sites.

3. Technological support for digital protection of buildings
The virtual reality technology needed in this paper is mainly implemented by UNITY. It is a multi-platform game development framework, and the UNITY engine is not limited to game production, but also covers education, architecture, virtual reality and other areas.

Virtual reality, short as “VR”, refers to the combination of a variety of modern advanced technologies, so as to produce an immersive interactive system relying on the media such as VR controller or helmet and through computer technology. Through virtual reality technology, people can simultaneously experience the environment with their vision, touch and hearing, as if they were in the real environment of simulation. Virtual reality technology is a forward-looking information technology, and there are relatively mature products presented at home and abroad, which has achieved very good results.

In this paper, 3DSMAX is adopted to realize the digital protection model of buildings. Three models with different precision need to be made for each building- the high-precision model, the medium-precision model and the low-precision model. Through the UV demolition, mapping, baking normal and specular mapping technology of the low-precision model, the model is completed. The following is the schematic diagram of the technological process of the digital protection of the building:

4. Digital protection of the city gates and walls

4.1. Terrain making
To make the digitally protected terrain more realistic, we first need to restore the terrain data. According to the coordinates of Wandu mountain city, the corresponding terrain information was found in Baidu map as reference to make the terrain simulation. In addition, using the UNITY engine's vegetation system, the terrain is added with maps, grass, trees, flowers, etc., and the sky, fog, lighting, camera, and character perspectives are added with the UNITY engine.
4.2. Model input
The building model made by 3DSMAX was input in the UNITY engine, and the locations of the buildings were restored at the same time. During model making, the faces of the model should be strictly controlled. We should try to use low-precision model to process, and pay attention to the unit settings, to unify the whole scene. Static art resources export model information to the FBX format, and dynamic art resources export PSK format through the ActorX plug-in.

![Figure 4 Model import](image)

4.3. Model collision
The model made by 3DSMAX is free to enter without blocking. When VR virtual interaction, to achieve absolute simulation, the first thing is that the character does not have the phenomenon of collision. Using the paintbrush tool in UNITY creates BlockingVolume to crash objects around the building. There are two modes of model collision in UNITY engine. One is, regular graphics such as rectangle, splicing collision mode, and the other is, through the shape of the model itself, making collision.

![Figure 5 Terrain and model collision display](image)

4.4. Display of digital protection of buildings

![Figure 6 Scene VR demonstration](image)
5. Conclusion
The technology of digital protection of buildings is to realize all-round realistic simulation of cultural sites and ancient villages that have disappeared through the three-dimensional technology of computers. At the same time, the latest virtual reality technology is added to realize panoramic simulation browsing through the mouse, keyboard (network) and VR headset (in the scenic spot). As a meaningful attempt, this paper hopes to provide reference for the digital protection of similar historical sites and ancient villages, and contribute to the protection of cultural relics and cultural heritage of the country.

Project
The 2018 "13th five-year" social science research project of Jilin province department of education "digital protection of traditional Chinese villages" -- a case study of "Kanto folk village, Luhuan village, Donglai township, Tonghua county, Jilin province", project no.: JJKH20181327SK, host: Huang Jianfeng.

The periodical achievement of the "digital protection and research of cultural relics based on virtual reality technology -- a case study of the puppet Manchu Palace Museum", the social science project of the "13th five-year plan" of the education department of Jilin province in 2020, project no.: JJKH20201314SK, host: Gao Hua.

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