Research on Integration of Digital Protection of "Cultural Relics" Architecture and Virtual Reality Technology

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Abstract: With the rapid development of science and technology, virtual reality technology has increasingly important value and significance in various fields. At present, the traditional digital protection techniques of cultural sites are through manual repair, construction and restoration, or in the form of text, pictures, film and television materials to protect the site. These digital protection methods are too simple, the data is not stored for a long time and is particularly vulnerable to damage. Therefore, it is urgent to find and apply a suitable digital technology. This paper is a study of the integration of digital protection of "cultural relics" and virtual reality technology.

1. Introduction
Due to the use of modern construction techniques and materials for restoration work, in a sense, the protection of ancient buildings is the process of secondary destruction of the site. Some ruins only have some parts or no longer exist, and only have written records. Such ruins cannot be repaired manually, and the paper text and image data are not easy to save. \cite{1} With the continuous development and application of science and technology, the continuous research and development based on virtual reality technology, the realization of digital protection of ancient buildings has become an important part of cultural protection. Affected by the current trend of digital protection technology exhibition, the construction of a modern, efficient, scientific and technological ancient building protection system has become an important research topic in the industry. \cite{2}

2. Digital protection software application
Virtual reality technology, when constructing 3D models of ancient buildings, usually has multiple choices, in which different software achieves different functions. Among them, SketchUp software is usually used to construct relatively simple ancient building graphics. There are relatively few software commands, and it is easy to learn and operate. The drawing format is more stylized, while saving a lot of PS retouching work. Rhino software is extremely scalable, and can be integrated into several parameters for logic programming. It is mainly used in the modeling of ancient building product forms and curved ancient buildings. Maya software manufactures shaped and nonlinear ancient buildings. 3Ds Max software's home model library is very complete, which can be used for indoor rendering. The internal decoration of ancient buildings can be applied in it, and it is the most widely used. The drawing speed of Revit software is extremely fast, and the data statistics are included in the software, and its data management and processing capabilities are very powerful. The digital protection of ancient buildings is usually carried out in combination with the application concept of BIM technology.
As shown in Table 1, the functions and focus of all modeling software are different. In different ancient buildings, the required virtual reality technology needs to be organically integrated to achieve the best expression effect. Figure 1 is a 3D model of an ancient building constructed using Revit software.

Table 1 Common modeling software and functions

| Common modeling software name | Functions and features |
|-------------------------------|------------------------|
| SketchUp                     | There are relatively few software commands, and it is simple and easy to learn, and the operation is simple, which is conducive to the construction of simple geometry. The drawing form is more stylized, while saving a lot of PS retouching work. |
| Rhino                        | The software is extremely extensible, and can incorporate several parameters for logic programming. It is mainly used in the modeling of industrial product shapes and curved buildings. |
| Maya                         | Maya software manufactures shaped and non-linear buildings. |
| 3Ds Max                      | The 3Ds Max software home model library is very complete; we can use the home model library for indoor rendering. And it is the most widely used. |
| Revit                        | The drawing speed of Revit software is extremely fast, and the data statistics are included in the software, and its data management and processing capabilities are very powerful. |

3. Using modeling software to develop digital protection strategy

3.1. Data information collection
Data information collection is to carry out comprehensive statistics and analysis of the information content of ancient buildings, and at the same time to effectively record and measure the spatial shape, structural members, node connections and other contents of the building, and then to achieve the accuracy of the information content, thereby achieving more accurate digital display effect. For information recording, we can use the GIS technology, unmanned aerial vehicle, laser scanner and other related equipment to carry out the information collection of ancient buildings. Finally, manual screening on the collected content was carried out. Therefore, the accuracy of information collection is extremely important. On the one hand, information data is the basis for all software calculation and conversion, on the other hand, it is also an effective support for the quality of later rendering. Therefore, it is necessary to improve the accuracy of ancient building information data, and then construct an effective expression of the model.

3.2. Construction of three-dimensional model

3.2.1 Production of three-dimensional model
3Ds Max is displayed and applied, and the structure and content of the model are effectively adjusted and corrected. On the one hand, there can be data input errors, on the other hand, there can be misunderstandings in the expression form. Then, the generated ancient building model are scientifically compared with the actual ancient building, and the details and content of the model are gradually improved. In particular, the internal structure of the model needs to be synchronized with the relevant building structure and internal information to achieve the correct expression and display of ancient buildings. The model construction is not only the external content, but also contains the internal decorative environment, the texture and structure of all decorative materials, so as to achieve a more realistic presentation. When the relevant buildings need to carry out directional repair work, virtual models can be used to display dynamically, effectively reducing the uncertainties that the repair
work may bring, reducing the risks and crises of ancient buildings, and realizing the effective protection and scientific management of ancient buildings.

![A 3D model of an ancient building constructed by 3Ds Max software](image)

**Figure 1 A 3D model of an ancient building constructed by 3Ds Max software**

3.2.2 Production of texture
After the 3D model is built, Unity does not need to be reset before importing it into the virtual engine. The Unreal 4 engine needs to set the texture of the model to a format that the system can apply. The resources of the texture are mainly drawn and processed to the needed form by Photoshop and other software. For example, the UDK-Virtual Engine platform has special requirements for the texture, that is, the file size is $2^n$, that is, 64, 128, 256 and other sizes. The general texture format is TGA, BMP and other formats. VR display

3.2.3 Importing the model into Unity
When the finished model produced by 3Ds Max is imported into Unity, it is very simple to name the folders and files as much as possible in English, Pinyin and numbers. The model must first export the FBX mode file in 3Ds Max. After that, in the ASSETS folder in Unity, move all models and textures to the ASSETS folder. Pay special attention to the fact that the FBX exported by the model must be placed in a folder with the textures, otherwise the textures will be lost. [3]

3.3. Input of attribute information
The construction of the model is the preliminary realization of the digital protection of ancient buildings. Therefore, in order to further realize the effective expression of the relevant contents of ancient buildings, it is necessary to effectively input the materials, construction methods, characteristics of the times, construction technology and other series of ancient buildings into the software system. We build ancient buildings simultaneously with different software to realize the effective expression of the entire system, and combine the output focus of each software end to realize the clarity, efficiency and accuracy of the expression content. Finally, the model is effectively rendered, and 3Ds Max is used for later rendering production. At the same time, the external image content of the ancient building is targeted for improvement and adjustment. On the one hand, the current ancient buildings may have the problem of color distortion. On the other hand, the use of virtual reality technology can restore the external characteristics that the building should have at the time of construction [4].

3.4. Virtual reality technology engine display
There are many kinds of virtual reality technology software, among which two are commonly used, Unreal 4 and Unity. Table 2 is a comparison of the advantages and disadvantages of the two virtual reality products.
Table 2 advantages and disadvantages of the commonly used VR technology engines

| Name   | advantages                                                                 | disadvantages                                                                 |
|--------|---------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Unity  | 1. Long market time;  
2. Use C# and JavaScript coding;  
3. There are more plug-ins available, which improves the development effect;  
4. Have simple and intuitive UI interface;  
5. Low-configuration hardware also ensures smooth operation; |
|        |                                                                           | 1. Compared to Unreal 4UE4, the picture quality is not the best;  
2. Material Shader is more complicated;  
3. The original code is not public |
| UE4    | 1. Have special design resources to create high-end and rendering VR;  
2. Use visual editing;  
3. Better picture quality, easy to use material editor; |
|        |                                                                           | 1. The master of C++ is relatively difficult than C#;  
2. The loading time is relatively long; |

VR glasses are used to dynamically display the ancient building model to realize the reproduction of the original scene of the ancient building. At the same time, a visual rendering effect with real feelings is constructed in the simulated environment to realize the effective display of virtual reality technology. It should be noted that due to the simulation capability of virtual reality technology and its close to the most realistic effect, its digital protection value and protection potential are extremely great. It is necessary to continuously improve the modeling quality and modeling parameters of related software and continuously improve the dynamic effect of the software [5].

4. Conclusion
In conclusion, the use of modeling software to demonstrate the application value of virtual reality technology, combined with all the information content of ancient buildings, effectively reproduces the original scene of ancient buildings, and realizes the dynamic display mode of architectural models to further implement the protection, repair and management of ancient buildings to realize the value and significance of digital protection strategies.

Project
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.

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.
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