Research on Cultural Ecology of Modern Historical Architecture based on Digital Simulation Technology

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Abstract — With the continuous development of modern computer and network technology, the protection and development of the national cultural heritage and cultural resources has gradually entered the digital field. First, digital acquisition and storage technology for integrity protection of national cultural resources to provide a guarantee, digital restoration and reconstruction technology for the effective inheritance provides support; secondly, the virtual reality technology for the development of these cultural resources by expanding the space; at the same time, digital display and communication technology provides the widely shared platform. Among them, with respect to the digitization of earlier books, dance and other intangible cultural resources, as an important part of the intangible cultural heritage, for historical building digital development and application has become the world a new topic, particularly the remains of the city more, construction quality is good even in the use of historical buildings, with distinct characteristics of the times, but also the important material carrier of traditional culture, in recent years, also caused the attention and research of academic circles at home and abroad. The times calling for the current digital survival can not only improve the protection level of historical and cultural resources, but also can protect the digital protection and development of historical and cultural resources. Digital protection and development of historical and cultural resources, is the trend of the development of the times.

Keywords - digital technology; historic buildings; protection and development

I. INTRODUCTION

The development of virtual city models has provided novel possibilities for analyses that require consideration of building heights in urban areas. The theoretical model developed is validated by comparing numerical predictions with the available experimental data in the literature. The operation temperature can be controlled well by the attendance of phase change material and the longer melting time can be conducted by using a multi-fin hybrid heat sink respectively. Top Abstract This chapter examines the challenge of creating and sustaining a virtual city model and illustrates how the success of such efforts may depend on strategic collaborations between multiple organizations. It argues that a city model which is aligned to the development of the real city, to visually and analytically assess urban planning proposals, is more likely to be regularly used, continually updated, authoritative and sustainable in the longer term. The increasing development of three-dimensional virtual city models and leading-edge computer software applications is providing innovative possibilities for analyzing the performance of existing city-centre public squares. In the design and assessment of city squares, the use of accurate virtual city models is often limited to visual geometrical assessment alone. There is little evidence that such models are being adapted to carry out urban performance simulations. The 3D models created to support rehabilitation design emerge as an important tool for the monitoring of anomalies in structures and to assist decisions based on the visual analyses of alternative solutions. These applications allow the visual simulation of the physical progression of each type of work and also assist in the study of the necessary equipment needed and how it functions on site.

II. METHOD PRINCIPLE

At present, there are three stages in the development of cultural resources, namely, information transformation, data processing and resource sharing. The digital development of the historic buildings is also based on the original data collection, the establishment of the database, the design of the virtual model and the establishment of the sharing platform, and so on.

Figure 1. Chinese modern architecture
A. Domestic Research Status

In 2000, the Southeast University around Nanjing city wall of the Ming Dynasty inscription, launched the virtual reality in the protection of historical and cultural resources and research application. In 2004, Tongyi University expert on Chinese architectural history Bing Jibe Lu Professor using digital scanning repair in the Yuan Dynasty, the big Buddha, 2005 with the utilization of 3D laser scanning technology in cartographic survey of historic buildings in research, repair the prince tower of Putout Mountain Buddha in the Yuan Dynasty. The Relations Department also in 2008 officially launched "e-Palace theme website. Microsoft Research Asia University system in 2008 opened the world's first virtual Summer palace were displayed, provides a lot of restoration image for the anniversary of Yuanmingyuan Garden, the virtual summer Palace theme website. Microsoft Research Asia University Relations Department also in 2008 officially launched "e-Heritage" theme research program, will cutting-edge computing technology and Application Research on confirmation of heritage, culture, history, archaeology, etc., protection, preservation of heritage and to spread to the education and protection purposes[10].

B. Collecting the Original Data and Establishing the Database

The collection of original data for historical building is the foundation of digital. Raw data is usually obtained through field mapping, and its accuracy directly affects the accuracy of the design of building restoration. The establishment of the database is to protect the historical building information archive, but also to provide design basis for the restoration design. Previous major domestic use of graphs, tables, text and other forms of archival conservation of historic buildings, this way not only the amount of data, and cannot be directly reflects the building real effect; and the use of photos, films and other image archiving although intuitive, but cannot get accurate physics data and structure relationship, very difficult for precise protection and scientific research, is not conducive to reconstruction, imitation and restoration work carried out. Therefore, by using GPS and total station instrument, measurement robot and close range photogrammetry for representatives of modern 3D building surveying and mapping technology is gradually replacing the traditional measurement methods of two-dimensional, improved and enriched the modern means of original data collection[7]. Among them, the more advanced digital surveying and mapping can be combined with 3D scanner, conveniently in different scale of real objects surface point sampling, obtain the point cloud data of different accuracy, by on point cloud and grid processing, analysis and recognition algorithms, three dimensional surface model is constructed and 3D information directly as the surveying and mapping results form[13].

C. Building 3D Modeling

Based on collecting the original data through surveying and mapping means, using professional software to build three-dimensional information model, is one of the common means of the digital development of historical buildings. On the one hand, for the upcoming demolition, the overall relocation or remote restoration of historic buildings, the preservation of detailed three-dimensional data, will become an important basis for the restoration of its original. [12] On the other hand, the historical and cultural relics that have disappeared or are on the verge of disappearing can also be reduced by digital technology.[1] Accurate three-dimensional digital model can contain real the most accurate basic data, such as engineering data, material data, process data, the disappearance of the cultural relics constructed a new platform for the study of visual information, expand the research means. At the same time, the combination of digital 3D building model and virtual reality technology can also be used in tourism development and cultural publicity. Through the modern computer technology, has been able to overcome the geographical restrictions, to achieve a real, fast and accurate visual display, and even to achieve interaction with the model environment. [4] Can not only reduce the damage to the kind of people, to achieve the purpose of protection, but also to expand the propaganda, to bring economic benefits.

D. Create a Digital Platform

At present, in the process of digitizing construction of our national culture resources, widespread low-level redundant construction, low degree of sharing. Therefore, it is necessary to describe resources through effective organization and standardization, the establishment of efficient resource sharing and management platform. Digital platform mainly refers to the use of Web and other network technology, in the database has been established on the basis of the establishment of the implementation of information technology and integrated management system. Through the platform, database of historical buildings in about text information, pictures, multimedia, video and other digital processing, and editing, online rapid retrieval and browsing, this media sharing culture resources in historic buildings.[9] By creating a digital platform, first of all, there are conducive to the improvement of the relevant departments on architectural history of management level, the current management work more rigorous and efficient; secondly, digital cultural resources of the network share, for the
III. STATE OF THE ART

A. Build Index

Digital 3D building model can be easily used to study and spread the value of these buildings, and reduce the damage to the real object. The combination of digital 3D building model and virtual reality technology can also be used for tourism development, virtual display, and expand the economic benefits of tourism industry. Increase people's understanding of the details of the physical contact. In the initial state, the entire tree structure only a root node, the only one data point, there is no any routing node[5]. Root node in the management of the whole data area. When a new node is added to the index tree. The root node accept new nodes join and the data area is divided into 2 parts .By section 1 describes the nodes join and exit the method, the index system formed a network of virtual tree structure consisting of a large number of nodes[8].

With the rapid development of the technology of computer aided design and use of computer design and construction space form is established 3D model of digital product model is one of the key technologies of space form with complete geometric and topological information, to facilitate the extraction of the shape features, construction further finite element analysis and optimization design, construction interference check to provide support. [6]On the other hand, engineering drawings is to 2D views to express a kind of effective means of 3D objects, is the engineering and technical personnel exchanges between the professional language, is widely used in mechanical, architectural design industry, in the early 1960s, first published on since the stereogram of the reconstruction from three views, based on reconstruction of engineering drawing three-dimensional shape of the study by the widespread attention in the research field of computer application.

B. Data Operation

Different to the traditional modeling method based on 2D sectional drawing and modeling technology of 3D laser scanning using non-contact measurement method by discretization of scanning solid surface direct access to the point cloud data that three-dimensional coordinates information processing, again through reverse engineering method, is utilized to obtain the point cloud data reconstruction a scanning entity corresponding to the surface. This method is not affected by the complexity of the solid surface, and the reconstruction accuracy depends only on the sampling density. Point cloud data processing is the core technology of 3D laser scanning modeling, the research began in the 1960s, including point cloud surface reconstruction, multi view point cloud registration, model of multiresolution representation, large point cloud data simplification, point cloud data feature recognition and extraction and 3D texture mapping and so on several aspects.

C. Data Point Cloud

D data point cloud is the use of three-dimensional scanning equipment on the building surface scanning, and the building of the surface of the three-dimensional coordinates of the point data. In recent years, with the development of information technology, 3D scanning equipment performance continues to improve, the scanning device to scan the reality of ancient Chinese architecture surface to rapid, multi range acquisition of ancient architecture of high precision 3D surface data[2]. It is one of the main research directions to use the data point cloud of the object to carry on the 3D reconstruction. The research and use of data point cloud is mainly divided into matching, simplification, reconstruction and so on. According to the point cloud data of large ancient buildings, it contains a lot of redundant data, which is difficult to be directly used for 3D reconstruction. The simplification algorithm of data point cloud and its 3D reconstruction method are discussed in the paper[14].

IV. SPATIAL BLOCK OF DATA POINT CLOUD

A. Calculate the Minimum Rectangular Bounding Box

First, calculate the minimum rectangular space that contains all the data, set up I, J, K, respectively, the length, width and height of the cube space.

\[
I = \text{ceil}(X_{\text{max}} - X_{\text{min}}) \quad (1)
\]

\[
J = \text{ceil}(Y_{\text{max}} - Y_{\text{min}}) \quad (2)
\]

\[
K = \text{ceil}(Z_{\text{max}} - Z_{\text{min}}) \quad (3)
\]

Among them, \((X_{\text{min}}, Y_{\text{min}}, Z_{\text{min}})\) is the minimum coordinate of the space rectangular bounding box, \((X_{\text{max}}, Y_{\text{min}}, Z_{\text{min}})\) is the maximum coordinates of the rectangular bounding box. In the algorithm, the coordinate of the cube bounding box is the largest and the smallest value is stored in the global variable. As a function of rounding up.
B. Data Clustering and Sorting in Layers

First from the $Z_{\text{min}} \leq p_i \rightarrow \text{po int, } z = Z_{\text{min}} + \tilde{z}$ start, to find out the layer, the coordinates of $X, Y$ of the maximum and minimum points, respectively, the coordinates are saved as:

$$P_a(p_a \rightarrow \text{po int, } x, p_a \rightarrow \text{po int, } y, p_a \rightarrow \text{po int, } z) \quad (4)$$

$$P_b(p_b \rightarrow \text{po int, } x, p_b \rightarrow \text{po int, } y, p_b \rightarrow \text{po int, } z) \quad (5)$$

$$P_c(p_c \rightarrow \text{po int, } x, p_c \rightarrow \text{po int, } y, p_c \rightarrow \text{po int, } z) \quad (6)$$

$$P_d(p_d \rightarrow \text{po int, } x, p_d \rightarrow \text{po int, } y, p_d \rightarrow \text{po int, } z) \quad (7)$$

From the beginning of the $X$ coordinates of the minimum point of $A$, excluding the $X$ coordinate of the point of maximum $B$ and $D$ point coordinates and a data area $1[A, B]$, point $B$ and the coordinate $X$ maximum $C$ and the $Y$ coordinate of the point of maximum composition data area $2[B, C]$, point $C$ and the $Y$ coordinate of the point of maximum composition data area $3[C, D]$ and starting point of $D$, point of composition data area $4[D, A]$.

Using this hierarchical organization structure can make the data block processing, speed up the layer block data processing speed, and can use the $Z$ coordinate data directly addressing, which can greatly shorten the 3D points that match the query time and the data query search process basically can think and the amount of data has nothing to do, thoroughly improve the retrieval efficiency, to the analysis of operation to solve the problem of bottleneck[15].

C. Reduced Data Specification

The algorithm starts from the plane, and in the range of $Z$ value of a given axis, the number of 4 data areas in each approximation plane is given.

According to the characteristics of the building surface curve, take the step size $k$, the number of data points to meet stay, delete the rest of the data points.

V. RESULT ANALYSIS

Using VC++ and object ARX algorithms, and applied to simplify the small wild goose pagoda in Xi'an building point cloud.

A. Build Index

With ARX two development tools, using the point cloud data clustering algorithm to simplify the characteristics of the point cloud, data point cloud simplification, the results will be simplified as a new DXF file. Feature points are then imported into the AutoCAD.

<table>
<thead>
<tr>
<th>Table I</th>
<th>THE CHANGE OF FILE SIZE BEFORE AND AFTER THE REDUCTION AND THE REDUCTION RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>File Sto. No.</td>
<td>Det. No.</td>
</tr>
<tr>
<td>k=3</td>
<td>2034kb</td>
</tr>
<tr>
<td>k=50</td>
<td>171kb</td>
</tr>
</tbody>
</table>

B. Query Cost

At the same time, with the increase of $k$ value, in the flat area of the building surface, the effect is good, and the detail of the data reduction will be lost in the area of sharp curvature change. When you weigh the reduction rate and detail retention rate, you can select the K value according to the need. And the reconstruction of the method can be used to make use of the symmetry of the building and to restore the partial deformity of the main body.

According to ancient architecture of the three-dimensional virtual display the specific application, you can choose high precision simple, the details by good texture mapping to compensate. The algorithm under the premise of effective to retain the building style and detail characteristics, the ancient architecture of the point cloud data were simplified and efficient processing, can effectively reduce the point cloud data of the scale, so as to ancient architecture 3D model fast to lay the foundation.

C. Reconstruction of Three Dimensional Model of Point Cloud Data

In fact, the 3D point cloud model of the ancient buildings only contains the spatial coordinate information of the surface survey points, and it is necessary to reconstruct the corresponding 3D geometric model through the surface, in order to realize the digital preservation and virtual display of the site. At present, the grid of large-scale point cloud data is realized by triangulation of point cloud. In the guarantee under the premise of the realism of the scene reconstruction, Dashing spots cloud mesh emphasized to reduce the algorithm's time complexity and space complexity.
D. Load Distribution

Figure 6 shows the image accuracy of the K=3\5\50 simulation map. Fig. 8 shows the image accuracy of the K=3\5\50 simulation map.

![Figure 6. The Simulation Results Do Not Map K](image)

![Figure 5. K Value Leads to a Range of Points](image)

VI. Conclusion

This paper focuses on the application of 3D laser scanning, 3D modeling, geographic information database and system construction and other advanced information technology in the protection of ancient buildings. In recent years, more and more people pay attention to the technology of Surveying and mapping, which has become a hot research topic at home and abroad. Such as in ancient architecture mapping, three-dimensional laser scanning technology to contact scanning for the 3D object, at the same time, the three-dimensional world information is quickly converted into a computer can process data can solve building human data acquisition caused unnecessary losses and maximize the remaining buildings of the original information, effectively guarantee the absolute security of the ancient buildings. It has the advantages of rapid, non-contact, real-time, high precision, strong initiative, full digital characteristics, etc., directly affect the efficiency and cost of the use of data. The in summary on the basis of existing literature and research results, according to the demand of planning of the protection of ancient buildings, 3D laser scanning, 3D modeling, GIS mapping information technology, research on the following aspects: analysis of the development process of inside and outside integration, digital direct to informationization surveying and mapping technology, and expounds the application methods and processes of advanced information mapping technology in the protection of ancient buildings.

At present, in the domestic digital development of historic buildings mainly used in certain cases, did not form a system, the lack of uniform standards, the database integrity, accuracy and digitization of the innovative application need in-depth study; at the same time, around about the historical building of digital resources are limited to internal research institutions sharing, not within the wider get effective development and exchange with each other. Visible, digital application in the field of historical building protection and development, there are still a single function, lack of standards and the lack of effective sharing and other issues. Nevertheless, I believe that with the continuous improvement of the technical support platform, as well as the development of policies and measures, digital development will become a new starting point for the modern historical building protection and cultural heritage.

The remainder of this paper is organized as follows. Section 2 describes the 3D technology and three dimensional point cloud model. Section 3 gave the simplified calculation method of three dimensional point cloud model. Section 4 presented spatial block of data point cloud. Section 5 analysis the experimental result. Conclusions are summarized in Section 6.

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References


