Research and Application of Historical Building Conservation and Management System based on UAV

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Abstract. Guangzhou is one of the most famous historical cities in China which has abundant unique cultural resources. With the development of economy and the acceleration of urbanization, the preservation of historical buildings and urban construction have fallen apart, which leads to the destruction of historical buildings and the lack of efficient supervision of the protection of historical buildings. For the difficulties in digital preservation of historical buildings in Guangzhou, it is necessary to construct a comprehensive application of high-precision terminal application, network platform and other technologies, to control the whole process of information interaction, data processing and arrangement, thus achieving the implementation of historical building preservation plan and management.

1. Introduction
The application of digital technology in the area of historical building preservation and management has been supported by mature theories and technical methods, such as 3d-modeling technology and information modeling technology [1]. For the past few years, the digital historical building preservation generally focuses on two aspects: geographic information technology and digital measurement technology. Geographic information technology can effectively organize and process the spatial information of historical building models and ensure the objectivity of historical building evaluation [2], where digital measurement technology can reduce the storage capacity of 3d-building models [3]. However, these technical information is restricted to a segment of the historical building preservation process, which cannot be managed in the whole life cycle of the work, and there is a lack of complete analysis and evaluation of the status, changes and development trends of historical buildings [4].

Guangzhou is one of the most famous historical and cultural cities in China. With a long history of more than 2,000 years, Guangzhou has accumulated rich historical and cultural resources. However, there are significant differences in the progress of conservation work in different districts, and the published standards for historical buildings are uneven [5]. The protection of historical buildings is out of line with urban construction. For this reason, this study focuses on the emerging digital technology to change the traditional working methods, contact media and form of results, and gives effective solutions from the three aspects of standard formulation, platform construction and mechanism improvement.

2. Process Platform design
This process platform is a digital historical buildings preservation platform based on the technologies of GIS, Internet, software engineering and CAD, which is in order to implement the integration of field...
collection, data warehousing, information management, achievement display and public service, as well as the dynamic supervision and warning mechanism of historical buildings information, as shown in the Figure 1. The digital preservation platform for historical buildings is developed based on SOA architecture and unified technical standard. On the basis of the industrial mobile equipment research and development of information collection system, this platform is able to achieve high-precision point positioning, internal and external integration of data collection and storage. It provides functions of querying, browsing, statistics, analysis, display, and share information in the form of OGC standard interface. The information of historical buildings is presented to the public in the form of text and graphic, and diversified services are provided for the public to achieve the information sharing of historical buildings.

2.1 Infrastructure Layer
The infrastructure layer includes hardware, software and network. The hardware includes servers, storage devices, PCs, mobile terminals and printouts, where the software mainly includes operating system, GIS software, development software, database software, etc. The network is mainly government Intranet, government extranet and public service network, which are separated physically.

2.2 Data Resource Layer
The data resource layer mainly includes the special database of current historical buildings, the database of basic spatial information and other databases. The special database of current historical buildings stores the registration forms, images and scope lines of the survey of historical buildings. The basic spatial information database supports the storage of digital line mapping topographic map, government electronic map, Internet map, image map, DEM, administrative divisions, geographical names and addresses, where other databases are responsible for storing real image data, laser-point cloud data, 3d-model data, structure drawings, etc.

2.3 Application Layer
The application service layer is the core of professional application of the platform, including information management subsystem, data management subsystem, operation and maintenance management subsystem, and a shared exchange system (exchange system with each municipal and county construction committee, exchange system with each municipal and county planning bureau, and share exchange interface with other provincial units). Its main functions include the background system that supports the general operation of the system and the data sharing service interface, which can offer efficient indexing and analysis of geospatial data, provide geographic support for historical building data mining applications, functional support for each application subsystem, and provide the underlying
services for complicated business functions.

3. Key technique

3.1 One-stop terminal data warehousing platform

One-stop terminal data acquisition processing mechanism is applied on the platform, a high-precision GPS positioning module and a mobile terminal of acoustic image sensor can be used on multidimensional historical building information acquisition and rapid input, which improves the efficiency of the field survey and efficient management of historical data.

The internal industry data platform provides the functions of collecting engineering management, monitoring of field researchers, workload reporting and on-site feedback, as well as the planning of the time, sequence and route of the field investigation.

Furthermore, the data processing terminal also provides data quality inspection, format conversion, high-precision coordinate conversion and other data processing tools, which are efficient supplementary tools for data warehousing and sorting.

3.2 Multi-media data archiving

For the shortcomings of the traditional historical building surveying and mapping method, Wang Yuannan [6] worked on the method of rapid collection of high-precision and high-density point cloud data with the three-dimensional laser scanning technology, and made accurate and complete current situation drawings, carried on the fine 3d-simulation modeling, which verified the feasibility of the application of 3d laser scanning in the area of historical building conservation. Ye Minlu [7] explored the detailed mapping of historical buildings based on 3d laser scanning, UAV (unmanned aerial vehicle), Electronic Total Station, laser rangefinder, digital camera and other technical tools, and verified the integration of internal and external operation process, which can provide integrated technical solutions for the conservation of historical buildings.

The Digital Historical Building Conservation and Management System utilizes the inclination model, laser point cloud, panoramic image and other new media data to clearly demonstrate the appearance form and detailed features of historical buildings.

Through the new data display technology, the multi-media display of information of historical buildings is achieved, which is convenient for the local amplification and research of buildings, and supplemented by 3d roaming demonstration of fine scenes, which provides high-precision data basis for the maintenance and repair of historical buildings.

4. Modules

4.1 Multi-Source data management

The multi-media and multi-type information database builds a new method for the data archiving and management of historical buildings. In addition to the basic information of historical buildings, it also includes new data such as point cloud data, structural drawing, 3d model and real scene image, which also opens up a new way for the construction, publicity and protection of historical buildings.

4.2 Multi-layer data interface

The platform collects the information of historical buildings in the whole city, and reserves the interfaces of cultural relics, historical and cultural blocks, intangible cultural heritage and other protection objects, in order to support the overall protection from historical buildings to famous cities. The platform actively connects with other planning information platforms, provides digital technical support for the coordination of historical and cultural protection and urban development, and sets up the management concept of combining preservation and utilization. Users from different levels of departments can edit, consult and dynamically maintain relevant information of historical buildings with their authority through the special account login platform, which guarantees efficient and real-time information
interaction between provinces and cities. The assessment methods for the conservation of historical buildings in Guangzhou are studied, and the assessment indicators are taken as an important part of the platform. Each district can report the progress of protection work through the platform, and the municipal level can conduct real-time monitoring and guidance for each district. The platform's functions of data statistics and quantitative analysis provide important scientific basis for the planning of the conservation of historical building and the formulation of laws and policies.

4.3 Multi-Dimensional integrated data acquisition module
Based on the image-based modeling and rendering technology, the multi-dimensional integrated acquisition and modeling module is built. The main modeling methods are 3d software modeling and 3d laser scanning. Image-based Modeling and Rendering (IBMR) is an extremely active research field in the field of computer graphics, which overcomes the disadvantages of the 3d software modeling methods, such as high technical requirements and long Modeling cycle, and the high cost and long cycle of 3d laser scanning. This platform integrates DSLR camera, camera platform, UAV and other hardware to construct a multi-dimensional integrated data acquisition platform, and carries out production test in lightweight image modeling software and professional inclined photography modeling software, which makes mapping texture and modeling faster, more convenient and more realistic.

4.4 Multi-type LiDAR data collection module
Traditional mapping technology cannot be compared with Ground LiDAR (Light Detection and Ranging) in digital elevation model, high precision 3d model and texture and other fine mapping. This platform uses different types of ground LiDAR to complete the building elevation measurement, 3d model construction and topographic map measurement and construction, focuses on solving the LOD model rapid construction method of scanning massive scattered point clouds by ground laser at a single station.

4.5 Low altitude telemetry data acquisition modeling module
The low-altitude telemetry data acquisition module integrates six Gopro4 motion camera, panoramic installation platform bracket, GPS and other equipment on a fixed wing or rotor wing UAV based on a technological process, in order to build the UAV mapping platform. In addition, The adaptive track planning system (including the console module, flight monitoring and mission planning, etc.), the inclination 3d production system and the real scene 3d production system are developed, which can transform the UAV image data to the inclination 3d product, real scene 3d product and DOM generation.

5. Summary
The digital historical building conservation and management platform solves the problem of how to collect, sort out and archive relevant data and information of historical buildings systematically and scientifically, as well as manage and use the achievement in urban planning.

Instead of the method of traditional paper recording, the platform solves the problems such as arbitrary record content, irregular record format and inconvenient outdoor use, among which the field information acquisition system based on UAV can directly use text, sound and image and other multimedia technology to collect information of historical buildings and enrich the information dimension.

The standardization of data entry format greatly simplifies the intermediate process from field data collection to internal data processing and reduces the workload of internal data processing.

The digital historical building conservation and management platform can complete the whole process from field investigation to result display in a short time, which improves the efficiency of historical building information management.

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