Research and Design of Field and Office Work Integration System for Historical Buildings Conservation: Case Study on Guangzhou

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Abstract. In recent years, GIS-based technologies have been applied in multiple fields of study, including historical building conservation. In the field of historic building conservation, GIS technology is mainly used for the spatial information display and spatial analysis of buildings. In terms of traditional methods of historical buildings information collection, GIS technology is mainly applied in the functions of data warehousing and statistical analysis, but barely in the early stage of data acquisition. This article introduces the technology of historical building information acquisition based on mobile GIS device, as well as the integrated data acquisition system, which changes the pattern that separates field and office work. The field collected data is directly imported into the data processing system on the basis of unified data standard, which shortens the intermediate link and integrates the field and office work. As a result of the improved pattern, the efficiency of historical building conservation will be significantly increased.

1. Introduction
Guangzhou is one of the first famous historical and cultural cities in China. As the cradle of Lingnan culture, Guangzhou has a long history of more than 2,000 years, which accumulates abundant historical and cultural resources. Due to the cultural influence in China and the west, the local Cantonese culture has been constantly communicating and integrating with various cultures. In addition to its natural, economic and cultural characteristics, it has generated a variety of unique architectural styles and preserved a large number of distinctive historical buildings. These buildings carry the common memories and deep emotions of the citizens of Guangzhou. Therefore, it is necessary to preserve the original spatial pattern and characteristics of the city while it is in a rapid development. In order to provide accurate basis for the conservation planning of historical buildings, GIS analysis needs to be applied. GIS spatial analysis is based on the rapid acquisition of GIS data, where the establishment of an efficient integrated platform for field data acquisition and data processing can effectively accumulate GIS data and provide data basis for the conservation analysis of historical buildings. Compared with the traditional way of using paper forms to record field data, the application of mobile GIS data collection devices can solve the problems of arbitrary record content, irregular record format and inconvenience of use [1]. The application of electronic maps is more environmentally friendly and improves the reusability of data rather than paper maps [2]. After the organic integration of GIS, mobile Internet and mobile positioning technology by mobile GIS acquisition equipment [3], the information of historical buildings can be accurately collected and directly transmitted to the data processing system of the industry through the network, significantly improving the efficiency of information acquisition. The
establishment of the integrated historical building conservation system is based on the rapid acquisition of vector data and attribute data of mobile devices, as well as the efficient data conversion and communication between field and office work platforms. On this basis, we can constantly expand and improve other applications, and constantly complete production process of the integrated historical building data.

2. Research of System Applications

2.1 Workflow of Historical Building Conservation

The primary task of historic building conservation is field investigation and information management, including accurate positioning of historical buildings, pictures and information collection, etc., followed by the comprehensive management of the field data acquisition results. Due to the diversity of cultural values contained by historical buildings, it is necessary to integrate the theories and situations of history, architecture, sociology and archaeology[4], collect field information and related documents for in-depth analysis, and provide a basis for the research and evaluation of historical buildings conservation.

The conservation research and evaluation of historical buildings includes the comprehensive evaluation of historical value, artistic value, scientific value, environmental value, social value and other factors of historical buildings. In addition, the assessment also includes the preservation status of historical buildings, protection scope and construction control zone, surrounding environment, and existing historical building conservation and management conditions. Through the comprehensive evaluation of multiple factors, the protection value, importance and social, environmental and cultural impact of the historical building, providing a basis for the planning of the conservation.

After the assessment is completed, a detailed plan of historical building conservation will be confirmed, as well as the related measures and an effective mechanism for the conservation and management. Through the supervision of the construction process of engineering projects, the demolition and damage of historical building can be prevented. Finally, with the evaluation of the cyclic updating of the conservation workflow, the work results are summarized, and the corresponding adjustments are made to the historical building conservation plan, in order to improve the work efficiency.

2.2 Digitalization of Historical Building

The digitization of historical buildings mainly includes the digital data acquisition of historical buildings, the digital storage of historical buildings and the establishment of historical buildings conservation system. The traditional pattern of data collection of historical buildings is based on traditional measuring instruments, paper, pens, cameras and other manual operations, and data recording and storage is mainly in the form of paper carrier [5]. However, handheld mobile device is used in the process of digital data acquisition, data collectors can directly input texts, images and location information of historical building into the system and convert them into digital information data. The digital data acquisition effectively improves the efficiency of data management, reduces the workload, and ensures the unity and integrity of data results.

Digital storage of Historical building mainly includes digital expression and archive. digital expression of historical buildings is composed of text format attribute information, combined with the professional image capture and processing equipment, visualization technology, supports the digital information processing and visualization expression, and output the final digital files. Therefore, the digital storage of historical building data can be achieved by classifying and analyzing the digital files, as well as the application of computer storage equipment and database software.

The establishment of the historical building conservation system is one of the most important components in digital conservation of historical buildings. After building database through computer software technology, geographic information science and data format standardization, the system is able to provide shared services such as data browsing, querying, editing and representation, which improves digital management, information search and analysis on historical building conservation.
3. System Design
The historical building conservation system achieves the integration of field and office work through three modules, including field data acquisition, indoor data processing and information management, as shown in the Figure 1. The field data acquisition platform is responsible for collecting and editing vector data, attribute data and multimedia data of historical buildings. The data processing platform is responsible for data arrangement, format conversion and content editing after data warehousing. The information management platform is responsible for the storage and integration of the arranged historical building data results, release the results to the front end for information display. Bidirectional communication is implemented among the three modules.

3.1. Field data acquisition
The users of the mobile GIS information acquisition terminal are historical building information collectors. The device provides the applications of multi-layer display and switching of high-resolution image maps, digital maps, and topographic maps. The built-in high-precision GPS positioning module provides accurate positioning capability, track recording function and mobile navigation function. Moreover, the mobile GIS acquisition terminal supports the operation of length and area measurement on the map, which supports field operators to obtain the necessary spatial information.

The field data can be collected and uploaded with the mobile acquisition devices. Field collectors can rapidly input the text information and image information with the standard format through the set input interface. Furthermore, the system also provides the capability of photo taking, video and audio recordings through the camera and recording module attach to the mobile devices, enrich the information dimensionality of the historical building data with the multi-approach and multi-format information input.

The data arrangement capability of the system achieves the direct management of mobile terminal information, instead of the tedious operation of data editing and management only after data is imported into the professional processing platform of desktop terminal. The system provides the operation of adding, editing, deleting and querying the current situation information form based on the location, field collectors can associate the text information with feature elements, record relevant information with editing function, and support the industrial planning and design.

Furthermore, on the basis of uniform data formation standard, the mobile GIS acquisition device is provided with data interaction with desktop, including importing research base map and template, as well as deriving field acquisition data. The collected data can be directly transmitted to the data processing platform of the industry through the network, which simplified the process from data acquisition to data processing, improves the efficiency of data processing.

The structure of Field data acquisition is as shown in the Figure 2 below.
3.2. Data Processing
The field data is imported into the data processing platform in uniform standard format, followed by the unified and standardized data processing. Through the powerful processing performance of the desktop, the system provides batch cleaning, conversion, execution of the data, including operations of more complex spatial information editing, batch coordinate conversion, etc. Since the file format of the GIS mobile terminal is compatible with the file system on the Windows platform, data can be imported into the working environment of the historical building information processing module, avoiding the error caused by manual integration or re-input in the traditional drawing operation mode.

3.3. Information Management
Historical building information system is a unified platform integrates multiple technologies, such as GIS, network, software development, CAD, etc. It has the features of multi-user concurrent engineering, focuses on the information communication, data processing and management, as well as the connection and coordination of the urban planning, especially statutory planning. The processed historical building data information including the location, architectural plane, elevation, age, protected area is stored on one single platform in standardized format, which achieves the capability of data sharing and coordination among different regions. Administrators can publish the list of historical buildings and relevant information through the system, so the public can search specific knowledge on the website. The department can extract, merge, inspect and associate the attribute information of historical buildings. On the other hand, the system provides statistical analysis of relevant information according to the demand of urban planning and management, including historical building distribution, quality of conservation, age, types and functions of the building and architectural form. Moreover, the system is able to design customized mapping template, including the layout, legend, scale, multi-layout window, in order to complete the standardized batch output of planning achievement drawings.

4. Cases
Data acquisition system for historical building field information collection, is deployed in high-precision GPS acquisition device. It can collect historical building information through images, text, voice and handbook, and record the current location, display the result in the acquisition terminal, provide the support for the data collectors examine the quality of acquisition.

The data processing system manages the basic spatial information database, historical building database and other databases involved in a project. Coordinate transformation software is provided to integrate the data of different coordinate systems. For the characteristics of census and historical data, a
specialized data collation and input system is developed based on PC equipment. Data collected by mobile terminals are imported to PC equipment for editing and output.

The information management system will display and share the data of historical buildings to all government departments, and its functions include GIS operation, information editing, information display, real-time warning, file management, printout, etc. The system provides analysis results of multidimensional statistical analysis and data mining, to offer decision-making support for the implementation of historical building conservation policies.

5. Summary
The integrated conservation system for historical buildings solves the problems of collecting, managing and storage related materials and information of historical buildings with a systematical and scientific method, in order to support the urban planning and management. The system also solves the problems of arbitrary record content, irregular record format and inconvenient field use, instead of the traditional method of paper records. The field data acquisition system based on GIS mobile terminal can directly use multimedia technology such as text, sound and image to collect the field information of historical buildings and increases the information dimensionality. The standardization of data entry format significantly simplifies the intermediate process from field data acquisition to data arrangement and alleviates the workload of data processing. The establishment of the system reduces the time from field investigation of historical buildings information to the achievement of the final results, which improves the efficiency of information management of historical buildings.

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