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The Development of a Digital Management System for Historic Buildings in Taiwan

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Received: 28 May 2018; Accepted: 23 July 2018; Published: 3 August 2018

Abstract: Because of the numerous types of world heritage that currently exist, UNESCO divides them into four categories: cultural heritage, natural heritage, cultural and heritage dual heritage, and cultural landscape heritage. Taiwan's Cultural Heritage Preservation Act stipulates that tangible cultural heritage include monuments, historic buildings, commemorative buildings, groups of buildings, archaeological sites, historic sites, cultural landscapes, antiquities, and natural landscapes and natural monuments, whereas its intangible cultural heritage include traditional performing arts, traditional craftsmanship, oral traditions and expressions, folklore, and traditional knowledge and practices. Because of continually increasing tasks associated with cultural heritage management, this study adopted research approaches such as compilation of relevant laws and regulations and interviews with managers to identify their needs in managing cultural heritage. This study posited that digital-based information management is highly conductive to managing cultural heritage. Thus, a dynamic cultural heritage management system was developed to help managers perform various heritage preservation and management-related work. The proposed system enables digitalizing related documents to facilitate their preservation, provides diversified functions that allow managers to conduct remote interactive management, and enables establishing various economical monitoring functions. This study used actual cases of cultural heritage preservation and input data collected from various management tasks into the proposed management system. Accordingly, the management functions of the system were verified successfully. The proposed system can help relevant departments manage cultural heritage, diminish the occurrence of problems concerning heritage management, reduce unnecessary waste of resources, and elevate the management quality of monuments and historical buildings.

Keywords: digitalized management; dynamic management; historic building; life cycle; historic building management system

1. Introduction

1.1. Preservation of Cultural Heritages in Legislation

Taiwan's current Cultural Heritage Preservation Act (Cultural Heritage Preservation Act 1997) categorizes monuments based on the competent authorities whose jurisdiction they fall into, and divides them into three classes, namely national, municipal, and county (city) level (Cultural Heritage Preservation Act), which correspond to Class I, Class II, and Class III, respectively, in prior versions of the Act (before 1997).

Since amendment of the Cultural Heritage Act in April 1997, the central government is no longer responsible for the management of individual monuments, which has been passed down to cultural affairs bureaus (or equivalent agencies) under county or city governments, thereby substantially increasing the responsibilities of such local-level agencies. Cultural heritages designated as monuments after the amendment were thereafter categorized as "national," "municipal," or "county" (city) level monuments instead of based on the prior class system. However, Class I and Class II monuments designated before the amendment retained these classifications.

A main bottle neck for the archiving of historic culture heritage information is that information is collected and archived by a variety of institutions and that each archiving organization has its own protocol and tradition of data storage and dissemination (Steenberghen et al. 2012). Monuments are classified according to their historic significance, and the classification of a monument is subject to change based on perceptions of this significance in different times. Furthermore, as awareness of cultural heritage preservation increases, numerous monuments have been recognized as such based on cultural significance as opposed to age; some are aged younger than 50 years old. Therefore, the term "monument" is no longer synonymous with centuries-old buildings. There are no tools capable of fulfilling all the specific functions required by Cultural Heritage documentation and, due to the complexity of historical assets, there are no solution as flexible and customizable as Cultural Heritage specific needs require. Bruno and Roncella have conducted a research on the implementation of a Historical BIM system for the Parma cathedral, Italy, aimed at the maintenance, conservation and restoration (Bruno and Roncella 2018). Arches is an open source software platform freely available for cultural heritage organizations to independently deploy to help manage their cultural heritage data. The needs and challenges in the heritage field identified have been confirmed through interactions between the Arches project and a range of practitioners (Arches 2018). The suitability of Arches to address these needs is demonstrated through steady growth of the open source community and an increasing number of implementations of the Arches platform (Myers et al. 2016).

1.2. Needs for the Digitalization of Cultural Heritages

History involves the preservation of valuable heritages over time. As such, monuments are valuable heritages that require preservation and maintenance. When historic buildings are left vacant, they are at a greatly increased risk of damage and decay as well as being a potential blight on their locality. The best way to protect a building is to keep it occupied, even if the use is on a temporary or partial basis (Pickles 2018). However, the diversity of monuments and overwhelming volume and complexity of related documentation have posed a formidable challenge to local-level governments. Thus, the Ministry of Culture in Taiwan participates in the Digital Development Project initiated by the National Development Council, which aims to collect all related information to provide an integrated service (Yang et al. 2007). In the Digital Development Project, digital technologies are used for the "preservation, interpretation, open access, and public use" of history with a view to passing precious historical relics on to subsequent generations. To this end, digitalization of cultural heritages should be implemented down to every detail to preserve and document every monument on an "as is" basis.

1.3. Research Motive

According to the Cultural Heritage Preservation Act, the historical buildings shall be examined and registered by the competent authorities of the municipalities and counties. These cultural assets shall be notified for inspection by the central competent authority. Historic buildings were built by the Netherlands, the Qing Dynasty, the Japanese Occupation, and the Republic of China, retaining valuable and representative buildings throughout Taiwan. Management of cultural heritage in Taiwan is often flawed, partially because cultural heritage is highly diversified and requires extensively varied management measures, and partially because the county or city level agencies that such management is entrusted to are commonly not provided with adequate training and effective management tools as well as lack the funds, human resources, and expertise for such an undertaking. These flaws threaten

the integrality of preserved cultural heritage and also serve as a sign that conventional management practices are insufficient for such a complicated task.

1.4. Research Purpose

The dynamics of cultural heritage management involves two aspects: the dynamics of value identification of each generation that cultural heritages represent and the external dynamic changes that cultural heritages experience in physical spaces (Jung 2008). Because cultural heritage is recognized consecutively, the number of sites continually increases. For example, Taiwan currently contains more than 1300 recognized historic buildings, and the documents related to each one generated during various stages of management are so diverse and high in number that only digitalization can facilitate the storage of these documents for subsequent examination, surveying, and circulation. Moreover, the standardized procedure of digitalization facilitates the preservation of such documents and the creation and formulation of new resources, products, and concepts to meet the needs generated when discovering new information. Furthermore, the publication of digitalized information on open platforms for academic, educational, and general use can promote public sharing and participation. Therefore, the research objective of the present study was threefold and is described as follows.

A. Explore the management of the life cycle (LC) of historic buildings and compile a data list required for each management stage as a basis for the development of digital management tools.
B. Analyze the database architecture required by a historic building management system as well as the attributes of its columns and rows and their relationships for the establishment of a database.
C. Establish a low-cost and low-requirement management system and associated digitalized dynamic management module in a network-attached storage (NAS) platform to improve the management of historic buildings.

2. Methodology

2.1. Literature Review

The present study reviewed and analyzed the Cultural Heritage Preservation Act and associated codes and regulations, the Historic Site Maintenance and Examination Manual, and operational details for the historic building LC management to identify appropriate information management methods to establish database architecture for historic building management. The columns and rows of the database as well as their attributes and relationships were analyzed, after which input and output interfaces were developed according to the operational content of various management stages and thus can be used by the public and administrators (Lin 2012). In addition, the present study consulted the literature for difficulties faced by authorities worldwide in the management of historic buildings and analyzed the strengths and weaknesses of management tools used to render the proposed management system suitable for Taiwan's specific needs.

2.2. Interviews with Administrators

First-line administrators of historic buildings were interviewed regarding the problems they faced, content of their administrative and management roles, and desired features for the aforementioned management tool. After discussing with managers and experts, the difficulties encountered in the management of historic buildings include:

A. Building owners' willingness to apply for monuments is generally low;
B. The damage to buildings caused by improper use of monumental users and climate change;
C. The construction and repair of historic sites are very extensive, and the management of the project is not easy;
D. The scourge from people, including war, urban development, improper management, etc.;
E. Insufficient management manpower and resources of historic buildings.

The requirement for the function of the historic building management system includes (1) the management system is easy to operate, (2) the interface is user friendly, (3) the data is stored centrally, and (4) data query and management is fast and instant. The results served as a reference for the development of the management system.

2.3. Establishment of the Management System

The developed prototype may lessen the future investigation effort of heritage specialists by making the chronological information of a historical building more integrated and coherent, through increased readability, accessibility, and visibility. This, in turn, supports the planning of restoration projects, as well as provides a static and comprehensive archive (Saygi et al. 2018).

This Historic England guidance sets out the process of investigating and recording historic buildings for the purposes of historical understanding. It aims to assist professional practitioners and curators, managers of heritage assets, academics, students, and volunteer recorders in compiling or commissioning records that are accurate and suited to the purposes for which they are intended (Rebecca 2016).

The functions of the proposed management system, including the storage, duplication, editing, transmission, examination, statistical analysis, and analysis of digital data, can improve the implementation of management strategies and regulations and enhance management effectiveness. In contrast to the one-way republication of ordinary databases, the proposed system could be integrated with other hardware and software for additional functions to enable a comprehensive and all-encompassing dynamic management tool for historic buildings.

3. Results

3.1. LC of Cultural Heritage Buildings

The LC of a building is the process of its planning, design, construction, use, maintenance, and eventual demolition (The Magic School of Green Technologies)[1]. The LC of a cultural heritage building consists of the following stages.

3.1.1. Review

The LC of a cultural heritage building is similar to that of any building except that it begins with a review and registration stage, during which competent authorities organize a committee to review the designation, registration, or revocation of the building in question (Article 6, Cultural Heritage Preservation Act). The participants in this stage include business owners, property owners, competent authorities, and experts. The management responsibility of managing historical assets is allocated to individuals, which has complicated the relationships among stakeholders and led to dissipation of assets and conflicts. Jang et al. have focused on community involvement in the conservation management of Kanazawa Machiya, a Japanese historic building (Jang et al. 2017). Adu and Ngulube have used the survey approach to address the digital preservation strategies deployed across public-sector organizations in Ghana. It underscores the link between the conceptual framework and the literature to analyze the various digital preservation strategies (Adu and Ngulube 2016). A hierarchical Bayesian model has been developed for predicting monthly residential per capita electricity consumption at the state level across the USA (Wang et al. 2017). Zhang et al. have proposed an approach that can be used in the industry to provide positive guidelines on the safety management of historical buildings against public structure construction damages in Wuhan, China (Zhang et al. 2015). On-site investigation and literature searching and collection have been used by Jia to investigate ancient buildings located in Jin-Fen, Shanxi Province, China. In this project, the spatial

[1] http://www.msgt.org.tw/research2.php?Type=15&menu=research2_class&pic_dir_list=1# (accessed on 28 May 2018).

distributing Geodatabase of study objects is established utilizing GIS. The BIM components library for ancient buildings is formed combining on-site investigation data and precedent classic works (Jia et al. 2017).

3.1.2. Restoration Planning

After a building has been recognized as a cultural heritage by a review committee, it enters into the restoration planning stage. In contrast to the planning and design stages of a new building, the agencies responsible for restoration planning consult experts regarding restoration, repair, improvement, and reinforcement tasks to restore the building to its original state. The use of authentic material helps to retain the character of historic buildings and in turn supports traditional industries and vital craft skills. Buildings inevitably decay over time and will need repairs or materials replaced. However, sourcing the correct replacements can in some instances require considerable expertise and investigation (Historic England 2018).

Conservation, restoration and retrofitting interventions in historic buildings do not have the same objectives as in modern buildings. Additional requirements have to be followed, such as the use of materials compatible with the original and the preservation of authenticity to ensure historic, artistic, cultural and social values over time (Loli and Bertolin 2018). The participants in this stage include business owners, property owners, competent authorities (e.g., the cultural affairs bureau, fire department, building management agencies), experts, craftsmen of traditional architecture, and contractors.

3.1.3. Construction Management

After the scope of required restoration work has been determined, the required tasks must be conducted in accordance with existing codes and regulations, including those related to construction methods, craftsmen's credentials, and selection of construction materials. The participants in this stage include experts, architects, supervisors, qualified craftsmen, and contractors.

3.1.4. Operation Management

After appropriate planning and restoration, the registered cultural heritage building is brought back into use. Depending on needs, the building can serve educational, research, or display purposes or be leased for other uses. The participants in this stage include property owners, leaseholders, visitors, business owners, and researchers (Teng 2004).

3.1.5. Revocation and Demolition

If a building is damaged and loses its original appearance, loses its main structure because of natural disasters such as fire, flood, or earthquake, or loses its value as a cultural heritage for other reasons, competent authorities review its current state and determine whether to revoke its cultural heritage status. The participants in this stage include business owners, competent authorities and a review committee, building management agencies, environmental protection agencies, and waste disposal contractors.

3.2. Digitalized Dynamic Management

Factors such as global climate change, conflict with urban development, and owner participation can all influence the preservation and management of historic buildings. In the various management stages with the multiple variables, competent authorities must implement dynamic management thinking and methods to cope with the need for instantaneous management, emergency management, routine management, demand-based management, mobility management, and active management. Therefore, a proposed management platform should provide unobstructed communication channels

between administrators and users and overcome legal restrictions or technical problems to ensure smooth technical operation and data maintenance (Yang 2009).

3.3. Difficulties and Challenges Inherent in Conventional Digitalization and Information Management

Through interviews with historical building management personnel, historical building maintenance personnel and information management experts, this study has summarized the management difficulties and challenges encountered in the process of digitalization and information management of historic buildings. The difficulties and challenges inherent in the conventional digitalization and information management of historic buildings are described as follows:

A. Hardware

(a) Hardware is costly to manage and must be upgraded after reaching its lifespan, which is also costly.
(b) Data transfer—a necessary stage of updating hardware—entails a high risk of data becoming corrupted or being lost.
(c) Requirements for additional functions or features may be difficult to meet; for example, the functions of monitoring, live streaming, and statistical analysis are relatively costly.

B. Software

(a) The transmission, duplication, editing, and storage of data rely on trained information engineers.
(b) Software supporting specialized management features may be expensive owing to high development costs.
(c) Independent software development is difficult.

C. Other

(a) Information management may require outsourcing if administrators lack expertise in information technologies.
(b) Conventional one-way management systems cannot simultaneously satisfy the needs of all related management levels (central government, city or county government, and subsidiary agencies).
(c) Management system requirements can be extremely complicated owing to the highly diversified management targets (e.g., various types of monuments, personnel, and files).

3.4. System Structure

3.4.1. Hardware Architecture

The emergence of network-attached disks provides the possibility of transferring data between the storage system and the client directly. This offers new possibilities in building a distributed storage system (Ma and Reddy 1998). In contrast to conventional management systems that require specialized information engineers and high-end servers, the proposed system has the advantages of low hardware costs, a low technical threshold (easy to learn), and high expandability. Thus, it can alleviate administrators' technophobia and eliminate the need to hire specialized information engineers to assist in data transfer or hardware upgrade due to the increase or change of digital data. Additionally, the proposed system enables both the administrators and users to identify the most adequate solutions to meet their needs through their continuous interaction via the system.

Network-based storage systems have traditionally been dominated by NAS and Storage Area Network (SAN). Cloud-based storage systems, including object storage, have gained growing popularity among users in recent years (Ou et al. 2018). Use of NAS has considerably increased the usage rate of digitalized data related to historic buildings, primarily because such data are no

longer stored in conventional high-end servers but in the NAS. Thus, administrators and general users are no longer denied access to such data because of server shutdown. Moreover, NAS substantially simplifies data management by simplifying the complicated setup procedure—which originally had to be performed on the server—into several easy steps. This not only saves administrators a lot of time but also greatly lowers the technical threshold. Overall, NAS has the following advantages:

A. Convenient data sharing, access, and authority management;
B. A higher processing speed, and hardware can be expanded or upgraded based on various management stages or needs;
C. Secure data preservation with multiple backups;
D. Simplified settings and a low technical threshold;
E. Accessible from diverse platforms such as personal computers, smartphones, tablets, and televisions;
F. Convenient data sharing and other convenient features in addition to data storage;
G. Diversified applications such as database management, video streaming, image storage, and website construction.

3.4.2. Features of the Proposed Management System

The software developed in this study is aimed on the system analysis and establishment of software. The tool is designed for administration personnel to improve management tasks and promote performance. The management system structure is integrated through literature review, regulatory evaluation, and clarification of the unique life cycle stages of historic buildings. The proposed structure is then discussed with the historic building managers for various forms and processing information for different management stages. The proposed system has following features:

A. Homepage: user instructions, file download, and video streaming.
B. Application section: Application submission and document upload (ownership certificate and associated documents).
C. Review section: Documents required for application, site visit records and documents, review committee minutes, provisional meeting minutes, and reporting procedures.
D. Design and planning section: Restoration and reuse proposal, review committee minutes, project budget proposal, and design drawings.
E. Construction management section: Construction management plans, construction diaries, construction supervision reports, and progress reports.
F. Operation management section: Routine maintenance and periodic repair plans, reuse operation and management plans, emergency plans, maintenance and management plans, measures against anomalies, disaster prevention plans, insurance policies, maintenance reports, test reports, repair reports, records of major disasters, records of notable events and activities, visitor statistics, purchase contracts, volunteer roster, chronicle of notable events, financial statements, and payment balances.
G. Revocation and demolition section: Architect information, contractor information, site supervisor information, restoration and reuse project director information, construction progress report director information, planning and design director information, site director information, craftsmen information, review committee member information, construction methods, construction materials, volunteer roster, competent authorities, and roster of personnel on duty.
H. General information maintenance section: Architect information, contractor information, site supervisor information, project director information, construction management director information, planning and design director information, site director information, craftsmen information, review committee member information, construction methods, construction materials, volunteer roster, competent authorities, and roster of personnel on duty.

I. Inquiry section: Codes and regulations, personnel information, and application progress. The management system is primarily designed to be used by competent authorities; therefore, general users are only permitted to inquire about the procedure and progress of applications. However, this restriction may be relaxed when necessary.

4. System Development Process and Results

4.1. Hardware Selection

The present study forewent the conventional practice of storing digital data on a server, instead proposing that competent authorities should select appropriate NAS devices depending on management stages or budgetary considerations. Specifically, this study advised competent authorities to analyze the specifications of various management devices and select hardware based on the authorities' scope of jurisdiction and their level of digitalization for data preservation. The QNAP TS-431X-2G network storage server (QNAP Systems, Inc., Taipei, Taiwan) is used in this study. The selection mechanism for this device is based on the specifications provided by the device manufacturer and the researcher's own experience. This device can support up to four hard disks.

The proposed system relies on its hardware's default features for competent authorities to perform account registration and access settings (adding, editing, and deleting data and other inquiry functions) based on the tasks and responsibilities of various administrators (supervisors, site investigators, and data management personnel).

For the back-end management interface of the proposed system, various types of free software provided by the system developer were installed according to the tasks involved in the management work. Table 1 contains a list of the installed software. The reason for using the software in Table 1 is because they are free. Mobile inspection and control such as cloud-based monitoring and site monitoring could be achieved through the installation of corresponding applications on mobile devices.

Table 1. Software list for the proposed management system.

	Name	Type	Function
1	Windows Explorer	File management and browsing	Browsing of management files and data
2	Music Station	Audio file management and browsing	Browsing and playing of audio files
3	Photo Station	Image file management and browsing	Browsing and displaying of image files
4	Video Station	Video file management and browsing	Browsing and playing of video files
5	Surveillance Station	Surveillance file management and browsing	Surveillance
6	WordPress	Establishment and management of blogs and websites	Establishment of websites, bulletins and application interfaces
7	Joomla	Establishment and management of blogs and websites	Establishment of websites, bulletins and application interfaces
8	phpMyAdmin	Database	Provision of digital database management tools
9	Virus protection	System protection	Regular update of virus pattern files to protect the system from virus attack
10	LimeSurvey	Digital surveying	A survey management system for surveying and analyzing various management tasks
11	QmailAgent	Email management	Quick access to contact information

4.2. Operating Interface and Access Settings of the Proposed Management System

Super administrators set administrative privileges based on different users. Different competent authorities and their subordinate administrators log in their accounts on the management system (Figure 1) based on their levels of access authorization. The users in the system were assigned different execution authority to assure the security and privacy of the data. Through the back-end interface

(Figure 2), administrators can choose a default function to perform; alternatively, they can download new tools to add functions they need (Figure 3). Management can also be performed on mobile devices (Figure 4).

The NAS has a built-in surveillance system that can incorporate a separately sold cloud-based web camera for site surveillance (Figure 5). Recorded image and video files are directly stored within the system. Thus, a separate monitoring system need not be purchased. For historic building management departments, the site surveillance system is used to monitor the managed objects. When there is improper external damage, personnel can access the surveillance film to find out the perpetrators and prevent the protected objects from being vandalized by external factors. The administrators are allowed remote control of the surveillance system through mobile devices (Figures 6 and 7) and can organize data on personal computers (Figure 8). This approach is expected to effectively enhance dynamic management performance.

The proposed management system is equipped with a page for administrators and general users to submit applications (Figure 9). Administrators are responsible for adequately preserving and inspecting the digital data generated in the various stages of a cultural heritage building's LC, namely the review, design and planning, construction management, operation management, and revocation and demolition stages (Figure 10). As mentioned, general users are also permitted to submit applications for the recognition of new cultural heritage buildings and inquire the progress of their applications to promote civic participation. An additional benefit of this practice is that the review process achieves greater information transparency.

The administration department of this study is Cultural Bureau, Changhua County in Taiwan. The sample managed target is North Classroom Building in Zhongshan Primary School in Changhua County. There are too many historic buildings to be managed by the Cultural Bureau, and there is insufficient manpower to assist in management. Through this management system, the personnel can remotely inspect the building territory, visualize the appearance of cultural relics, examine environment cleaning, and manage the daily equipment maintenance.

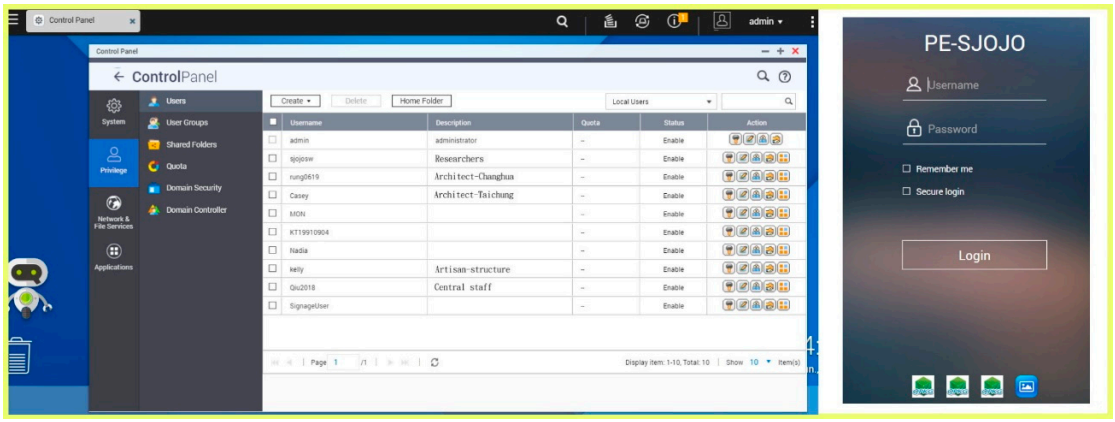

Figure 1. Permission setting page and system login page.

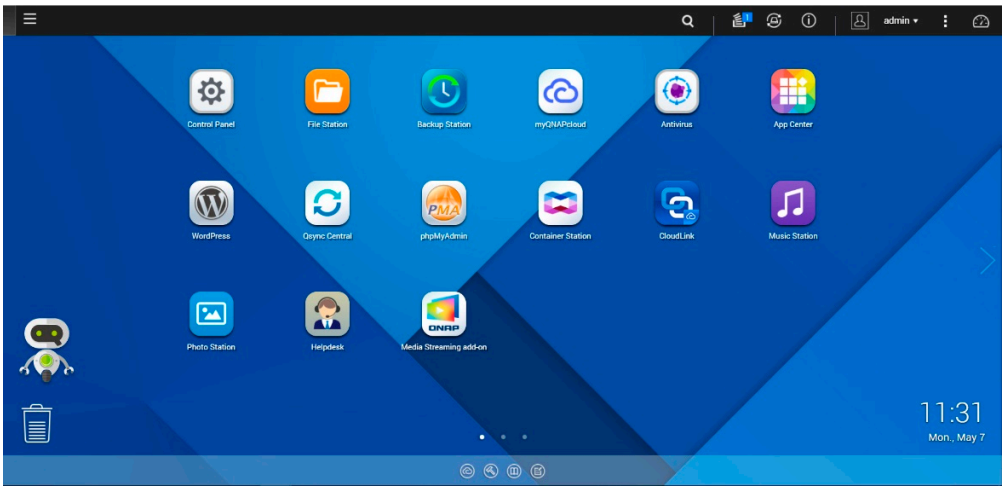

Figure 2. Back-end interface.

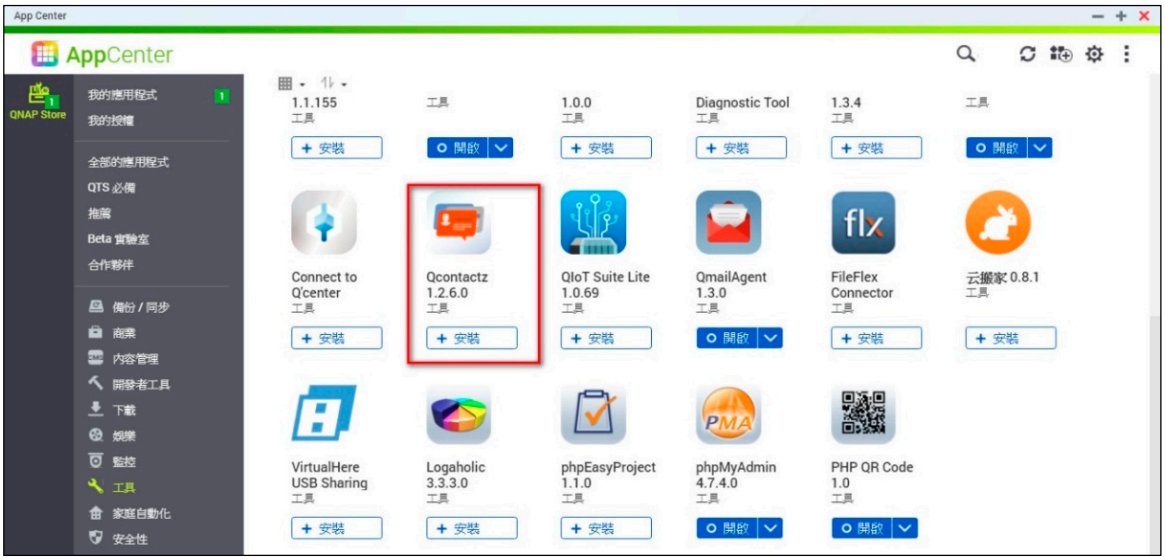

Figure 3. Downloadable free apps.

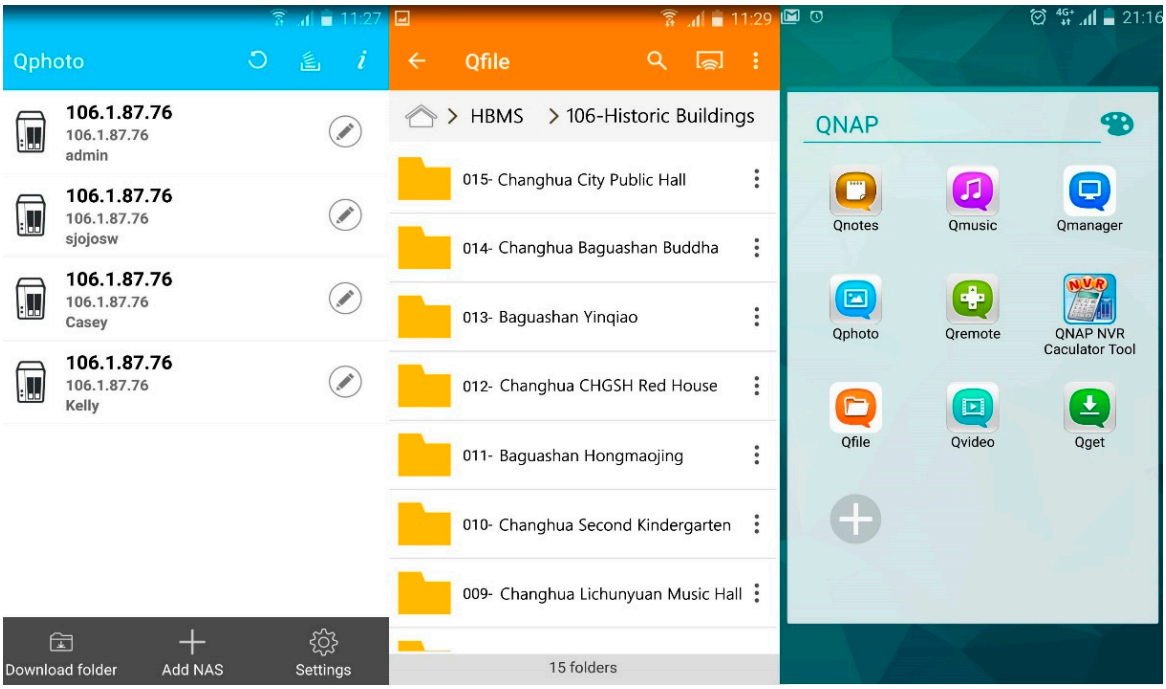

Figure 4. Software management interface on a mobile device.

Figure 5. Cloud-based surveillance system with wireless camera.

Figure 6. Monitoring interface on mobile devices (warnings and notifications).

Figure 7. Panorama of a site displayed on a mobile device.

Figure 8. Backup interface of the surveillance and management system on a personal computer.

Home | Fill in | Review | Design planning | Construction management | Operation Management | Abolished, demolished | basic information | Query Job

Information			
	Application number	Cultural assets law NO.14	
	Application unit		
	Date of Application		
	Application category	Monuments	
	Address		
	Name		
	Application scope		
	Species	House	
	Ownership	Buildings	Public
		Land	Public
	Construction owner application	Building owner	
		Building users	
		Building Manager	
		Landowner	
	Historical evolution	Created	
		Narrative	
	Overall features	Building style	
		Environmental characteristics	
	Situation		Good
	Note		
Upload			
	Photo Or Description		
	Feature Photo Or Description		

Figure 9. Application page on the management interface.

Home | Fill in | Review | Design planning | Construction management | Operation Management | Abolished, demolished | basic information | Query Job

Traditional craftsmen	
Name	
Nickname	
Gender	
Date of birth	
ID	
Address	
Phone	
E-mail	
Traditional technical work items	
Upload Cancel	

Figure 10. Information maintenance section on the management interface.

4.3. Investigation Management Software

The proposed management system supports a mobile app version for use by administrators and general users (Figure 11). Once the app has been turned on, it automatically initiates the Global Positioning System for location services; the user can fill in the information about a site by the default categories in the blanks at the right side of the window. In addition, when the user is investigating a historic building, he or she can turn on the app and take a snapshot of the building as a record (Figure 12).

If damage is noticed, a user can directly highlight it on the mobile device (Figure 13) and upload the image to the management system after filling in related information of the building (Figure 14).

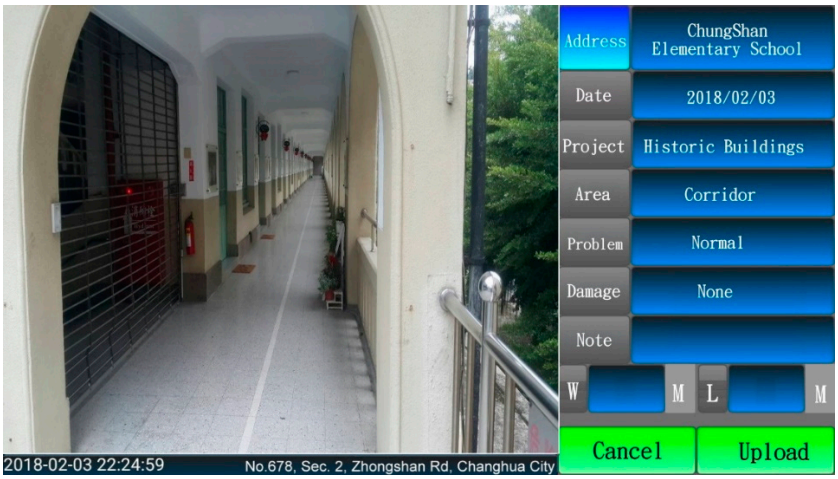

Figure 11. Automatic positioning and default information categories.

Figure 12. Page for taking snapshots of a building.

Figure 13. Marking out a certain area.

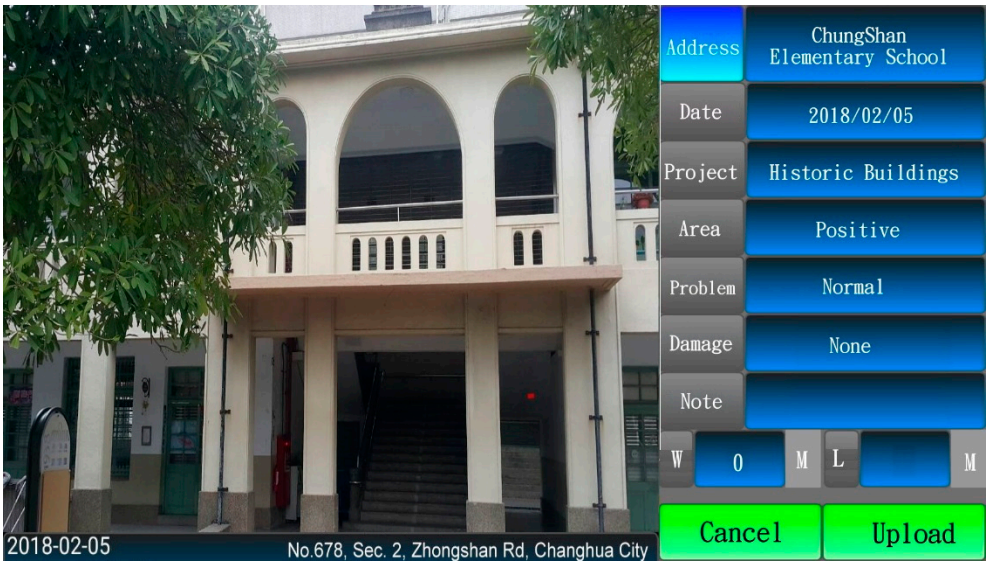

Figure 14. Filling in related information before uploading the image.

5. Conclusions and Contributions

5.1. Conclusions

The present study developed a digitalized management system for historic buildings. The system is a convenient and user-friendly platform that enables competent authorities to perform quick, centralized, and economical management of the digital data of various cultural heritages. Overall, the system possesses the following advantages:

A. Convenient: The structure and required functions of the software are developed after interviewing with the historic building management personnel. The software system is developed according to their needs, therefore, which is convenient for their management requirements.
B. Ease of operation: Administrators can perform cloud-based data management through web browsers.
C. User-friendly interface: The interface of the system is also a commonly used window component, which is familiar to the operator, so it is quite easy to get started.

D. Quick data review: During a site visit, administrators can use mobile devices to quickly send investigation data back to the management system through the mobile app for management and storage purposes.
E. Centralized data preservation: The management system can categorize and store surveillance images, digital data (image, text, video, and audio files), investigation reports, and applications for later use.
F. After the system is developed, the maintenance tasks will be transferred to the administration department. By transfer of maintenance documents, no additional cost is required for professional information engineers. Additional hard drives can be purchased if users need to expand storage spaces.

5.2. Contributions

The present study examined the problems inherent in contemporary digitalized systems for managing historic buildings and developed a new management system. Potential users of this system are the historical building administration departments of counties and cities across the country. Therefore, this study can be considered to have made the following contributions:

A. This study investigated the processes and problems of contemporary practices for managing historic buildings.
B. This study examined the practices of preserving the digital data of historic buildings and established key management tasks in each stage of such a building's LC. The various functions of the proposed system can provide guidance for administrators who are unfamiliar with historic buildings.
C. This study established guidelines for the digitalized management of cultural heritages, promoted digitalized management for historic buildings, and developed a management system suitable for city- and county-level agencies. Moreover, the results are expected to be applicable to other types of cultural heritages.

Author Contributions: Conceptualization, Y.L.L.; Methodology, M.J.L.; Software, Y.L.L.; Validation, M.J.L.; Formal Analysis, Y.L.L.; Investigation, M.J.L.; Resources, M.J.L.; Data Curation, M.J.L.; Writing-Original Draft Preparation, Y.L.L.; Writing-Review & Editing, Y.C.S.; Visualization, Y.L.L.; Supervision, Y.C.S.; Project Administration, Y.C.S.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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