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2D BARCODE-BASED PROPERTIES BREAKDOWN REPORTING AND MAINTAINING MANAGEMENT SYSTEM

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ABSTRACT

There are many educational properties and facilities (such as PC, projectors, and lights) in every classroom of school. Generally, maintenance worker need to inspect and maintain the educational properties one by one in each classroom. Usually, maintenance workers use sheets of paper to record the maintenance information. In traditional process, it is serious rework progress in maintenance progress. Regarding to properties breakdown reporting process through the paper-based documents, the breakdown reporting process are ineffective and can not get the quick respond real-time if the property doesn't work. This paper demonstrates the effectiveness of a mobile 2D barcode-based property maintenance management application, called the M-BPMM system that responds efficiently and enhances breakdown reporting performance and maintaining management. The M-BPMM system is then tested in a Taiwan University to verify our proposed methodology and demonstrate the effectiveness of Facility Management. Benefits of the novel solution includes not only improved breakdown reporting effectively for students when property or facility don't work in the university. They also enhance the maintaining management efficiency for maintenance workers in significant improvements of maintenance information management. Finally, the results of utilized M-BPMM system will be a useful property management system by utilizing the 2D barcode and web technologies.

Keywords: Information management system, Facility Management, Property management, 2D Barcode, QR code, Web-based.

1. INTRODUCTION

Maintaining management performance can be enhanced via web technology for information communication and record. Information management problems of properties management of classrooms contains too many types of property to fixed, and user uses sheets of paper in reporting process and maintenance worker always use sheets of paper for maintain progress in Taiwan school. Those kinds of process are time-consuming and inefficient that makes the low quality of education

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environment and bid communication between offices, maintenance workers, and managers. According the trade of 2D barcode contains characteristics of high contain quality and error correction capacity, and the smartphone are much more common than ever. Therefore, this study applies 2D barcode, smartphone and wireless that make the real-time maintaining system – 2D Barcode Properties Breakdown Reporting and Maintaining Management system. It be abbreviated M-BPMM system that can check and maintain property's information in time in the school through Internet. The goal of this study includes: (1) To provide a much more convenience trade and transporting information in time, so that M-BPMM system can provide information management efficiently. (2) To access the web-system and two-dimension barcode improve information transformation and wireless communication between users, mangers and maintenance workers. (3) To reduce rework and enhance Facility Management. (4) After the case study, to apply case study and identify advantages, disadvantages and limitation for future application.

2. BACKGROUND

Originally, the use of barcode was to tracking merchandise. However, someone found it too small to storage the information (the maximum of 20-30 digits). In 1994 of Japan, Denso Wave created one of the most popular types of 2D barcodes – QR code, which abbreviation for Quick Response code. QR code can be readable and decoded very quickly (Roebuck 2011). In the 1999, Denso Wave releases the patent of QR code, and then it was corresponded with ISO in 2000. So that everyone can use codes for free without paying anything. It has an error correction capacity in four level 7%, 15%, 25% and 30%, and the maximum dada capacity of QR code includes: Numeric code up to 7089 characters; Alphanumeric up to 4296 characters; and Chinese up to 984 characters. Users of QR code can find a lot of free (creatable or decodable) app software on the Internet (Lyon 2009; Weir 2010; Winter 2011; Roebuck 2011). Facility Management (FM) is defined that providing a good service and operation, which can make all related machine at lowest cost level (Richard 2007). Therefore, good service and operation of property management is important part of FM. Now in Taiwan there still less references about 2D barcode in Facility Management. Most of study about the basic of FM introduction or road plan. Saeed et al. (2009) used GPS, RFID, NFC and two-dimension barcode and connect with Internet, mobile device to create the system. Which can lead the user to destination and show surrounding information about destination in the virtue city. Chiang (2009) used barcode technology to developing the model of automatic guidance path planning for Cross-floor indoor. Huang (2010) created an automatically property coding system that can help to finish record work with transparent information. Lin et al. (2012) combined the barcode and BIM technologies to creating a preliminary system. The next sections of this study will describe the system design and implementation and case study applies in FM.

3. SYSTEM DEVELOPMENT

Due to the paper-based properties breakdown reporting process, the maintenance worker and manager usually waste time reworking and travelling to obtain information in communication process of FM. This study utilizes the 2D barcode and web technology to enhance the breakdown reporting and maintaining progress much easily and efficiently than before. The system will control and provide user the problem report of property, and maintenance worker will share and update real-time maintained information via the M-BPMM system in order to enhance the efficient of property management in school. Therefore, the M-BPMM system selects the i-Pod touch as smartphone hardware integrated with 2D barcode through Internet to connect the user and reporting system. The smartphone can extend the system from office to the property location. When the properties were selected, each of 2D barcode for property was made, it storage the system's URL and property's code, unique ID number were entered into M-BPMM database, then it can be scanned with 2D barcode to enter system. When user scans 2D barcode, he/she can connect the system and click one bottom to breakdown reporting quickly. And the maintenance worker scans 2D barcode, it can quickly connect the system, access to a wealth of properties information and update the information real-time and in time.

The system is programming by ASP.net to coordinate the web-based system which can be used by users and maintenance workers. The system contain three module includes: (1) Property module is to contain the basic information of properties including property's code, location, model, date of purchase...etc. (2) Maintain and Monitor module to let maintenance worker can check the real time reporting information, and update maintain results via a smartphone. And maintenance worker also can display the checklist for reporting about time, conditions, result, description of problems and suggestions...etc. For manager can access database to monitor the breakdown reporting and the progress of reporting. (3) Reporting module is to allow user to report problem of property directly via their smartphone in classroom. After the report is update, the maintenance worker and manager will get the FM effectively. Figure 1 illustrates framework Overview of M-BPMM system. There are two roles in the system. When user scans the QR code to access the system, user then selects the property problem and click report bottom to access the breakdown repotting process. So that the breakdown information will be updated in the system. For maintenance worker who can log-in and check repair location, time, problem...etc in the system, the manager can also update and monitor the FM results in time. According the above technology and designing of the system that can achieve the goal of this study.

4. CASE STUDY

The traditional FM processes of school were inefficient. The first process reporting property problem for user, the second process maintaining management for maintain workers. As explained above, the study proposed the M-BPMM system to optimization some steps of these two processes.

In order to vivificated the system for FM process of Taiwan School. The following case is applied in classrooms of Taiwan school, which contain PC and e-Table...etc.

The M-BPMM system based on Access and ASP.net to create the system, and it is developed to transmit the problem information of property in time, then the process of maintaining management can be eliminated. As it applied in traditional workflow, these two main Facility Management processes use 2D barcode of the M-BPMM system with an i-Pod touch as smartphone hardware (see Fig. 2).

Reporting property problem for user

The process used the paper documents or oral to get the reporting information. Usually, the information was missed, lofted and transported for long time to maintenance worker. Sometimes, user is unwilling to reporting problem due to the complex process. The new process, user can just scan 2D barcode then the system will connect the system automatically. System will import ID number automatically, then user can just choice the problem of property to reporting. The information can be transported in breakdown to maintenance workers without missing or misplaced when the user connects to the network.

Maintaining management for maintenance workers and manager

The existing process: (1) The problems was informed via oral or paper, and it needs to be checked at office by manpower. (2) When maintenance worker finish a reporting, he needs to feedback the result with paper recode, than repeated data entry to existing system when goes back to office. (3) The manager needs to check the schedule of reporting by manpower for a long time. In the period of existing process is wasteful and error prone because it requires repeated data entry and missing data easily. With the M-BPMM system, the reporting is transported in time. The maintenance worker accesses the information into system after inspecting or fixing properties, updating the recodes with new or replacement property information (see Fig.3). The information will be synchronized with the central database when the work connects to the network. Then, manager can monitor the schedule in time via system even the attendance of workers.

In the case of results indicate that users and maintenance workers feel the M-BPMM system are effective tools for FM in school. Table 1 show the comparison between traditional and proposed methods. The principal advantages of M-BPMM system are concluded as follows: (1) Integrated the 2D barcode, it has characters of error correction capacity, easy to readable and low-cost. It can avoid high frequency of replace 2D barcode. (2) The system is easy to use. The users can just click 2~3 steps to report or finishing the recode of reporting. (3) When maintenance workers read the 2D barcode of property, system will imports the ID number of property automatically and shows the information, then updates the repair status right away. (4) The managers can monitor FM progress, the reporting s' breakdown situation and the maintenance worker's attendance, so that can truly reduce time and manpower. With the smartphone and 2D barcode getting common and convenience, it makes more easy and convenience report and maintaining management. With 2D barcode and

M-BPMM system that provide the quick and efficient mechanism of information transmission. The disadvantages of M-BPMM system includes that smartphone require at least 30 million resolutions and light to reading 2D barcode. If the distant between barcode and smartphone is too far or too crooked that the barcode will be read unsuccessful. And the system need in the Internet environment that can connect the system to check latest result and update the recode quickly. The limitations of system are the accept degree of maintenance workers using the M-BPMM system, and the maintenance workers will not accept the reporting when they getting off duty, it maybe cause the low efficient of maintaining management.

5. CONCLUSION

The inefficient of facility management process, breakdown information and efficiency management of properties influence the overall FM activities. This study presented and provided the M-BPMM system to improving maintenance management with communication and data transportation real-time among participants. The systems combine 2D barcode, mobile devise and web-base technologies to bring maintained information in real time and connect the system via Wi-Fi or 3G. The 2D barcode is a critical tool in storing URL, property's code, and connecting system automatically. The smartphone as an interface which presents the system, and input data in anytime. Integration of above technologies and tools can be utilized to enable an efficient, improve maintenance management process.

The M-BPMM system functions includes: establishing data transportation channels for participants (users, maintenance workers, managers); developing and managing a real-time procedures; and monitoring the processes of reporting and attendances of worker. Therefore, the primary goals of this study were provided an mobile 2D barcode-based property maintaining management, accessible over wireless on mobile device, can further improve communicate, monitor, and update real-time information among participates in anywhere. With validation and certification the system, this study applied in case study of Taiwan school, which shows how information can be transmitted, integrated, updated efficiently to manage and compile the data in systematic. Overall the user of properties, maintenance workers, and managers are willing to use the M-BPMM system. The M-BPMM system can reduce wasting processes, provide accurate and real-time electronic data, and increase efficiency in maintenance management. The expectation that there will apply more cases to feedback system, and revise the M-BPMM system makes it better. Future studies are required to further improve the user interface of the system and enhance the functionalities of system, such as electronic properties manual, attendance management, and so on. Since damage of 2D barcodes impact by environmental and time factors easily. Therefore, it is recommended that manager attach the protect mode on barcodes, that will make the system more complete and extend the use of time.

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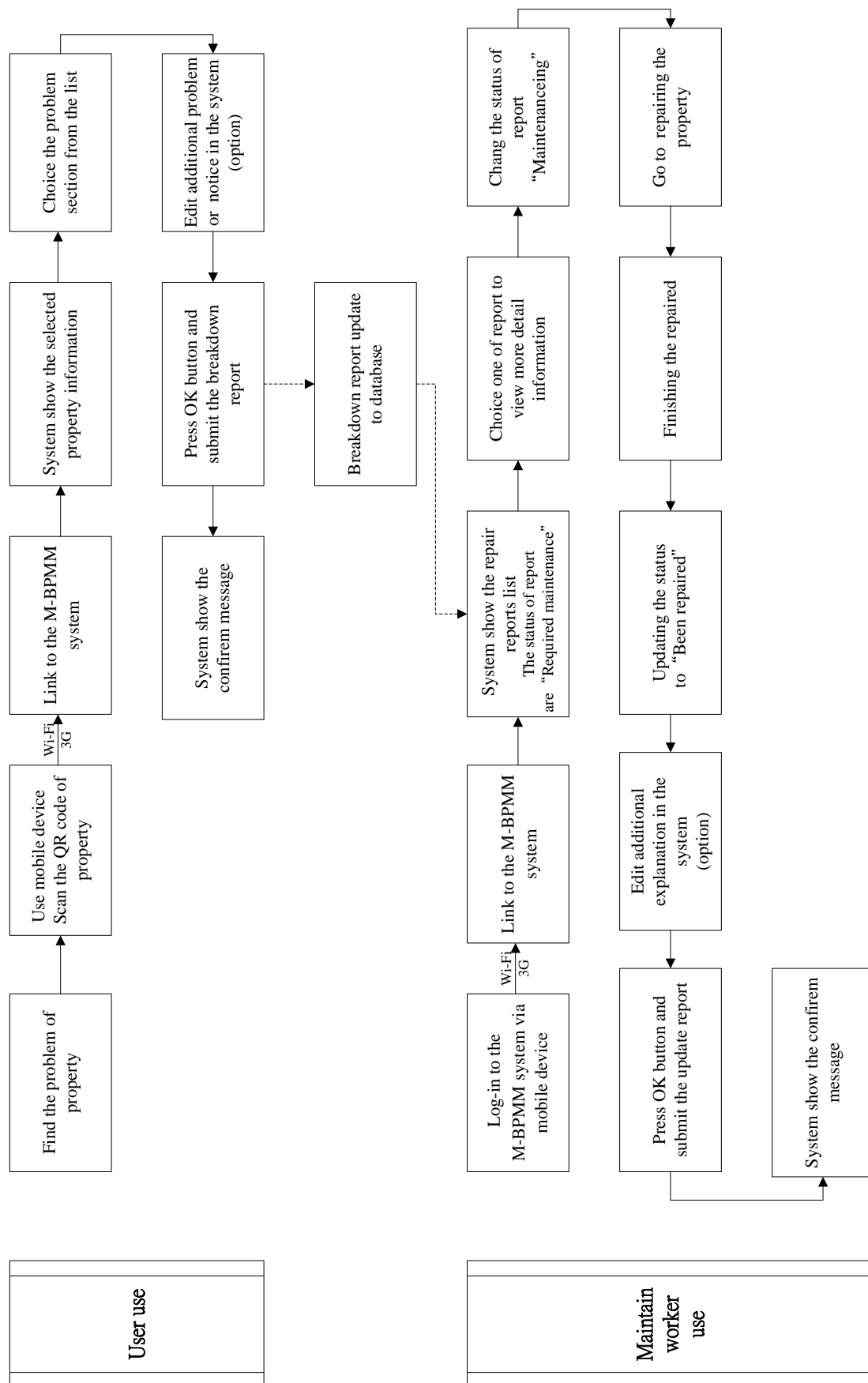


Figure1: Framework Overview of M-BPMM system



Figure 2: displayed the E-table attached 2D barcode label



Figure 3: displayed interface of M-BPMM system

Table1: Comparison between current approach and proposed approach

	Current Approach	Proposed Approach
Maintain Management	<ol style="list-style-type: none"> 1. Use the paper-bead process to transmitting the mission information and recode. 2. The information need be collected to management part for data reentry. Therefore, it takes long time to acquire information. 3. In traditional process, it was waste time, manpower, and ineffective data managing for maintain management. 	<ol style="list-style-type: none"> 1. User can report directly via smartphone in classroom, and easy select the problem of properties to reporting in breakdown situation. 2. Maintenance worker can get latest reporting information from system in anywhere, and he/she can scan the 2D barcode and update the recode information directly to system. 3. Manager can use the system monitor the real process of FM and maintenance worker's attendance situation. 4. In proposed of the system, it provide an better channels of data transport and management for all participates of maintain management.