An Online Equipment Management System Utilizing Prescriptive Analytics

Mark Anthony M. Tamayo, Praxedis S. Marquez
Technological Institute of the Philippines, Quiapo, Manila, Philippines.
markypolly@gmail.com; mayamarquez@yahoo.com

Abstract - In this paper, the researcher aims to develop An Online Equipment Management System Utilizing Prescriptive Analytics for Property Department of University of Perpetual Help System Laguna using latest technology in tagging, the QR code technology. Specific objectives of the study is to (1) develop a mobile equipment management system using QR Code to tag and monitor the equipment status. Also, (2) to apply prescriptive analytics in to determine the status of such equipment and generating reports for decision making. And (3) to evaluate the performance of the proposed system in terms of efficiency, reliability, operability maintainability and security.

Keywords - Quick Response, QR, equipment management, prescriptive analytics, web based, security, property custodian, ISO 25010, bootstrap

I. INTRODUCTION

Property Management plays a significant role in every industry. It helps most of the proprietor as well as the property management department to monitor various equipment that are used for such purposes. Furthermore, due to infinite enhancement of modern technology, most of the company and institution are embracing in automated solution. [1]

However, it is difficult to monitor and analyze each equipment depends on its condition. First, if the acquired equipment is subject for repair or maintenance? Second, if such equipment is for disposal? Third, whether it is for upgrade or replacement. Fourth, if the equipment stays in mint condition or in good condition. Therefore, there is need for better Property Management System to offer prescriptive data analysis for better decision making.

This study aims to develop An Online Equipment Management System Utilizing Prescriptive Analytics for the School Division of University of Perpetual Help System Laguna. It is also utilized with the latest tagging technology, the QR code. QR code technology overtake its predecessors the barcode that holds a small number of characters. Unlike QR code, it can handles up to 7000 characters which is enough to embed description, website URL and other important details that describe the equipment.

II. RELATED LITERATURE

A. Quick Response (QR) Code

In 1994, Denso Wave developed quick response (QR) code in Japan. QR codes are two-dimensional bar codes that are capable to store large amount of information or data compare to its predecessor, bar codes. In comparison between these two technologies, QR code can hold information in both vertical and horizontal directions, while bar code contains information in one direction only.

Figure shows the sample layout of QR code. This piece of code can contain huge information such as URL, emails, product information, promotional details and others. It can hold up 7,000 characters which overtakes its predecessor, the barcode.

As mention earlier, QR Code holds a considerably greater volume of information or data types than a bar code .Data types such as: Contact information: contain contact details, name, contact number, email address, postal address, website/webpage and more. Calendar event: affair title, date and time, place, description, and event poster, E-mail address, Phone numbers, Location / Geo location: QR code can be link to a Google Maps location. Instead of encoding the address manually, just simply scan the QR code and it will provide the specific location [2].

Furthermore, QR code can be place in various mediums. QR code can be seen on product packages, promotional flyers, posters, product labels, calling cards, and even license cards [3].

To date, more institutions and companies came across to this type of effective tool to disseminate information and promote services [4]. Example, in marketing industry, QR
code is further popular due to mobile technology [5]. By using smart phones, just simply scan the provide QR code and instantly proceeds to the specific landing webpage.

**B. Prescriptive Analytics**

For a business want to stay competitive, it is significant to endlessly adjust for any types of business process. Today, modern data processing is continuously experimented specially in the use of sensor technologies to gather huge amount of data that may potentially be used for data analytics driven process [6].

One of the fascinating types of data analytics is the Prescriptive Analytics. It provides great help for the decision makers to analyze not only the present situation but also forecast potential opportunities and solution in the future [7]. Sharda defines Prescriptive Analytics as dissecting information, facts and figures to create judgment, solution or recommendation. Recommendation in a way of answering directly yes or no for a particular question, states amount to show cost and benefit analysis or value of an item, or providing a comprehensive set of idea for better decision making. With this set of information, it may present to the management or decision makers as a report or directly use to a prescriptive analytics system [8].

**C. Evaluation Score**

According to the National Atmosphering Deposition Program for their Guidelines for Evaluation and Approval of Equipment for the NADP WetDeposition Networks (URL: http://nadp.isws.illinois.edu), one of the table stated the specification of a particular equipment and right beside is the status whether the equipment is pass or fail to the evaluator as seen in figure below. In connection with this benchmarking, the researcher grew the idea in evaluating the property equipment in the same way by scoring of each equipment peripherals. If peripherals are usable the evaluator score a pass percentage, likewise, if the peripherals usability is not usable, the evaluator score a failed percentage score.

Also, the researcher foundation on theory for disposal of an equipment is based on Public Procurement Act, 2003 (Act 663) in Ghana (https://www.ghaudit.org/gas/site/reports/download_report/531). Reason for disposal of the equipment stated Items can be available for disposal due to: required to be disposed of under a particular policy; no longer required due to changed procedures functions or usage patterns; occupying storage space and not being needed in the foreseeable future; reaching their optimum selling time to maximize returns; no longer complying with occupational health and safety standards; found to contain hazardous materials; and/or beyond repair but able to be sold for scrap.

**D. Equipment Monitoring**

To ensure the equipment is always in place and its condition is by means of manual monitoring. Recording each status and condition of needs time and effort. Today, automation made lot easier, most of the organization use tagging system to monitor equipment in most convenient way [9].

De Chavez also stated, that most of the government agency uses equipment monitoring to ensure the security and monitor the inventory of equipment. The boy scout of the Philippines conducts a study for Automated Inventory property management. Both QR code and bar code is used to tag such equipment that being used by the Boy Scout. It provides report for inventory process. Moreover, it is important to government agencies to move towards an automated approach in their inventory systems. Annual inventory report are required of all government entities to be submitted to the Commission on Audit. Under COA’s Audit Jurisdiction, COA has the right to collect inventories and audit of the properties of every government entities.

**III. METHODOLOGY**

The research goals are:

i) To develop an equipment management system with QR Code technology to tag and monitor of equipment status; with this, it will help the property custodian to document all equipment acquired for the school. Also, it will serve as reference for evaluation process of equipment condition.

ii) To apply prescriptive analytics in monitoring equipment and generating reports for decision making; With this system, it will be beneficial for the user specially for the department head to determine which of the equipment are in “good condition”, “for upgrade/repair” and for “disposal”.

iii) To evaluate the performance of the proposed study in terms of efficiency, reliability, operability, maintainability, and security base on ISO 25010. Three key players are involved in using the system:

i) Administrator/Property Management Department Head can review the Prescriptive Analytics Module and also responsible for handling over the user privileges.

ii) Property Custodian who approves the inventory request coming from requesting department and conducts the actual inventory.

iii) Property Management supervisor, responsible for monitoring repair, equipment safety and use.

All property information will be stored and backed up to local server.

The software that will be involve in developing are PHP, this is open source programming language is the use to execute procedures to provide recommendation and prescription for equipment that is being analyzed. MySQL serves as the database of property equipment that is acquired, Java to facilitate the use of android thru mobile.
phone. Instead of using expensive QR code reader, the researcher uses an ordinary smartphone with a camera that runs in the Android operating system. Last is Apache Server—a Windows or Linux-based server that executes the program written in PHP code.

In figure 2, the property management department performs profiling of each acquired equipment such as brand name, model number, serial number, product description as well as the warranty. The details of the equipment were encoded into the database and generates the QR code stickers for tagging purposes. To process the evaluation of each equipment, the department secretaries need to submit a request for evaluation. At that juncture, a property custodian accepts the request, visits, and performs the evaluation process. An Android application installed on a mobile phone is used to scan QR code stickers which are tagged on a particular equipment and also to evaluate its performance as well.

Hereafter, all collected data will be saved on the database and analyzed whether if the equipment’s condition is “in good condition”, “for repair/upgrade” or for “disposal”. With this, it will help the property department manager to decide which particular equipment is worth to keep, needs upgrade/repair or to dispose.

In figure 3 shows the parameters on how to evaluate the equipment’s performance. It is measured by performance and time. Performance includes the physical appearance, whether if it is presentable or need for maintenance. Also, the installed peripheral and other functional devices attached are evaluated too. As an example, if the property custodian evaluates the performance of a laptop, it is necessary to determine the physical condition. Likewise on its performance, power cord, and battery.

IV. RESULT AND DISCUSSION

The results and discussion are related to the 3 project goals as follows:

Goal-1: To develop a system for equipment management system.

In figure 4 shows the QR-PAB desktop application for generating QR code for each property equipment. In this module, the property custodian can encode all property equipment as well as the newly purchased or recently acquired. Moreover, this module requires necessary details such as property number, serial number, model number, brand name, date of purchase as well as the warranty. With this, the property custodian can print all QR codes to sticker paper and ready to tag for each equipment.

For most cases, several companies or institutes use specialized QR code printers and papers which are at high cost. But then, the researcher implements the use of available resources such as ordinary printer and sticker papers.

Goal-2: To apply prescriptive analytics in monitoring equipment and generating reports.
Figure 5 displays all acquired equipment including the evaluation score of each evaluated equipment. With this, it will be a great help for the property department head to decide whether the equipment needs maintenance or subject for disposal.

**Goal-3:** To evaluate the performance of the proposed study in terms of efficiency, reliability, operability, maintainability, and security based on ISO 25010.

We conducted surveys during the test and evaluation to 22 concern personnel. Among of them are Property Management Department Head / Administrator, Property Management Supervisor, Property Custodian and Clerk / Secretaries. The system is particularly evaluated in 5 aspects: efficiency, reliability, operability, security, and maintainability based on ISO 25010.

Figure 6 shows that the highest mean is for Resource Utilization. It means that the gathered information helps the system to meet its function for report generation.

In contrast to old system, it takes time and effort to evaluate each issued equipment. The system is efficient in time for encoding and registration of property equipment of each department. Also, provided modules are easy to use and understood.

The property custodian can read and scan an equipment in no time. It takes only a blink on an eye (00:01:37 seconds) and displays all of the equipment details. While manual evaluation can take 00:29:20 seconds or more.
Figure 7 shows the evaluation result for Recoverability is the highest weighted mean of 4.56. It means that the users trusted the automated backup system from the website host and the system works properly after loading the backup files.

Furthermore, the system is capable in handling error. Lots of program conditions are provided to anticipate such fault. For instance, if the custodian forgot to indicate significant details of the equipment, the system will alert to supply missing fields that needs to fill out.

Figure 8 shows the evaluation result for Usability. It means that system is pleasant for the eye of the users, this design is powered by bootstrap. A simple tool that makes web application design balance color and responsive. Since the system is written in open source format (.php) it runs on ordinary server and free of license. Also the system does not required expensive servers and tool to operate the entire system.

An average desktop computer can serves as a server and capable to handle voluminous data or records. The system runs in any platforms, whether it is Windows or Linux. Also, it does not need to purchase expensive QR scanner. An ordinary smart phone with camera can serve as a scanner.

Figure 9 shows the evaluation result for Testability. A series of testing was conducted to the research area as well as to the concern department. It helps the researcher to test the accurateness and efficiency of the developed system during the test stage. Also, during the planning stage of proposed system, the researcher decides to use flexible platform like PHP that can adopt modification/changes in future. Since it is open source, it is easy to learn and maintain. Now a days, web based system is in demand. PHP is the most commonly used to develop and adopt vast changes of technology. Moreover, during the test and implementation, the users, both custodian and department secretaries are satisfied for the output of the proposed system. This system is not only ease their workload in terms of evaluation, but also for inventory purposes.

Figure 10 shows the evaluation result for Security. The users agrees in every aspect, the system imposed strict role for every user. The system implemented the level of access depend on their user privileges. Audit trail is provided to monitor the users’ login activities.
V. CONCLUSION AND FUTURE WORKS

An Online Equipment Management System Utilizing Prescriptive Analytics gives an opportunity to pilot area to maximize time and effort in monitoring and evaluation of each issued property equipment. It is essential for a company to monitor the condition of each equipment. To date, most of the companies spend money to upgrade and embrace to modern technology.

In this paper, the project vision is to monitor the condition of each equipment using modern technology but not spend as much as others. The researcher introduce common tool to achieve pilot areas’ achievement. Open source language such as PHP is used to develop a system not just record equipment details but also analyze and prescribe suggestion for better decision making of the management. The system can produce reports such inventory, condition of equipment and list of issued equipment in a particular department. With this, it helps the Property Management Department Head as well as the Property Custodian to monitor the condition of each equipment.

In addition, standard mobile phone (android) is used as a key tool to evaluate such equipment. Instead of investing costly QR code scanner, the researcher utilized android mobile phone as QR scanner. QR code is commonly use not just to promote or guide to visit a particular website. QR codes are capable to record 7000 characters, which is possible to embed every single details of a particular item/equipment.

We achieved the 3 specific objectives of the study:

First, the successful implementation of the system for the pilot area. By comparing to the old way of evaluation of each equipment by cross checking on the provided list, we managed to implement the use of mobile phone as scanner and analyzed the condition of each scanned equipment. The analyzed data would then be sent immediately to the server for report generation.

Second, the new system is capable to analyze and prescribe prior to equipment evaluation. The proposed system is capable to determine whether the equipment is “in Good Condition”, “for Upgrade/Repair”, or “for Disposal”. The system also manages to create a report among these equipment conditions through hard copy, Microsoft Excel format, Portable Document format or as PDF.

Third, to ensure the efficiency, usability, maintainability and security of the system, we tested the system in every aspects based on ISO 25010 which is a standard procedure to test a software capabilities. As a result, positive feedback are gathered from the satisfied users.

It is essential for the company to monitor the status of the each equipment. That is why the researcher conducts a study to utilize one of a kind monitoring system using the latest technology. In time, QR code may face new rival as technology continuously evolve. For the future researcher, I recommend that this system has its way to improved and used for the entire university.

REFERENCES

[1] De Chavez, M. A. D. 2015. an automated inventory system using quick response (qr) code and barcode for property