Development of QR-CIMS: A QR-Code Inventory Management System

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Abstract: In supply chain management, handling inventory is a challenging for many businesses. The common challenges are to understand customer demands and the need to make smart decisions in managing inventory as it is holding costs. The traditional way managing inventory requires a lot of paper work. Most of the available inventory management system (IMS) on the internet using the barcode system and require license. To increase the efficiency and reduce the cost of business operation, a computerized system with the implementation of QR code is the promising advantages. This paper presents the development of QR-CIMS, a QR Code Inventory Management System that enables the users to detect, scan and retrieve the stock from database accurately using the QR Code. The QR-CIMS are also provided with the notification feature, where users will be notified via email when the stock reaches the minimum threshold. In addition, stock planner is another feature embedded in the system to ease the management of inventory.

INTRODUCTION

In this era of modernization, technology is growing very fast. In turn, productivity growth comes from the rapid development of new technologies. Today, more and more companies embarking on IT to expand and maintain their business to be running at a good pace. An inventory management system (IMS) is a must-have, whether the company is a store of brick and mortar, a supermarket, an eCommerce site, or a logistics company. It is a tool that allows company to track inventories/goods across business's supply chain. It optimizes the entire spectrum spanning from order placement with your vendor to order delivery to customer, mapping the complete journey of a product. Before the era of technology, inventory management is done manually using paperwork in which all the transaction information is kept in physical file that require more paper and cabinets. This can cause very difficult exercise to the company when the number of inventory increases. With the advancement of technology, today, inventory management can be automated embedded with tracking technology such as barcode and automated identification and data capture (AIDC) technology to manage the flow of goods. The use of barcode in supply chain management (SCM) has been the backbone since 1980s. To invest huge amounts of capital in technology that is yet to prove is risky for many business communities. The information contain in a barcode is very limited, typically is just consist of digits. Due to the high cost of delivery using barcode, many organisations from both, corporate and government sector adopt the use of the radio frequency identification (RFID) in the SCM as an alternative. However, most of the them are unsure which technologies offers the best return, barcode or RFID. While there have been many success stories of RFID, few have been related to inventory management system. There are also a limited number of articles, which solely promote RFID technology in relation to SCM. However, most of the information provided by Finkenzeller[1] pointed out in his book about the technical aspects concerning RFID and the licensing regulation of radio that prove to be one of the limitation factors of the application RFID in IMS or SCM on the global scale. During the recent year, there are major developments on the adoption of 2D matrix barcode or QR Code such as patient identification, passenger boarding pass, and so on [2]. As compared to the barcode, 2D barcode holding more information that can have about 2000 characters of information [3].

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However, few have been done in inventory management system. This paper presents the development of inventory management system using the QR code.

LITERATURE REVIEW

Quick Response codes (QR codes) are 2D matrix barcodes that are often used in tracking and marketing such as for the advertisements, magazines, and business cards. QR codes support four different types of data; numbers, alphanumeric characters, byte/binary information, and Kanji characters [2]. The QR code was initially approved by the (ISO/IEC18004) in June 2000 and was invented by Toyota group of companies in production control for automotive parts and later been used in many other areas [2].There are many advantages of using the QR code over barcode in IMS, for example, QR code can reduce the costs of required hardware, the label code can only be scanned using a smartphone, whereby barcode required a specific equipment (scanner). Therefore, worker in a warehouse can use its own/company smartphone for maintaining and managing the inventory without the need to purchase the expensive device/equipment. Comparing barcode to QR code, QR code can have more information that able to hold up to 2,000 number of characters with fast readability function [3]. There is also a built-in feature for error correction in QR code. It used the Reed–Solomon error correction algorithm with four configurable error correction levels ranges from 7% to 30%. There is also a limitation of QR code, in which, the higher the error correction the lesser the storage capacity. Figure 1 is the QR-Code example.

Figure 1. QR-Code example

With the adoption of QR code technology in IMS, the inventory managing process in multiple locations can be done efficiently [3]. The implementation can also be easily done as it requires very minimal effort and the productivity will become faster. Today, there are number of applications developed for supply chain management and inventory management is part of the feature. Magaya [4] for example provide the end-to-end solution for logistic company. Magaya is a cloud-based system that enables user to monitor and access the system in real time, tracking and recording the goods/items in using the barcode

scanning system for managing the warehouse. Another example of inventory management system is AppAdvice[5], that specially designed for small businesses to manage their inventory using smartphone. It's also used the barcode scanner to record asset. FocusWMS[6] is the warehouse management system that integrated with financial management system and solution for enterprise resource planning (ERP). It is also a cloud-based system that uses advanced wireless and barcode technologies. Most of the IMS available on the internet are using the barcode technology and licensed is required for the production used. This paper presents the development of a QR-Code inventory management named QR-CIMS. This prototype system is a mobile application of IMS that uses QR-Code for tracking and recording inventory for small businesses use.

SYSTEM DESIGN

This section presents the development of QR-CIMS. The technologies used are android studio and firebase database. Android studio is used as a platform for the android-based application development. The prototype system is develop using RAD with incremental prototyping approach. In this methodology, three phases (analysis, design and implementation) are perform repeatedly until it achieves intended requirement. In the planning phase, the system scope and the user requirement are also identified. System specification is developed during the design phase which involve the physical design, interface design and program design. To build the interface, the QR code scanner and QR code generator are used to be embedded in QR-CIMS. Most of android device have a built-in DR-Code reader. Figure 2 is the login screen of QR-CIMS. The authentication is required to use the application to avoid unauthorized access. Figure 3 is the menu screen of QR-CIMS. There are four buttons provided in the screen; Inventory, In/Out product, low stock and register. The inventory menu will direct the user to the inventory form, where user can see the number of available stocks for each item (see Figure 4).
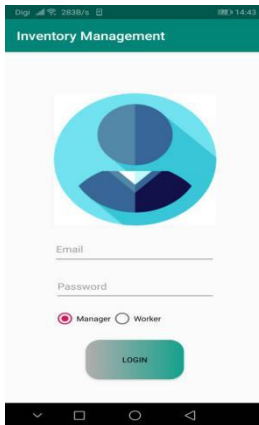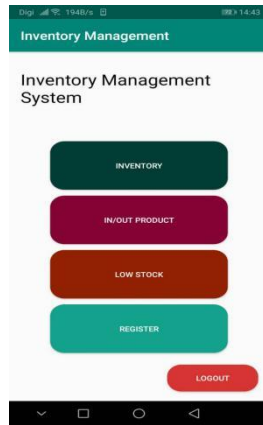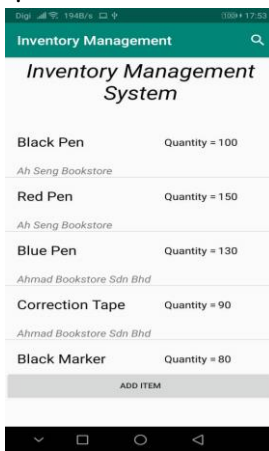
Figure 2. Login Screen

Figure 3. Menu Screen

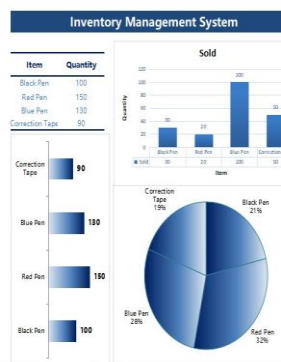Figure 4. Stock number report.

Figure 5. Stock planning graph

The In/Out product menu will direct the user to screen where user can see the in our out flow of an inventory. The user can also see the statistic of inventory information as shown in Figure 5. The database used to store the information of inventory is Firebase.

CONCLUSIONS

In this paper, the development of QR-CIMS is presented. The QR-Code is the technology adopted in QR-CIMS that require no specific device for inventory scanning. All the user needs are only a smart phone. It's believed that with the utilization of QR code in the proposed system, many advantages can be offered to the users. It can help businesses to reduce the cost and ease the operation, thus increase the productivity and make the inventory control more efficient. In addition, the notification feature provided in QR-CIMS can help the users to make the smart decision for stock planning, especially when the stock has reached the minimum threshold. Thus, the issues such as short or over number of stocks can also be tackled.

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