Enhancing User Experience using Mobile QR-Code Application

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***Abstract*— Two-dimensional (2D) barcodes technology are becoming one of the foremost tools used in business industry precisely, in marketing strategies and business promotions, particularly using the *quick response code (QR-Codes)*. Although, its applications are still in vague to the common man whose usage of the technology would help to ease his everyday life. This paper illustrates how the use of the QR Code technology can help to improve the experience of the users particularly in the field of retailing. The illustration featured a prototype system showing how code can be used as an alternative to the normal shopping process in some retail stores thereby easing off difficulties faced by shoppers while shopping through the use of their smartphones and at the same time providing opportunity to harness some of the potentials of both the QR code technology and their smartphones. RAD design (Throwaway Prototyping) methodology was used in the development of the system and PHP scripting language was used to generate the QR codes and designing the interface, MySQL Server served as the backend tool for the prototype system. The developed prototype was successfully tested and illustrated as a domain study in a private institution.**

Keywords-quick response code (QR-code); 2D matrix; barcode; smartphone; user experience

I. INTRODUCTION

Shopping malls today are increasing in dimension with more abundant goods and variety of wares due to improved living standards resulting to pursuit of high quality consumer goods, which in turn reveals the demand for efficient shopping processes [1]. According to [2], a similar trend exists for the online shopping system at even a greater pace than the traditional shopping malls. However, they also come with a number of flaws, thereby limiting the objectives of electronic shopping. Some of the major problems faced could include security, fraud and more often, delay in delivery of orders. In addition, envisioned customers are accustomed to walk in to see and feel the products before purchasing. In the light of these, the author proposes a shopping process that will allow envisioned customers easily locate and have forehand information on products in large malls through the use of their mobile devices. By and large, the system will help in delivering accurate statistical data and reports.

One dimensional matrix codes known as the barcode are prominent in use by most retail stores, mini marts, pharmacies and lots more. It is used for cost accounting purposes and keeping inventory of goods and services. For example, in most retail stores, barcodes are found on every item or product. These codes store information about the product and are read by point-of-sale (POS) machines during checkouts, which is an important way of calculating cost and at the same time updating the inventory at the database level.

Two-dimensional matrix codes also known as the QR Code (Quick Response Code) or 2D barcodes, on the other hand, is advancement over the Barcode Systems and is used for various commercial purposes. Unlike the barcodes, the QR Code stores information in two dimensions that can be scanned and read by an application known as the QR-Code Reader. The QR code can be used to store various form of information ranging from information about the item, to images, videos, web-links and a lot more. The ideas behind the use 2D barcodes are far from being totally new as companies in the airline business [16] and [17], embed2D codes to fast-track self-serviced check-in for passengers.

This paper proposes the use of QR code as an alternative to the usual shopping process in major retail stores, thereby addressing some of the problems highlighted as follows:

(i). Lack of adequate information about displayed products such as sizes, colors and such on the product shelves as practiced by many retail stores. This problem renders most customers helpless, as in most cases are left with the choice of seeking the attention of an attendant which may not be readily

available. (ii). More often than not, products displayed on shelves or customer's preferred choice, unknowingly to the customer may not be available at pick up points. This usually leaves most customers disappointed and do not get value for the time spent while shopping.

(iii). Due to the modern trends in technology, retail stores now adopts the use of online catalog that provide customers with vast information about their products. However, only a minimal percentage of their customers make full utilization of this wealth of information.

II. LITERATURE REVIEW

A. *Quick Response Code (QR-Code)*

Quick response codes are a type of two dimensional barcode developed by Denso Wave in 1994 [3]. As a way of holding information in two dimensions (horizontally and vertically), they are strictly described as a matrix code than barcodes [4]. They can embed greater amount of information than a normal barcode within a limited space [4]. While barcodes are seen as one dimensional since information is stored only horizontally. QR-codes are also called "2D' barcodes that can be read by downloadable smart phone readers with camera-scanning capabilities [5].

In his article, [6] described QR-codes as a means of easy access to information through our smart phones. [7]Further described them as having the capability of storing up to 4,296 alphanumeric characters and about 7,089 numeric characters with 7% to 30% error correction ability of the altered data.

The patent right of QR codes is owned by Denso Wave, but they however decided to make it open to the public through the ISO (International Standard Organisation) international standard (ISO/IEC 18004:2000&2006), which implies that it's specifications are open to the public all over the world and are known for their high storage and speed reading capacity [8].

B. *Structure of QR-Code*

[9], describes the structure of a QR code as a matrix type symbol with a cell structure arranged in a square (see figure 1). This contains all the functional patterns that enables easy reading of data and has a data area where data is stored. "QR code has finder patterns, alignment patterns, timing patterns and a quiet zone". [10], added that the finder pattern helps in easy identification of its position, size and inclination. QR Code has 40 versions and four levels of error correction whereas the maximum symbol size can encode up to 7089 numeric data or 4296 alphanumeric data. The QR Code structure can be illustrated in figure 1 below:

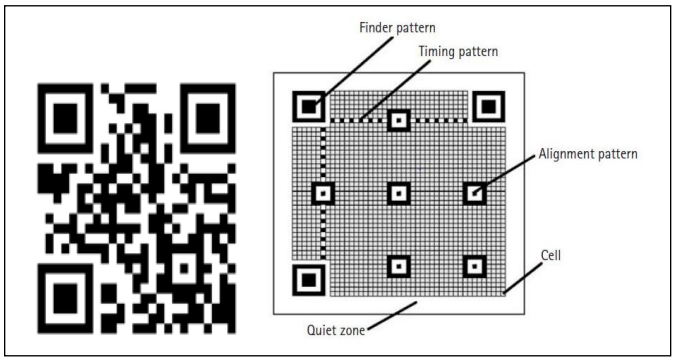

Figure 1. Structure of a QR Code [3].

[9], explains the alignment pattern as a correction pattern that enables the correction of distorted QR codes; the black and white patterns enable the timing pattern to identify and correct the central coordinate of the data cell when the QR code symbol is distorted while the quiet zone is seen as a margin space that is necessary for reading the QR code; and the data area as where the encoded data is stored in the symbol.

C. *Adoption of QR Code*

The adoption of QR code was seen to originate from the use of barcodes designed to speed up purchase processing and tracking inventory. Hence, QR codes can be said to be similar to barcodes but with a distinctive feature that allows them to store a large amount of data in a matrix format [11].

[11]then, pointed out three main reasons behind the adoption increase of QR codes in the United State. The reasons he gave were the fact that: the U.S. were embracing a complementary technology that enabled easy accessibility and adoption of QR codes. The creation and utilization of QR codes are free (thanks to Denso Wave); and the numerous creative uses of QR codes making it a versatile technology. However, not just in the U.S., but this is also applicable to other similar countries (such as in Asia and Europe) where technology is seen as the driving force behind market growth.

In addition, smart phones were seen to be the catalyst that will help accelerate the adoption of QR codes, they are free to generate and read, and the amount of information or advertisement that can be done using QR codes can be said to be unlimited.

Despite the tremendous rise in the use of smartphones worldwide, certain businesses or segments of people may seem not to have benefited from the advantages of QR codes. Businesses whose market share relies on the aged (old) people may likely fail if they adopt the use of QR codes in their marketing because they (especially due to old age) practically

rarely use smartphones. Similarly, certain business or market segments which do not rely on technology in their day-to-day lives may also fail to adopt the use of QR codes. However, QR codes can provide value to firms in many different ways, depending on the firm's strategic vision on the innovative approach in using QR code technology [11].

D. How QR Codes Enhance User Experience

In this context, the authorsconsider a shopping process where the customers are required to track and locate their choice of products by scanning the QR code tagged on every product item. The information revealed upon scanning the code include the floor map of the store showing the product location, the available product quantity, product description, discounts and promos, various colors and or sizes available as may be required by the customer.

However, this will require a code reader application pre-installed on the customer's mobile device or tablet, and internet connection that will link the device to the retailer's online catalog system enabling the user to harness real time information about a particular product. This also measures up with the fact that most shopping malls have experienced scale expansion having abundant goods and more variety of wares due to improved living standards [1].

E. Why QR Codes?

QR Codes; just as augmented reality technology, have become popular and accepted by the general public and are practically used to connect the physical world and the digital world by conveying information from the former to the latter [12]. This helps to enable users experience and feel the real world environment in a digital context through hardware sensors and mobile code readers.

However, e-commerce today has caused most retailers to adopt the use of augmented reality as the most effective technology to build consumer relationships, boost their revenue and above all add value to shoppers' experience [13].

F. Application Areas of QR Codes

It is fascinating to know that QR codes can be applied in so many fields today as it is no longer limited to use marketing or business companies to promote their businesses. Some of the applications areas of QR codes are seen in the society today include:

- Use of QR Codes in airline ticket reservation e.g. Malaysia Airlines and Air Asia
- Use of QR codes in the library to help supplement print resources and on reference catalogs [14].
- Application of QR codes can also be found in school bulletin boards
- QR codes are also found in industry applications such as Jewelry certification system and patient identification as used in Japan and some other countries [15]; [9] among others.

G. Characterisitics of QR Codes

QR codes have a number of characteristics that makes it superior to other types of codes. In addition its capacity to hold large volume of data, its high-density recording and high-speed reading, below is a list of additional characteristics possessed by QR codes.

- Ability to be read from all directions (360^o) in high speed
- Its resistance to distorted symbols
- Data restoration functionality which makes it resistant to smudge.
- Efficient encoding of Kanji and Kana characters
- Linking functionality of QR code symbols and
- Code confidentiality among others. [9].

III. METHODOLOGY

The design methodology employed for this system is the prototyping design methodology of the Rapid Application Development (RAD). The basic phases of the prototyping methodology include planning, analysis, design and implementation of the proposed system. This prototype could form the integral part of an entire 'enterprise-system' focusing mainly on enhancing customers' experience. A typical diagrammatic illustration of the phases involved in a prototype development is given below.

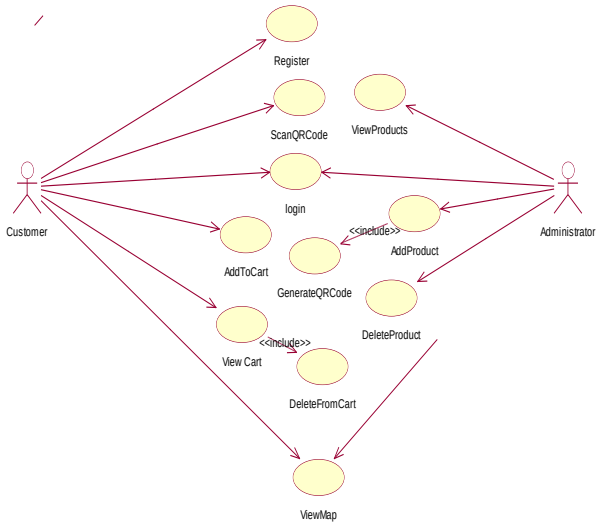

Figure 2. Use case description for the proposed system

Figure 2 above represents the use case of the proposed system showcasing the system actors and their various functions.

IV. RESULTS AND DISCUSSION

The system prototype was successfully developed and tested using PHP scripting language to design the various interfaces comprising of the product information interface (see figure 3) where new product information is uploaded and stored in the system's database and the code generator page (see figure 4) where unique QR code for every product is generated. MySql database was used as the backend tool, which was hosted on a domain site to reveal real time product information each time product code was scanned.

As expected, the encoded information in the QR code was decoded by scanning the QR Code (see figure 5) using either a smart phone or a tablet having the code reader application. Upon scanning, the device was redirected to the online database which served as the online catalog for the retail store thereby revealing real time product information. At this point the customer is able to add a scanned product item to the cart which can enable the user to check out. Finally, the database is automatically updated for accuracy and reliability of information each time the product code is scanned.

This process has proved to solve a number of problems associated with shopping as highlighted earlier. First and foremost, when a customer scans a product code, the embeddeduniform resource locator (URL) links the mobile device to the online catalog where real time information about the product is revealed. The customer is opportune to view the product in different colors, sizes or dimensions and is allowed to make his desired choices without necessary walking down to the pick-up location of the product. Additional information about the product such as promos, sales voucher and discounts are also obtained from the catalog. More so, the customer is assured of an efficient shopping by checking the available number of his choice of product in stock.

Secondly, the system is able to guide customers to the pick-up location of their desired products by giving them floor directions through their mobile phone. In addition, products can be added to online cart and eventually s check out process can be integrated. This generally reduces the time spent on shopping as choices are easily made and products are quickly located.

Furthermore, the system helps to quickly update the store's inventory in real time and also helps go mine customer information more accurately [1]. Time taken to replenish finished products from the shelf is greatly reduced through efficient monitoring of sales and inventory by the management.

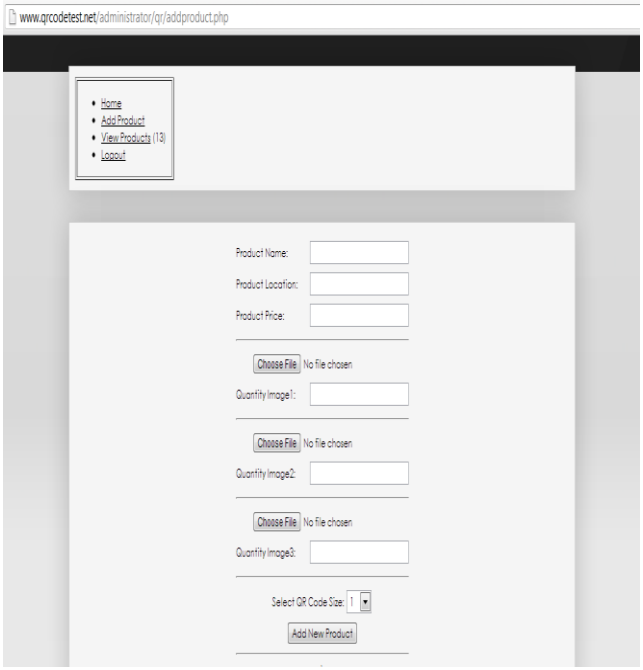

Figure 3. Interface of the proposed system for uploading product information

Figure 3 above shows the screen shot of the Add New Product interface for the proposed system. This function enables the administrator to add new products to the database, which can be later viewed in the View Products page.

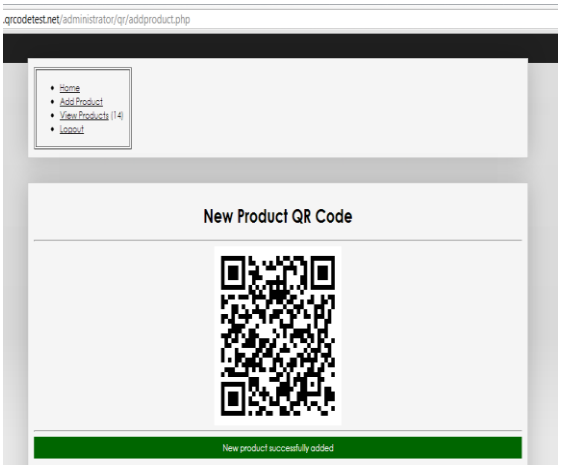

Figure 4. QR Code of the encoded product details

Figure 4 shows QR Code with the encoded product details. The code is generated after adding new product information to the database.

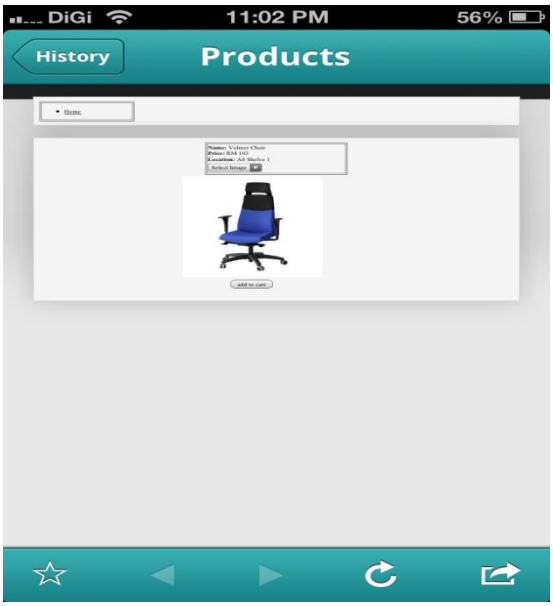

Figure 5. Screen Shot Showing Result of Scanned QR Code

Figure 5 illustrates the result of a scanned QR Code from a mobile smart phone. After scanning the code, it reveals the product information and an option button where users can select different image color.

V. CONCLUSION

This paper establishes that the use of QR code in shopping malls can greatly influence fast and efficient shopping on the part of the customers by enabling them access online real time information (online catalog system) about products by simply scanning product QR code. It also promotes customer familiarization of the shopping mall through floor directions as provided by the system. In addition, the system will enable accurate statistical data report and reliable data mining for the shopping mall on both consumer and product information. Customers are also given the opportunity to explore the capabilities of their smart phones.

VI. FUTURE ENHANCEMENT

There is however a number of ways to enhance the experience of customers which are to be further explored to this study. Firstly, there will be needfor the integration of checkout system with the developed prototype, so as to give customers a completely new experience (from making product choices to locating the products and checking out to avoid long queues) shopping in the storethereby making their retail concept a whole lot better. Lastly, to incorporate an enhanced security feature on the QR codes so that customers can securely scan codes and comfortably perform financial transactions using their mobile phones.

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