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DESIGN AND IMPLEMENTATION OF AN IMPROVED NAFDAC MOBILE AUTHENTICATION SERVICES USING QUICK RESPONSE CODE

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Abstract
The increasing rate of counterfeit products in the pharmaceutical industry in Nigeria has created the need for the design and development of a more sophisticated and flexible mobile authentication services. The deployment of a mobile anti-counterfeit system with the capability of verifying products using commodity smart phone and an un-cloneable Quick Response code anywhere and always is a solution to the current challenges confronting the pharmaceutical industries in Nigeria under the watch of the National Agency for food and Drug Administration and Control (NAFDAC). The aim of this research work is to Design and implement anti-counterfeit system for authentication of pharmaceutical product which can be deployed by NAFDAC to combat the fraudulent activities of imitation food and drug. A Smartphone and 3D Printing machine were employed for the enhancement of NAFDAC mobile authentication services. ScanTrust anti-counterfeiting services was used to secured QR codes to protect products. Results shows that our framework is effective for creating mobile authentication services with high user satisfaction rate and having reasonably low computing requirement.

Keywords: Mobile authenticating services, 3D printer QR Code, Counterfeit product, Encrypting, Decrypting, and Misbranding.

1. Introduction

Pharmaceutical products counterfeit activity in Nigeria has a huge impact on both human and economy of the country to raise concern as a global problem due to it widespread in recent years. A product can be considered as counterfeit or falsified if its source or identity is intentionally mislabeled (Kopp, 2019; Fighting counterfeit medicines, 2021). Food and drugs safety are general issues, the society is in urgent need of technological innovation and tools that can safeguard product safety. Counterfeited medical products are manufactured and misbranded to represent their effectiveness information. Such products are likely to be substandard or unregistered with the regulatory body due to the availability of wrong ingredient. Consumption of the toxic or replaced element in counterfeit and falsified drugs can cause several health risks like unexpected reactions, side effects, worsening health conditions or even death (Rahman et al., 2018).

About twelve (12) years ago, NAFDAC deployed the Mobile Authentication Service (MAS) scheme as one of its anti-counterfeiting approaches to detect substandard and falsified medical products. The method is scratch codes and Short Messaging Service (SMS) to empower consumers to verify the authenticity of it regulated products at the point of purchase. The power of detecting counterfeit products in the hands of the final consumer. The consumer scratches a panel on the product which reveals a unique, one-time use PIN. The PIN is sent toll- free via SMS short code using any of the mobile operators and the consumer receives a response in form of a text message stating that the product is either genuine or suspected fake. At the same time, the existing system of food and drug anti-counterfeit traceability technology faces problems such as data center-based storage, SMS clumsy process and data silos.

To further improve on NAFDAC existing Mobile Authentication Services we hereby adopt a novel method for carving a QR code on a surface of the product pack and customizing it with special material using additive manufacturing or 3D printing techniques to prevent it from been duplicated. QR codes are machine-readable optical 2D matrix barcodes which can be easily displayed physically on printed media or digitally on a screen (Yang et al., 2019). Information about a product is embedded on the QR code image and the 3D printed QR code are expected to be readable with use of a QR code reader installed on a smartphone. Investigation and experience have shown that the QR code images can at all times be scanned in different positions by mobile devices and it is possible to scan correctly and get all information that are stored in the image (Ofut et al., 2022).

With the readability function, we can achieve our aim with an optimization framework. We created the manipulation on the given QR code as a constrained optimization challenge. Using a QR code and a target surface, we reduce the change on the code and the loss of decoding large information and carve it on the surface in an engraved manner, with the limitation that the generated QR image is 3D printable, and readable by standard decoders in a traditional environment.

2. Counterfeiting and Existing Product Authentication Service (MAS).

Counterfeiting is an unauthorized copying or application of a trademark on items that do not originate from or with the approval of the brand owner (ICC Counterfeiting Intelligence Bureau, 2005). Counterfeiting has grown substantially over the past years to become the greatest threat to today's global market (Lei et al., 2005; ICC Counterfeiting Intelligence Bureau, 2005).

Duplication with the purposes of deceiving and defrauding in pharmaceutical field is common in Nigeria. Several research has shown that the phenomenon of counterfeiting is not new, but the question is what has changed about counterfeiting today in our society? Nigeria is reported to have one of the highest incidences of substandard and falsified medicines in Sub-Saharan Africa (Spink et al., 2016). Over the years, the estimated prevalence of substandard and falsified medicines seems to have reduced in Nigeria from 67% in 2001 to 5% in 2012(Spink et al., 2016). Also, there have been several reports of fatalities from the consumption of substandard and falsified medicines in Nigeria (Akinyandenu O., 2013). Consequently, the Nigerian medicine regulatory authority, NAFDAC adopted some approaches to address the problem of substandard and falsified medicines. Some of the approaches include deployment of product authentication devices like TRUSCAN® for in-the-field test for authenticity of product, retailer product authentication using radio frequency identification tagging and the Mobile Authentication Service (MAS) (Spink et al., 2016; Iwokwagh NS, 2013). MAS involves consumers' use of mobile phones to verify the source of medicines at the point of purchase, at medicine retail outlets.

However, several reports are suggesting strongly that there are challenges with the use of NAFDAC MAS in Nigeria. Several studies have documented underutilization by consumers despite a reasonable level of awareness. (Aisagbonhi & Ilomuanya, 2016; Eronmhonsele, 2016; Ezurum NR, 2015) A pilot study demonstrated that response was not always real-time (Adedini et at., 2016). Also, some community pharmacists reported that MAS impacted their practices negatively. These community pharmacists complained that response is not always real time, as expected, and consumers sometimes get no or wrong responses to MAS queries (Obinna C. et al., 2018). These points-of-failure of the MAS have inadvertently portrayed the affected community pharmacies as sources of substandard and falsified medicines. With the associated flaws above, it is difficult to ascertain the level of acceptability of MAS among community pharmacies.

To amicably address the above limitations, we introduce a user-friendly3D printed QR code that can encode and decode information about a particular product easily within a short response time to combat counterfeiting. Apart from the user-friendliness, 3D printed QR code can support the middleman authentication process for detecting fraudulent transactions, providing better communication within the supply chain.

3. Design Implementation

This section will present the Graphical User Interface (GUI) that has been designed for QR Code Generator, where data can be encoded in to QR code and a Scanner that can be used to decode the authentication information like product name, batch No. manufacturing date, and expiration date, as well as an image of the product. Currently, the working title for this web-based application is ScanTrust. ScanTrust is a Swiss company that provides an Internet of things platform for identifying products on the internet (Wu, 2019). ScanTrust Secured QR code can be scanned to verify the authenticity of your products. It works using a patented method for combining an anti-counterfeit secure graphic with a standard QR code.

The system has two main functions: QR code Generator and Scanning application for 3D printed QR Code.

3.1 QR Code Generator

Figure 1. Login Screen

Figure 1 is a login access for pharmaceutical companies with approval to manufacture certain products. This access is expected to be administered by NAFDAC the regulatory body for food and drug in Nigeria. Authorized manufacturers login successfully to figure 2 and generate QR code for their products.

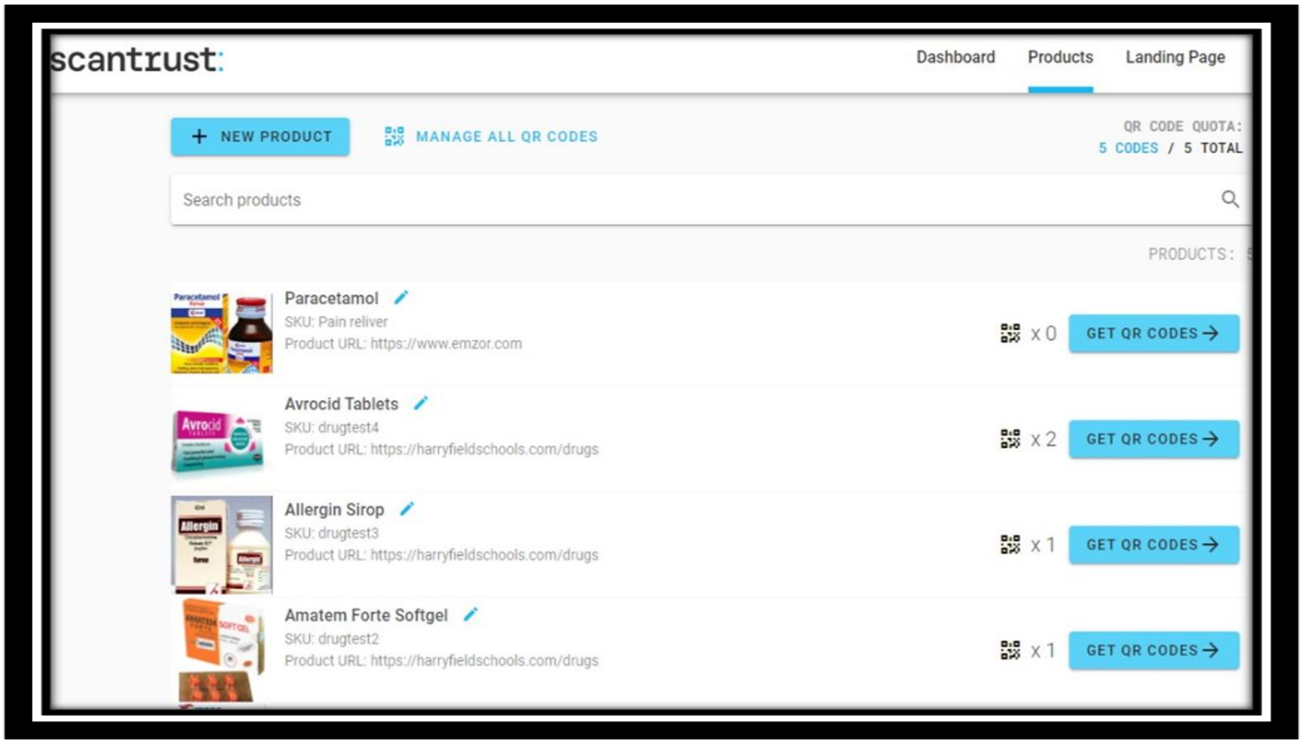


Figure 2: QR code Generator for Products.

Figure 2 shows how QR code are being generated for products. The information about a genuine product is encrypted by an authorized manufacturer and kept on a QR code image that can only be decrypted with the use of a corresponding scanning application.

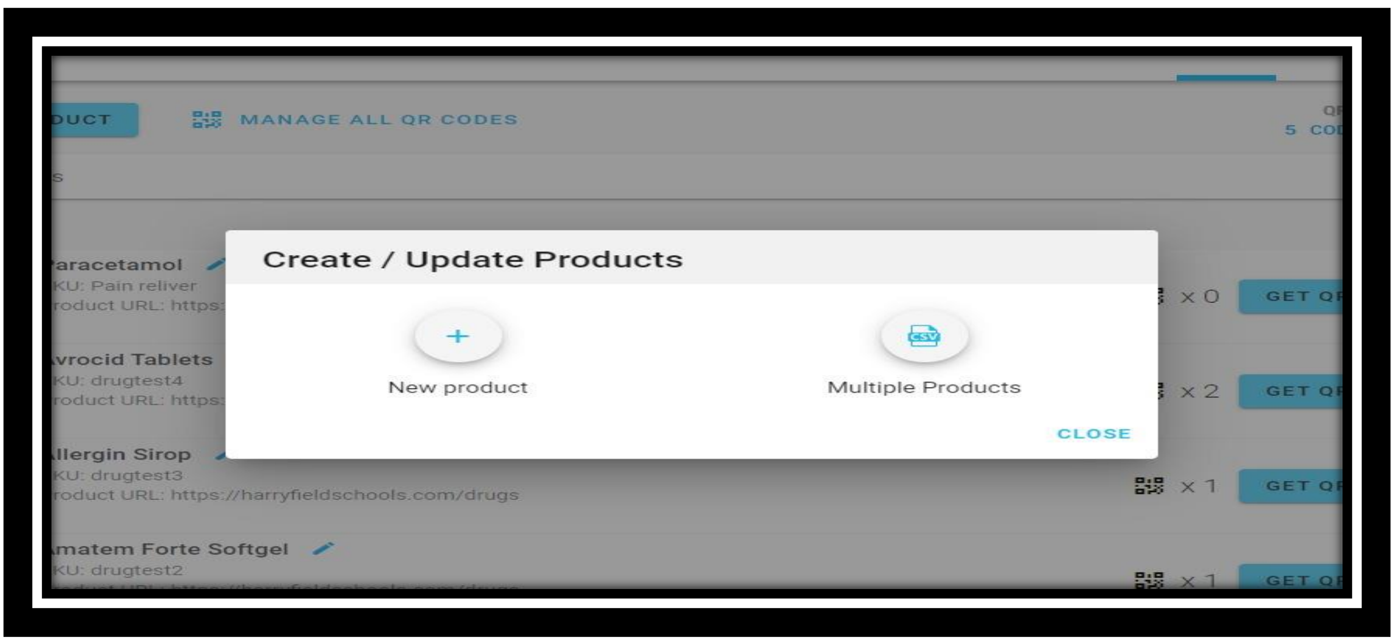


Figure 3 create/update products

When the user clicks on new product in figure 2 the system prompts the user to either select new product or multiple products.

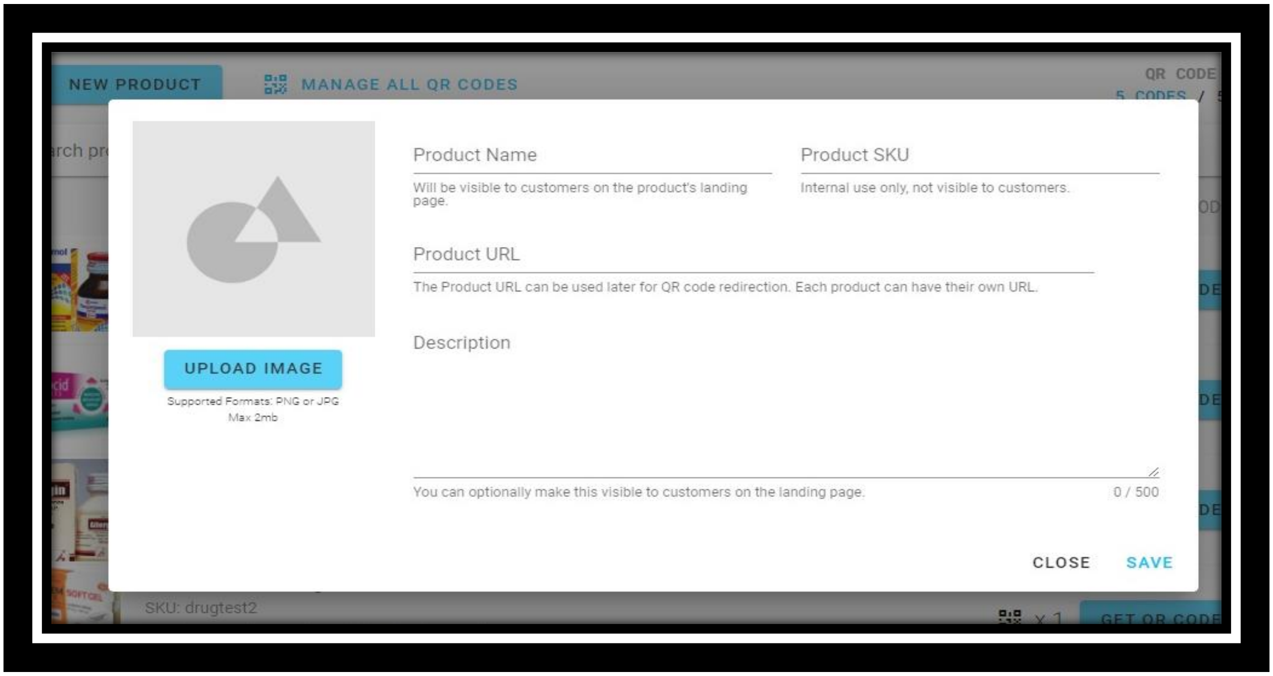


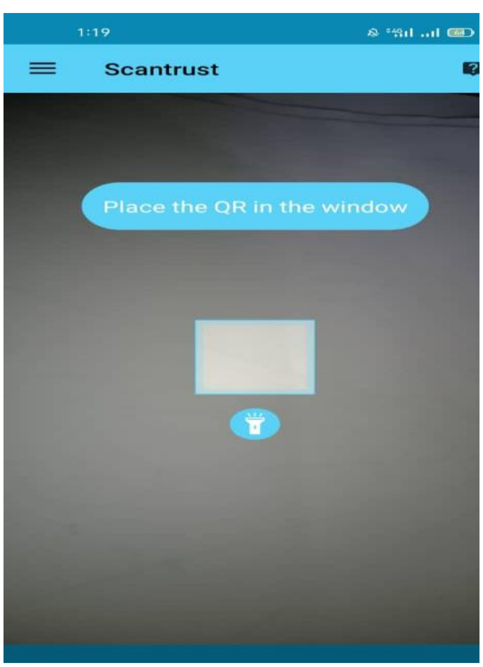
Figure 4. Product information capturing

Here the manufacturer supplies all key information about a particular product that is encrypted into the QR code image.

3.2 QR Scanning Application

The authentication process of products is shown in the figure 5. To scan 3D QR Code perforated on the pack of the product, we download ScanTrust mobile application for this experiment.

First, the proposed smart phone application scans the 3D printed QR Code on the product pack, the application response will give error message as in figure 6, if the QR code was not generated by ScanTrust.



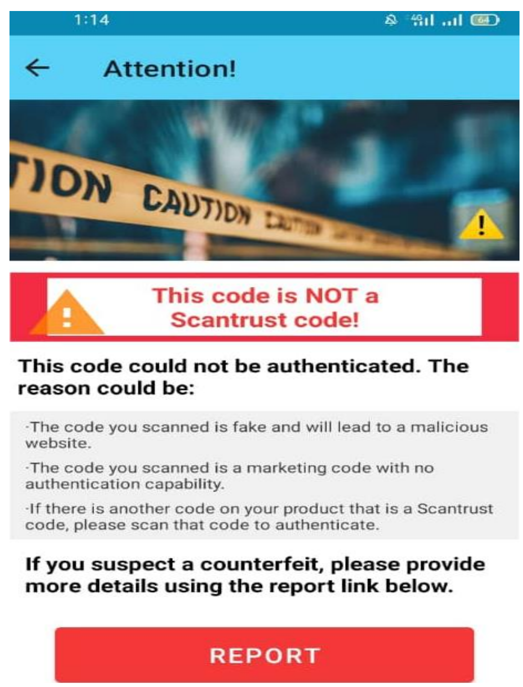


Figure 5. Scanning App. Figure 6. Error message.

Figure 7. QR code image for Amatem softgel product and the result after scanning

Figure 8. QR code image for Avrodcid Tablets product and the result after scanning

Figure 9. QR code image for Allergin Syrup product and the result after scanning

The QR code images in figure 7- 9 were verified via the mobile application scanner to decrypt the information that was encoded in figure 4 to verify the authenticity of the product. A typical QR Code is capable of 360 degrees (omni-directional), highspeed-reading capacity. This is made possible through position detection patterns located at the three corners of the image. These position detection patterns guarantee stable high-speed reading.

4. Discussion

This section illustrates experimental result with discussion. The new mobile authentication service for NAFDAC products was design to be scanned with the use of any smart phone device, with the requisite application installed on it (android was use specifically for this experiment) which fulfilled the following criteria: A mobile phone camera of not less than 8 megapixel and camera flashlight, allows user to scan the QR code image on the product pack in dark environment, we recommend this for best and fast scan. Minimum of android 4.4 operating system. A scanning distance of approximately 10 centimeters between smartphone and QR code.

It was observed that the scan process using android smartphone in daylight takes approximately 2 seconds.

For QR code generation as shown in figure 1 - 4 we deployed on Windows 10 (64 bit) computer with Intel Core i5 8th generation Central Process Unit (CPU) clock frequency 3.60 Gigahertz (GHz) and Random-Access memory (RAM) 8.00 Gigabyte (GB). We used a high Internet connectivity to access the ScanTrust server.

To confirm the readability of the carving 3D printed QR codes image, we generated and completed three experiments to evaluate the flexibility of our QR codes as shown in figure 7-9. A decoding process is regarded as a successful one if the QR code is decoded within 2 seconds. We also tested the reliability of the printed 3D QR codes to different scanning positions.

5. Conclusion

In this research work, the introduction of an enhanced approach for transforming the traditional QR code into a 3D printable and readable model with little or no changes became very expedience for improving the current NAFDAC MAS. Our system shall significantly minimize the circulation of fake drugs, due to the availability of a modified anti-counterfeit tag with a robust and flexible design for verifying the authenticity of a product in real time.

Our approach is affordable, reliable, does not take much time and effort to generate and automate authentication process from any part of the country under the regulation of NAFDAC. In addition, this research presents a practicable solution to both system design and implementation direction. The problems of uniformity and security between tag-and-reader are also considered.

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