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Identity Card Authentication System Using QR Code and Smartphone

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Abstract- Smart identity card is considered to be secured and time saving to validate the identity of an individual without the need for a PC or the Internet. However, smart card readers required for identity card authentication are expensive to produce and not available in all locations, especially in the developing countries like Nigeria. What is obtainable in some tertiary institutions of such developing countries is the administration of identity cards that can neither be verified nor authenticated. Such identity cards are susceptible to cloning and forgery. In this paper, an offline Identity Card Authentication System using QR code and Smartphone is presented as solution to authenticate the bona fide student of tertiary institutions. The proposed system in this paper subjects encrypted matriculation number of student to a QR generator that produces QR code. This QR code is printed on student identity card along with other details. The process is reverse using the App installed on a smart phone during authentication for reconciliation of the decrypted code with the student matriculation number. Testing the proposed system revealed impressive result of successful authentication in an average time of 3.4 seconds when the smart phone flash light is on and 6.8 seconds when it is off.

***Keywords: Quick Response (QR) code, Smart phone, Identity Card Authentication*.**

1. Introduction

The use and administration of Identity card is a common means of identifying any associate, staff or student of any association, organisation, bodies etc. However, what is obtainable in a typical tertiary institution is peculiar. It is peculiar in the sense that most times, huge number of diverse nationality, ethnics and races are involved.

In most tertiary institutions in Nigeria, identity cards given to student are without either means of authentication or verification. With the advent and access to cutting edge technology, such identity cards are susceptible to cloning by persons who may be desperate to be a student, or students who have lost their studentship or have ulterior plans. Therefore, there is a need for a mobile and accessible identity card authentication system as solution to both physical security and certain administrative duties that demand identity card authentication and verification.

This work proposes an embedded QR code on identity card to be given to students and introduction of Smartphone App which will be used to authenticate and verify the QR code on this card.
Since there is proliferation of mobile phone users in recent time, coupled with the fact that smart phone prices are now affordable, it is assumed that the prospective users of the proposed system presented in this paper, would have been used to the operation of smart phone. Thus, the proposed system will be accessible to these intending users at no additional cost and less training.

This paper presents an offline identity card automation system based on smart phone utilizing the QR code for reading and recognising the code embedded in the identity card using the in-built camera function of smart phones in an offline and real-time basis. Being an offline system, the proposed system is not dependent on the availability of network connection for its deployment unlike other existing systems. Therefore, making it deplorable anywhere, anytime, even in remote areas where there are no networks.
In the remaining parts of this paper, Section 2 discusses the theoretical background of QR code, Section 3 presents related works that has been proposed for identity card authentication. The conceptual framework of the proposed system is presented in Section 4. In Section 5, the results are discussed while the paper is concluded in Section 6.

2. Theoretical Background of QR Code

Quick Response (QR) codes are two-dimensional barcodes that visually encode bits of information represented as black square dots placed on a white square grid (Kevin, Harry, Derek, & Charlotte, 2014; Oonk, 2013; Qianyu, 2014; Uzun & Bilgin, 2016). QR was developed by a Japanese corporation Denso Wave in 1994. It was developed to safely and easily identify various components.

As a result of the proliferation of smart phones across many domains, reading and decoding QR codes has become much easier than using systems based on complex technology. A QR code system has edge over RFID-based systems: since reading QR codes requires closer proximity, which makes it almost impossible to read an undesired code. From this perspective, QR code reading is unambiguous, as it only requires close proximity of the reader device to the instrument to read the code from (García-Betances and Huerta 2012; Soon 2008; Denso 2011).

Another plus to QR code is that it is a two-dimensional barcode. Thus, implies it scans in two directions that is, vertical as well as horizontal compared to the traditional barcode. In addition, QR code-based technology is also superior in other ways, such as higher data storage capacity, lower implementation cost, technical simplicity, widespread use and widely available, free programs for reading and decoding by camera equipped smart phones (Kumar, Sharma, & Yadav, 2014; Oonk, 2013; Qianyu, 2014). These features make this technology popular for identification and authentication systems, especially in sectors with limited resources. QR code structure is shown in Figure 1.

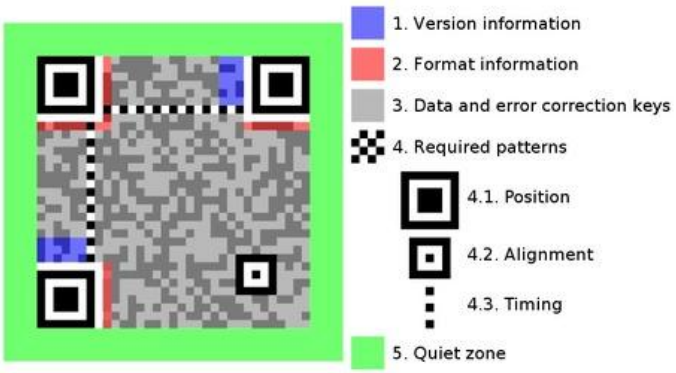

Figure 1. QR code structure

2.1 QR Code Error Corrections

QR code has a powerful error-correction mechanism that is implemented by Reed-Solomon algorithm (Oh, Kim, & Lee, 2011). This allows a QR Code symbol to be read even if it is dirty or damaged. There are four levels of available error correction that QR code possesses as shown in Table 1. The higher the

level, the greater the error correction, but also the larger the QR Code version (*QR Code ® Essentials*, 2011). In this work, Level L was adopted due to the limited space obtainable in Identity card size.

Table 1. QR Error-Correction Level and Approximation amount of correction (QR Code Essential, 2011)

Error-Correction Level	Approximate Amount of Correction
L	7%
M	15%
Q	25%
H	30%

3. Related Works

There are various existing research works on possible application and implementation of QR code, especially in educational sector. Some of these reviewed works are highlighted in this section. In a paper presented by Bajpai and Agrawal (2013), personalized data, signature and picture of card holders were captured, while the system dynamically generated 2D Barcode that represents captured data and affixed this barcode image on identity card. The card was thereafter used to validate and authenticate the holder in the central database online. The basic idea behind the authentication was to match the encrypted unique ID of the person in the barcodes with the one in the central database. The work presented by Bajpai and Agrawal (2013) depends on the availability of network for its operation.

Similarly, Singhal and Pavithr in their work applied the use of QR code and Smart phone to degree certificate verification and authentication. The verification process scans the QR code embedded on the certificate (M1) and decrypts the signature from the university's public key in order to generate the hash value (M2) (Singhal & Pavithr, 2015). If the hashed value generated from M1, matched that of M2, then the certificate under authentication test is passed or otherwise. This work does not look in the direction of an offline system that will save the technicality demands and cost requirements of an online system.

In addition, combination of QR code and Smart phone were proposed as solution to attendance system for both employees and student (Cho & Bae, 2014; Kumar & Kareemulla, 2017; Masalha & Hirzallah, 2014) . The attendance system proposed by these researchers was online system that requires lecturer to generate QR code that would be scanned by the students and sent via wired/wireless network for necessary automatic attendance checking (Cho & Bae, 2014; Masalha & Hirzallah, 2014). The major extension offered by the work of Kumar & Kareemulla was the introduction of fingerprint and voice verification for authentication in order to avoid proxy of attendance.

There is an existing efforts in the area of applying QR to review student profile management in order to eliminate gap between student and the institutional management (Maid, Bansode, Salve, Dhole, & Dhokne, 2017). The objective of this work is to reduce the problem of queue, wastage of time and reduction in paper consumption in a typical institutional environment.

Review of the earlier stated systems show that they are all online systems. That is, their operation is solely dependent on the availability of a network connection. Availability of a reliable network connection and the cost implication can be a big deal in some developing countries. This network dependence motivated this proposed work for an offline system.

4. Conceptual Framework of the Proposed System

While the proposed system in this work shares the good attributes of the existing efforts, it has the edge of being the first offline system to be deployed for identity authentication system to the best of our knowledge. The significance of this is that, there is no need for associated network connection requirements that is required to be online before this system can be deployed and used. As a result of being an offline system, it can be used effectively in non-network areas.

The proposed system has two modules which are: students' identity card with printing and Identity card authentication module. The block diagrams of these two modules are shown in Figures 2 and 3 respectively while the screenshots of the conceptual framework is presented in figure 4.

4.1 Proposed Procedure to Produce Student Identity card

i. Collection of students' data (such as; name, programme, department, matriculation number etc) needed for identity card production.
ii. Obtain Encrypted matriculation (EM) number value by the proposed system algorithm
iii. Feed EM to QR generator.
iv. QR generator produces QR code (QEM) which is printed at the bottom of the identity card along with other collected details.

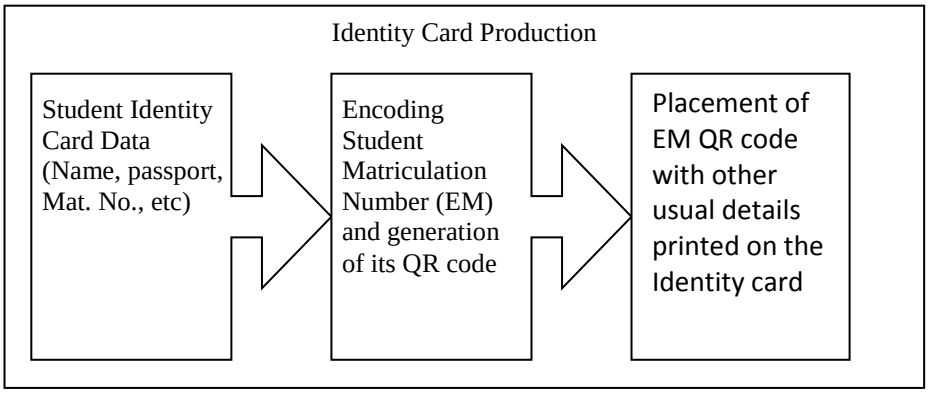

Figure 2. Proposed Identity Card Production model

4.2 Proposed Procedure to Authenticate Student Identity card

i. Launch the Student Authentication App installed on smart phone
ii. Manually input matriculation number on the presented student identity card
iii. The App carried out verification on the inputted matriculation number. This confirms whether inputted data conforms to the expected matriculation format of the institution or not.
iv. Reading of the QR code on the presented Identity card with a smart phone. The captured data is taken as supposed EM.
v. Decryption of the QR code (EM) captured
vi. Direct matching of M1 and M2 for identity. If they are identical, then authenticity of the presented Identity card is passed, otherwise failed.

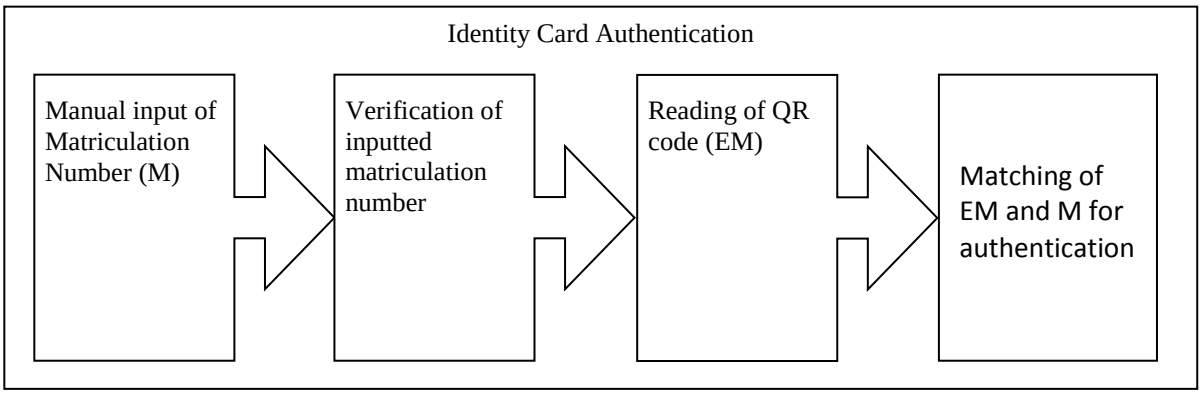

Figure 3. Proposed Identity Card Authentication Model

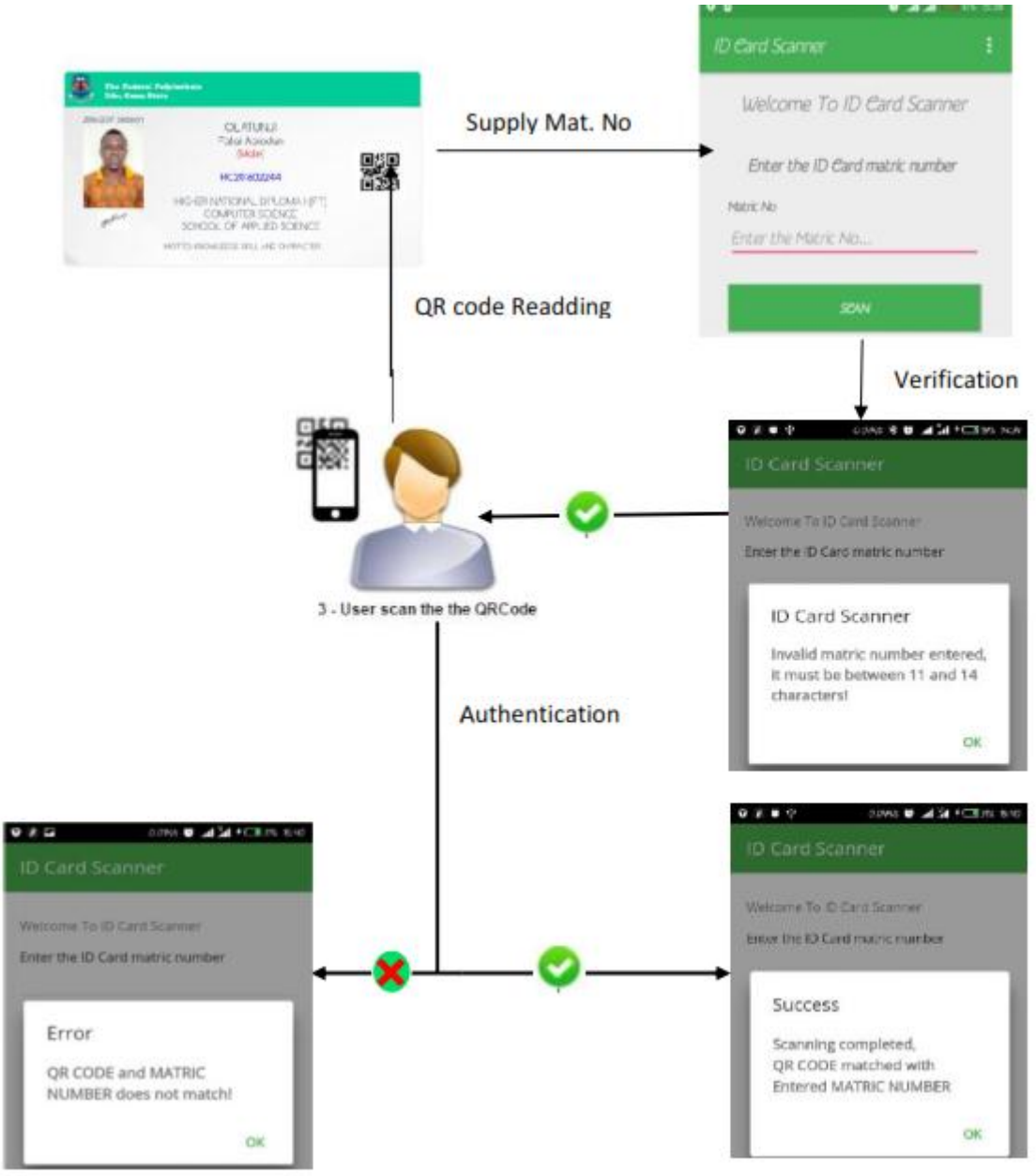

Figure 4. Screenshot Conceptual Framework of Identity Card Authentication System

1.3 Experimental Results

Ten different Identity cards were produced and authenticated based on the framework proposed. The parameters under which the experiment was carried out are presented in Table 2, while the results are presented in Table 3. The smart phone used for authentication was subjected to two conditions- With flash light on and without flash light on.

Table 2. Experimental parameters

Parameter	Value
Error Correction Level	L
QR code size (inches)	1.16
Smart Phone	Tecno W3 (5 MP camera)

Table 3. Experimental results

Illumination Condition	Time in seconds
Authentication Time Without flash light on	6 4 13 4 7 Average: 6.8
Authentication Time With flash light on	3 4 6 1 3 Average: 3.4

2. Result Analysis and Discussion

Result collected after the experiment revealed that our system performs faster when the illumination is high. From the result shown in table 2, the average time to authenticate an identity card with the smart phone flash light on is 3.4 seconds while without flash on is an average of 6.8 seconds. The reason being that, the higher the illumination in this context, the better the clarity. When the QR code is clearly displayed, QR reader embedded on the smart phone will be able to capture expected data in a faster time.

3. Conclusion

One of the main contributions of this paper is the possibility of an offline student identity card authentication system. Our system was experimented on printed identity cards which results to faster authentication when the camera flash of the smart phone used is on against when it is off. In the future, we will look into how to do away with the manual procedure of inputting student matriculation number before authentication.

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