Available online: www.unicrossjournals.com

JOURNAL OF CONTEMPORARY RESEARCH (JOCRES)

RESEARCH ARTICLE VOL. 1 (2) ISSN:2814-2241

Date Accepted: 30th Dec, 2022

Pages 39 - 45

UNIVERSITY OF CROSS RIVER STATE CERTIFICATE VERIFICATION SYSTEM WITH EMBEDDED UNCLONABLE QUICK RESPONSE CODE DIGITAL SIGNATURE

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Abstract

At the completion of every prescript programme in the University of Cross River State (UNICROSS) the institution is expected to issue a certificate to the students. The university's degree certificate has a huge impact on the beneficiary's life, but in recent years, fake credentials have frequently been created and given. This is because the availability of sophisticated printing and copying technologies makes it simple to counterfeit paper documents. To address these challenges, the aim of this research work is to develop a Certificate Authentication System using Unclonable Quick Response (QR) Code Digital Signature as an anti-forgery solution for UNICROSS. It is necessary to implement a contemporary technological procedure that can check and ensure the legitimacy of any UNICROSS Certificate, such as a secure 3D printed QR code. A solution for preventing the distribution of false degree certificates is suggested, in which the authenticity of a digital signature contained on the certificate may be confirmed online using commodity smart phone and QR Code.

Keywords: QR Code, 3D Printing techniques, Certificate authentication, QR code Generator, QR code Scanner application, UNICROSS Certificate.

1. Introduction

The advent of technology has made it possible to copy and print papers at a lower cost, which has increased fraud and degree certificate falsification. The integrity of the institution awarding the certificate as well as the certificate bearer has been compromised by this art. Because it requires numerous levels of human contact, manually verifying certificates is a tedious and clumsy process. Additionally, because the university might be forced to confirm all of the graduates from their institution, it is a time-consuming operation that adds to their burden. Currently, most universities use a manual method for authenticating certificates of her graduated students. The manual approach for document authentication that is currently in use has the following limitations as a result. 1) The institution doesn't have a centralized database to check each certificate it issues. 2) A correctly faked certificate can easily avoid the manual authentication process due to (1) above. 3) The manual authentication technique is ineffective in preventing staff corruption in educational institutions. 4) Manually authenticating degree certificates given by an institution requires a lot of time and resources. Hence, to address this menace it is very necessary at this age and time that UNICROSS should adopt an approach that can guarantee information confidentiality and the validity of her issued certifications.

This research work provides an automated authentication method that can address the problem of delay and forgeries by embedding

digitally signed QR code tag that works through a smartphone app, that enable you verify a degree certificate from UNICROSS. The digitally signed QR code tag makes it possible to verify the certificate independently of the organization that issued it. It encourages improved dependability and security in the current procedure of awarding university graduates' degree certificates.

The proposed digital signatures have been extensively utilized in networks to provide information electronic authentication. The digital signature provides a cyber-link to the identity of the signatory, providing security against forgery and manipulation. A digital signature (DS) is a numerical technique for confirming a document or paper is authentic [1].

The receiver should have good cause to believe that the document was authored by a reliable sender who can't possible deny sending the message and that it wasn't intercepted or altered in transit if the digital signature is well-established. The most typical usage of a digital signature is when it's crucial to spot fraud or tampering. [2].

In the process of deploying a digital signature into a machine-readable format a QR code would be require. To authenticate the certificate, the information that has to be verified is encoded in a QR code that can be scanned by anyone using a specific smart phone application. The main goal of the suggested solution is to do away with the tedious manual certificate checking process.

The key advantages of the QR code technology are its cheap, how easy it is to create a QR code or have a consumer mass market gadget read it, and the ability to integrate tracking information [3]. The major demerit of a QR code is that it can be easily duplicated or cloned. Due to the sensitive nature of academic certificate this problem has to be addressed first by producing an enhanced unduplicated QR code. The research proposes the use of Additive manufacturing or Three-Dimensional (3-D) is a substitute to the conventional product manufacturing process through which 3-D solid objects are manufactured [4].

In other words, 3-D printing and additive manufacturing are synonymous [5]. At the moment, additive manufacturing makes it possible and makes it easier to produce moderate to large numbers of individually customizable goods [6]. The 3-D printing techniques is intended to be use for carving a QR code on the surface of every certificate with a detail information of the bearer linked to the institution. The main reason for using 3-D printing techniques for QR codes printing is based on the fact that it provides an unavoidable and unmanageable process variation that occur during printing which can foster customization of our proposed digital signature.

2. Statement of the problem

Verification of academic certificate is a major concern to all relevant stakeholders in this contest, such as: academic institutions, recruiters and employers of labour. Employers of labour in recent time has experience a high rate of fake certificates in circulation. With the current increasing accessibility of cheap scanning input devices with as good-quality printing machines and excellent colour duplicating printing devices, due to the ease with which a paper document could be fabricated, the fabrication and distribution of phony certificates became affordable and simple [7],[8]. However, today's society seems to be quite concerned about significant documents being forged, such as degree certificates. In the 21th century a lot of fraudulent activities and misconduct has been recorded, most especially in the act of certificate falsification. The impact of these behaviors typically reduces worries about the institution's integrity [17].

The 3-D printer QR code digital signature can immediately improve the security of the certificate because it is different from the regular QR codes application that can be easily cloned or duplicated. It is concluded that a unique and unduplicated fingerprint can be produced using the variance in occurrence in the 3-D printed QR code.

3. Research objectives

The specific objectives of the study are to:

i. investigate existing systems of certificate verification and authentication;
ii. formulate new modified algorithmic model for automatic verification and authentication of UNICROSS certificates;
iii. develop a mobile application for automatic certificate verification and authentication compare performance of the proposed system with existing systems.

4. Literature review

With the use of Tata Consultancy Services Limited's (TCS) SmartDEGREE, a solution based on Radio Frequency Identification (RFID), universities can lessen the issue of bogus degree certificates and mark sheets. Using SmartDEGREE, a university can grant diplomas with embedded RFID tags that are digitally signed by the institution's administrators and encoded with the recipient's name, graduation date, degree type, complete transcript, photograph, and biometrics (fingerprints). [10].

The ISO 14443A-compliant passive 13.56 MHz RFID tag used by Smart DEGREE is implanted. Each tag includes 4–8 kilobytes of memory and is encoded with the certificate holder's name, graduation date, degree type, and whole transcript, as well as a photo and biometrics (fingerprints), all of which are digitally signed by the university administration [10]. To confirm the information on the degree certificate, they used a combination of fingerprint authentication and digital encryption technology. One can quickly get the data from the RFID Tag when needed by utilizing an RFID reader, at the University of IIIT-Bangalore, HP Labs revealed a Document Authentication System that generated diplomas with 2D barcodes. In order to service customers on a network, they developed a centralized Document Authentication System that could take data from numerous document issuers. This 2D barcode is easily accessible by barcode scanner technology or a smartphone with a camera because it is in a machine-readable format. Data is then transported via a secure network, where it is processed by the centralized system. Determine the legitimacy of the document by manually comparing the returned data with the one being validated [11].

In a current work by Basheer N.Ameen and Sawsan K. [12], the authors have introduced the encryption approach by investing in two specific selected areas to generate one ciphered QR code as in sender side. They developed the method by inverting two special selected areas to generate one ciphered QR code as in sender side In this encryption method authors have used bit-manipulation, byte reshuffling and generalized this method [12].

A novel Confidential Encrypted Data Hiding and Retrieval Using QR authentication System was created by Dey, Nath, and Agarwal [13]. In this system, each student's vital information, including name, roll number, registration number, semester and year of study, marks earned in various subjects, and grades earned, are kept in the QR Code. However, all of the information saved and encoded in the QR Code is encrypted before it is printed on the student's grade sheet. Therefore, in the future, the QR Code may be read, the encoded information can be encrypted, and the information can be provided if the student or other person wishes to view their grades digitally or send academic material to any university or organization in digital format. This research offered a revolutionary method in which a candidate's grade as well as details would also be encrypted in a QR Code.

5. QR code security

QR codes, in its traditional and most basic form, are square arrangement of composite black and white squares with data encoded on it. Due to its similar functionality to a barcode, users occasionally refer to QR codes as 3D barcodes. More data may be stored in a QR code than a barcode can, which can only represent short alphanumeric strings.

Regardless of the fact that QR codes have a number of beneficial uses, they can also be misused. QR codes make it possible for large volume of information to be arranged in small spaces due to its capability to hold a lot of information. The 2D nature of QR codes makes it possible to store more information in horizontal and vertical directions. In comparison, barcodes store data in vertical bars, limiting the amount of information they can hold.

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 [14].

Irrespective of its usefulness, QR codes nature makes them exploitable by attackers. Scanning QR codes from untrusted sources can expose you to numerous security threats. The fact that QR codes make sharing of information easy and fast that expose it to more security risks. Cybercriminals can easily clone or duplicate them to impersonate information encoded on it.

This study suggests a framework for end-to-end QR code verification for 3D printed digital signatures as a certificate anti-forgery tag, enhancing the security of QR codes. 3D printed QR codes or additive manufacturing affords greater personalization, given this importance, 3D printing has been hugely introduced in rapid prototyping and customization. In 2021, the market for 3D printing was estimated to be worth $13.84 billion. By 2030, it is expected to have grown fast to reach a value of $76.17 billion, with a CAGR of 20.8%. About 2.2 million 3D printers were shipped in 2021; by 2030, there would be 21.5 million devices in use. [16].

To Forder strengthen the security of a QR codes for the purpose of UNICROSS certificate verification, to create a distinctive fingerprint for the integrated QR code, we are investigating the implementation of random and unpredictable process changes present in 3D printing systems. We offer a framework for point 3D-printed QR code verification to accomplish this without changing the original QR code's functionality or protocol.

6. The proposed system models.

To address a rampant circulation of fake university documents in the name of certificate emanating from the University of Cross River State, we propose a QR codes certificates verification model which can be use with ease to verify and authenticate certificates awarded by the institution. The choice of QR code technology is due to the fact that its being known as a tech tool that gives a digital space to an item. QR codes have also become essential when fighting fake documents in this digital era.

Our model provides a view of the general solution to secure paper certificates using an encryption algorithm and a mobile scanner for authenticity verification. An un-cloneable QR code will be generated based on the instance of the student’s records, such as: Matriculation Number, Name, Class of Degree, Department, and Date of Graduation as well as photograph of the certificate holder encoded on the QR image. Figure 1.0 present an implementation structured model of our proposed system.

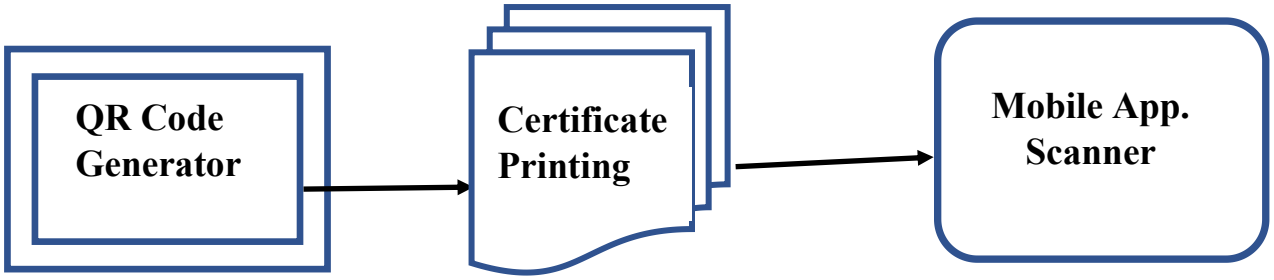

Figure 1: Simplified proposed system model.

Our model for UNICROSS certificate authentication system consist of the following modules: QR code Generation; Certificate printing and the Mobile Application scanner. The student information will be encrypted in the QR codes using the QR code generator. The generated QR code is in turn engraved on the certificate using a 3D printer. The QR code image on the certificate needs to be decoded by using the mobile application scanner. The information from the certificate is then extracted from the scanned QR code in the application, using a variety of image processing algorithms, in order to authenticate the certificate.

The Mobile QR-Code application scanner shall be regulated and managed by UNICROSS, were authorize Certificate from the institution would be authorize with a 3D Printed QR-code which legitimacy can be verified by employers of labour and others. The mobile application scanner is made to capture the image of QR-code and sent to the web-based verification system.

Upon receipt of the QR-code image the web-based verification system shall verify the QR-code fingerprint and quickly replies the user through the application. The web-based verification system is assumed to be administered by UNICROSS because the fingerprint of all QR-code shall be secured in a central database in other not to be hack by adversaries.

7. Conclusion

This Research work is exploring the advantages of QR-codes technology in different applications for authentication and verification to identify the originality of certificate awarded by the University of Cross River State. Through an improved integrated QR code creation and verification of University of Cross River State authentic certificate using 3D printers and smartphones, we offer a comprehensive approach to the anti-forgery 3d printing technology Certificate solution. Our research would be the first to examine and take advantage of the unmanageable process variation in a 3D printing machine to improve the current manual Verification Services currently run by the University after taking a look at several existing works of applying QR code for authentication services.

8. Acknowledgement

We thank all Directorate of Research and Development, University of Cross River State. This work is being funded by the Tertiary Education Trust Fund (TETFUND) Institutional Based Research (IBR) Grant.

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