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Design and Implementation of a Secured Online Transcript Processing Management System

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ABSTRACT

The process of securing academic transcript in most institutions of higher learning in Nigeria especially the Polytechnics is managed with the use of manual platform that involves physical movement of human and documents from one office to another. This manual platform is observed to be ineffective and inefficient due to challenges such as delay in the processing, dispatch, and loss of vital documents on transit. To solve these challenges, the Secured Online Transcript Processing Management System is a platform that allows the alumni of Polytechnics to virtually request and apply for transcript, and under strict security tools allows the authorized officer automatically process and virtually dispatch the transcript to the requesting institution without any physical movement of human and documents. This system was design and implemented with the use of NOD JS as web server and scripting language and MongoDB as functional database. Also, the user's valid login, the RSA Cryptographic Algorithm, and steganography were adopted as the security tools for protecting system's files during data processing and transmission. The system was tested and found to be effective and efficient in the overall transcript processing management.

Keywords: Alumni, Authorized, Encryption, Online, Steganography, Transcript.

I. INTRODUCTION

The need for keeping a detailed information about a student goes a long way to describe such a person academically (Matemilayo, Kamaldeen and Samson, 2017). This is achieved by educational institutions through the use of transcripts. Thus, transcripts serve the purpose of keeping a certified record of a student throughout a course of study having full enrollment history including all subject attempted, grades earned as well as degrees and awards conferred (Kunkolienker & Kamat, 2021). Therefore, transcript as a major document of one's academic life, its importance cannot be underestimated.

According to (Mulya, Novianti, Zayanti, Ramadhan, Wijaya and Yeremia, 2020) transcript is needed in so many processes which include but not limited to application for further studies, for job seeking and for the purpose of seeking a public position in this modern-day society. However, the process of securing academic transcript in most institutions of higher learning in Nigeria especially the Polytechnics is managed with the use of manual platform that involves physical movement of human and documents from one office to another. This is often difficult and frustrating, as it requires the document to pass through bureaucratic processes, some of which are not important and also attract cost (Amadin & Obieniu, 2017). This manual platform is observed to be ineffective and inefficient due to challenges such as delay in the processing, dispatch, and loss of vital documents on transit.

These scenarios do cost the applicant a number of failures. Admission process will not complete without including the transcripts with the admission forms especially for students going for higher degrees in other institutions. Some other cases may be the loss of a life time opportunity (Faluyi, Olanokunmi & Sade, 2018). Besides the issue of manually generating the transcript, the system of transmitting this document lack security, as it is usually sent to the recipient through public communication channels which are openly accessible by anyone, and to different types of attacks, hackers and threats.

Hence, as a result of the aforementioned challenges, this research therefore, with the use of web technology tools provides an online platform where the transcript processing management is more flexible, effective and efficient. It is a secured system, where data and files are protected with several levels of security tools in order to maintain the data integrity and confidentiality as they are being processed and transmitted. Protecting digital documents is a very significant matter in a networked society which includes adversary (Faluyi et al., 2018). Therefore, the documents being released has to be secured using some security measures which can be cryptography, steganography or digital signature (Bharamagoudar & Geeta, 2018).

Thus, the research makes use of RSA cryptographic algorithm for data encryption and steganography for information hiding. This makes the transcript being transmitted more secured and unreadable from hackers.

1.1 Aim and Objectives

The aim of this research is to provide a secured online transcript processing management system, and the objectives are to:

- (i) get and create database for relevant data and information used in transcript processing management.
- (ii) Design an interface for management of transcript processing.
- (iii) Implement the system with RSA Encryption Algorithm and Steganography for securing the transcript.

2. LITERATURE REVIEW

(a) The Concept of Transcript

The concept behind transcript is to give proof of education, it is a detailed record of one's academic performance and it is usually issued by the institution. Transcript are very confidential documents that need to be secured and kept away from indiscriminate access by unauthorized users. Transcripts are used to determine the genuineness of a student certificate and also get a summary of the person's academic career (Omogbhemhe & Akpojaro, 2018). Academically, a transcript is an official document of confirmation (Kunkolienker & Kamat, 2021), and if they are compromised, student's information such as grades are made public and may be altered.

(b) Types of Transcript

- i. **Official Academic Transcripts:** Are the transcript which are duly signed and stamped by the academic institution on their official letterhead. Most times, the academic institution takes longer to transfer or send the requested academic transcripts. Under such circumstances, the students can use the unofficial academic transcripts for the time being. However, they will have to get the official academic transcripts confirmed later on with their respective universities.
- ii. **Unofficial Academic Transcripts:** These are in the form of a digital copy or photocopy of the original academic documents. They have all the academic record of the student except the granting institution's official stamp and signature.

(c) The Transcript Processing Management

There are two methods of transcript management, Computerized and Manual method. The computerized information management for transcript management which will help to overcome the undesirable problem associated with loss of student records, student's grades, slow and stressful accessibility of student report and record, inaccurate record keeping and terrible information management

(d) The Data and File Security

(i) **RSA (Rivest Shamir Adleman) Algorithm:**

RSA Algorithm is a technique in which original data (Plaintext) is converted to some unreadable form of data (Cipher text) with help of some secret key (Public & Private) using some ciphering algorithm. In Cryptography, secret message is kept in an unreadable format to a third person, while in steganography method existence of secret message is hidden from the third person (Hidayat et al., 2020).

Encryption: This is the process by which documents written in plain text are converted into an unreadable format often known as cipher text. Cryptography involves the use of an encryption process to send confidential data through an insecure channel.

Decryption: This is the process of converting cipher text back into its plain and original format, making it readable and understandable.

(ii) **Steganography:**

Steganography technique, sender sends a message by hiding it within some multimedia data like text, image, audio or video (Tayde et al., 2017). Both cryptography and steganography try to protect data, this technologies alone can serve however it is better

to develop a system that makes provisions for this to be combined, thus, with both approaches present their will be a dynamic way of increasing the information security and to increase the degree of security of the system (Garikipati & Lim, 2006). In cryptography its always clear to intermediary person that the message is in encrypted form whereas in steganography the secret message is made to hide in cover image so that it could not be clearer to any hacker that whether there is any message hidden in the information being shared.

The cover image containing the secret message is then transferred to the recipient. The recipient is able to extract the message with the help of retrieving process and secret key provided by the sender (Kunkolienker & Kamat, 2021).

(e) Related Work

Bharamagoudar and Geeta, 2015, in this research, a system was proposed to computerize the manual process of student information management. This system was of great impact as it helps to eliminate the manual process, which made use of papers, into a paperless process that can be operated remotely. However, the security system implemented in this research, is the merely use of password which can be hacked.

Kunkolienker & Kamal, 2021, in this research work, an algorithm was developed for securing student data using a cryptographical algorithm. The research adopted the snake and ladder algorithm, and modified it. This modification made the algorithm resilient against brute force attack, and cipher only attacks. However, it was observed that the algorithm used, is a symmetric algorithm, which uses just a key and must be known by both parties.

Omogbhemhe & Akpojaro, 2018, a centralized transcript generating system was proposed in this research, this was aimed at eliminating the difficult encountered by students during the course of requesting for transcript. This proposed system will be able to increase the efficiency of requesting and processing transcript. It also allows the applicant to keep track of the transcript generating and processing process in general. Mulya et al., 2020, in this research an algorithm for data integrity check was developed, the algorithm is specifically used to check if the records of students have been modified, particularly their grades. It adopted the SHA-512 algorithm for checking data integrity, which is achieved by comparing both the initial and final hash values of the data.

Matemilayo et al., 2017, a system for processing and managing student records, especially students result was proposed, it made the access and retrieval of students records easier and much faster, thus removing the need for manual processing. However, the system did not take security of this data much into consideration, as the only layer of security applied is the use of password which can be cracked by anyone with a sufficient knowledge in computer security.

Mbam & Odachi, 2014, this research came up with a means to solve the administrative problem of transcript generation, it helped in reducing the cost implication of this process as well as the time consumption challenge. It also has a positive impact on the students who applied for transcript as it often part of the pre-requisite to be accepted in other schools. It was noted that the system made delivery to the requesting school timely. However, it was observed that the generated transcripts are barely secured, thus it can be freely accessed by anyone, which makes it open to changes.

Sivabalan & Balakrishnan, 2018, in this research a system was developed for securing the student records stored in the database, the research developed an algorithm used for encoding the data kept in the database using base64 encoding algorithm, which made the information inaccessible by unauthorized parties. However, with the new advancements in technology it is often possible to break an encoding scheme. Thus, suggesting that the safety of an encoded data is not fully assured.

Faluyi et al., 2018, in this research a system an algorithm was adopted that was used to secure transmitted data (student transcript) to its receipt. The algorithm was developed by combining image stenography with an asymmetric algorithm, RSA algorithm, where the records is first encrypted and then hidden in the picture. Thus, making the transmission secured, and therefore, removing any possibility of suspecting for the existence of any vital information.

4. ANALYSIS OF THE EXISTING SYSTEM

The existing approach to transcript management in higher institution of learning, especially the Polytechnics is manual, where there is a lot and voluminous paper work. The system involves the applicant (student) who wishes to obtain a transcript to manually pay the prescribed fees at a designated bank, after which a paper application form will be collected from the examination and record unit of the institution that is responsible for processing and issuing of the transcript. After the relevant information is manually field in the paper application form, the form is physically submitted, and the examination and record unit begin the manual method of processing the transcript. At the end, a paper-based transcript is produced after some processing time. Then this transcript is mailed or dispatched using any physical method like postal services to the particular college/polytechnic/university the student requested, this in turn involves some transfer time and cost. This physical or manual procedure is diagrammatically presented in figure 1 below.

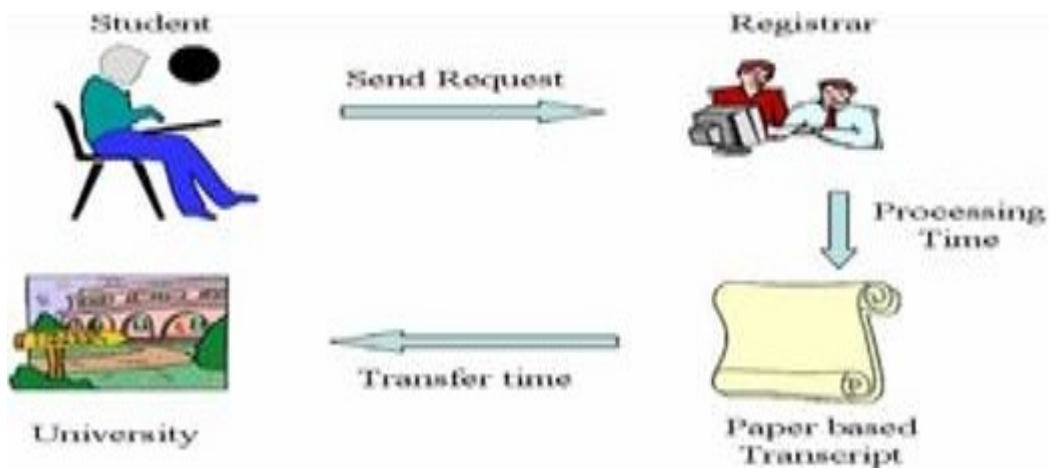


Figure 1: Manual Transcript Management (Adopted: Ramani and Billy, 2014)

5. RESEARCH METHODOLOGY

The methodology adopted in the development of the secured online transcript processing management system is the structured system analysis and design methodology (SSADM). This is a waterfall method (sequential design method) used for the analysis and design of an information system. The waterfall model is a sequential life cycle design model process, often used in dividing software development processes into phases (requirements specification, software design, testing, and implementation) of which each phase must be completed before starting a new phase with each phase performing a specific role. The figure 2 below is a representation of the waterfall model.

6.0 SYSTEM DESIGN

What follows depicts our system design

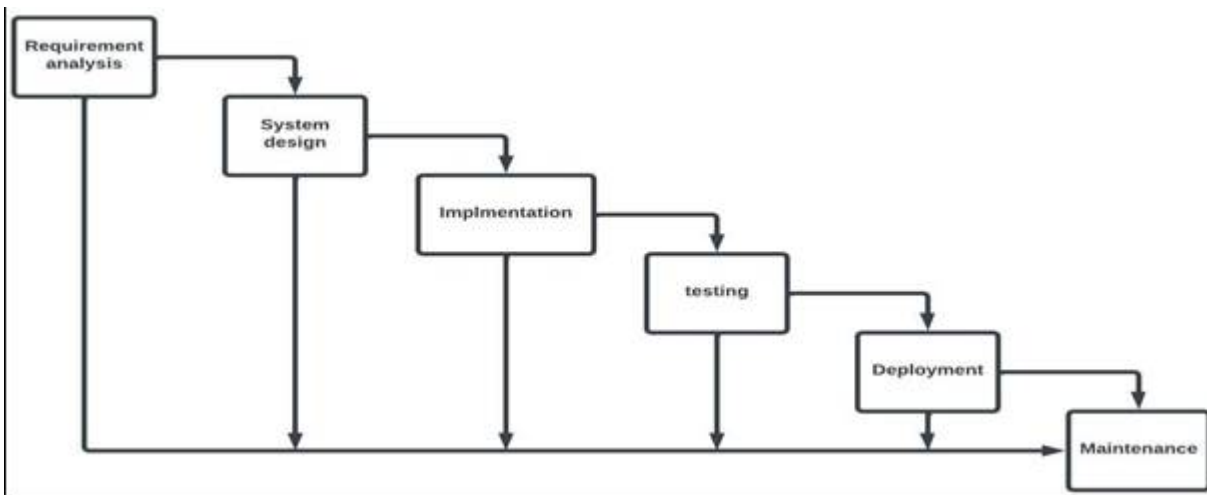


Figure 2: Waterfall Model

(Adopted: Nneji, Deng, Shakher, Monday, Agomuo, & Dike (2018))

(a) The Architecture of the New System

The model of the new system is as shown in the figures 3 and 4 below. The system devised a means of making the transmitted transcript secured by applying major security measure, and these are cryptography, using an asymmetric algorithm, RSA which uses two keys to secure the information being transmitted. The second security measure applied for data security is steganography, where the transmitted document is imbedded into an image and sent off to the recipient.

As shown in figures 3 and 4, the student applies for transcript through the online portal where the request is sent to the database and the administrative officers that are handling this process, generates the requested transcript, usually as a portable document format (pdf). The generated transcript is not sent that way, it is secured by through the means of steganography (figure 3) that allows the sending school to hide the transcript in an image (stegano image) and cryptography (figure 4) that allows the sending school to secure the transcript by converting it to a cipher text, which literally makes no sense, even if it is intercepted.