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RESULT CHECKING AND CERTIFICATE VERIFICATION SYSTEM USING USSD CODE

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Abstract:

Technology generally has developed in recent times. Education technology has also seen significant level of advancement as students and researchers seek more useful ways of combating various challenges bedeviling the educational sector. Most institutions especially developing countries have result processing software which are largely web based. In the area of certificate verification, most tertiary institutions have no automated way of verifying issued certificates, giving rise to a soaring figure in the use fake certificates in the country. In this work, we designed a system that attempts to address the issues of result checking and certificate verification with the use of USSD. Having explored the various systems in place and challenges faced by users, a hybrid model was designed and developed to solve the problem of result checking and certificate verification by making it fast, secured and easily accessible even with the most basic phone.

Keywords: USSD, SMS, result checking, certificate verification, Information Management System.

Introduction

The widespread use of mobile phones and other portable gadgets has made it easier for everyone to access and retrieve information, and the education sector is not exempt from this growing trend (Olusanya and Ogba, 2015). Computers with internet access have greatly improved inter-human communication. The telephone system which is the main mode of communication has come a long way since it was initially created many years ago. As a result, we now have mobile phones, fixed wireless phones, and other similar technologies.

Mobile phones now support a variety of technologies and provide or enable a variety of services to its users, including Short Messaging Service (SMS), Voice Calls, Video Calls, Internet browsing, and many more. Two other technologies that are supported or made possible by this development are Interactive Voice Response (IVR) and the most recent Unstructured Supplementary Service Data (USSD).

SMS is widely used, particularly in communication. In more recent times, it has been used to provide a variety of services, including banking, airline, and commercial services like Share and Sell (a new service launched by MTN Nigeria that other brands have adopted, giving rise to me2u by Airtel, etc., where subscribers can easily share and/or sell airtime and other services). SMS is a mobile technology that enables text and even binary messages to be sent to and received from a mobile phone. The USSD is an international standard for mobile communications that allows text messages to be sent between mobile devices and a networked application program (Zhou *et al.*, 2015). As long as network coverage is available in that area, any mobile phone (not necessarily a smartphone) could communicate with an organization's database system to retrieve information such as account details of a bank account, credit units of a billed network or status of a particular transaction whenever necessary.

However, because of institution's strong reliance on the implementation of web-based systems for result checking and certificate verification, students, parents and organizations intending to verify applicants certificate have not fully benefited from the technical breakthrough in the use of USSD code. Institutional over-reliance on web-based systems for certificate verification and result checking is subject to a number of drawbacks, including but not limited to issues with network infrastructure, coverage areas, user income levels, and easier and quick means of checking results and verifying certificates (Vikram and Timothy, 2018). For instance, there are still substantial gaps in the availability of telecommunications services, particularly when it comes to data services. Users in remote locations might only have access to the most fundamental phone features, such making and receiving calls and sending SMS, while more sophisticated activities like web browsing are still out of their reach. Additionally, employers may run into difficulties when seeking to confirm the validity and authenticity of academic records or certifications provided by job candidates during interviews. This process can be expensive and time-consuming, especially if a visit to the applicant's school is necessary. Fake certifications and results are being produced more frequently now than in previous years. Many people have turned to simpler and illegal methods to gain the degrees and credentials they want (Thisday Newspaper, 2022).

There is a long and concerning list of persons in Nigeria today who flaunt fake degrees and certificates. Fake everything permeates the entire country, from fake schools to fake teachers to fake physicians, and it affects practically every facet of our everyday lives. In today's police, military, academic, ministries and government institutions, as well as politics, many people display forged credentials for occupations they are not qualified to carry out. The nation's present strategy for achieving political domination appears to involve making erroneous claims, including falsifying credentials. The absence of a reliable database, dishonest government officials, and faculty and staff at postsecondary schools all exacerbate

this issue. Criminals who flaunt chains of medical degrees often endanger the lives of citizens. Additionally, there are individuals who teach at our colleges without holding a valid first degree. Confirming these certificates using the present verification system is laborious, time-consuming, and occasionally expensive procedure, especially if you need to do it frequently.

There is a need for a system that can independently fulfil the goal of automatically delivering the tasks of result checking and certificate verification within the shortest possible time. This study seeks to create a quick, rapid, and effective alternative method for students to check their exam results and to provide a very quick way for organizations to verify a certificate using even the most basic phone.

Literature Review

Numerous initiatives have been launched to solve the issue of verification, which has led to a widespread recognition of the problem of certificate forgery and the necessity for efficient methods of certificate verification. The standard method for verifying certificates, however, still involves a manual procedure that requires individuals to either personally visit the school or submit a written request.

To address these issues, Srushti *et al.* (2014) presented a certificate generation system that utilized thorough data and offered user-friendly mark sheets for the credit-based grading system (CBGS) in an effort to enhance certificate management. The administrator manually enters each student's grades into this system, which subsequently stores them in a database of internal data. The % and grade are manually calculated by the system. The solution includes a digitally integrated form into the mark sheet with an encrypted QR code to increase security and make sure that only authorized users can access the data. The system was ineffective despite these qualities because of its partial automation. A cloud-based architecture and a cryptography technique were presented in a study by Osman and Omar (2016) to improve the verification process and lessen instances of certificate fraud. This strategy attempted to improve the security, legitimacy, and confidentiality of diplomas. The author argued that some of the issues that limit operational effectiveness in student services at universities can be resolved by introducing a cloud-based approach, improving the standard of services offered. However, many institutions find it expensive because service providers often charge a high implementation and management fee for cloud infrastructures.

Yusuf *et al.*, (2018) carried out research that allowed end-users to define certificate templates and formats without needing to be familiar with XML. This was accomplished by merely typing and clicking buttons on the system's graphical user interface (GUI). The technology enabled simultaneous production of one or more certificates and certificate verification. However, the system was only partially automated and ineffective because it relied on inputting student information from an Excel file. Sighal and Pavithr (2015) did a study with the aim of implementing QR codes and a smartphone application to reduce the circulation of fake degree credentials. The QR code featured a digital signature that included important details like the name, enrollment number, roll number, and overall grade point average of the degree holder. The university's administration approved of this digital signature. People had to use a certain smartphone app that could scan the QR code and validate the certificate in order to validate the digital signature. By including QR codes onto degree certificates and creating a smartphone application, this approach successfully combated certificate fraud by enabling quick and reliable verification independent of the certificate granting institution. The deployment of this system resulted in a significant improvement in the mechanism for determining the authenticity of certificates, surpassing the speed of human verification and successfully and economically thwarting the production of counterfeit certificates. However, there is a possible accessibility issue because people without cell phones or without access to the smartphone application will have trouble confirming certificates.

Boukar *et al.*, (2017) developed a web-based approach for their research using Java Database Connectivity (JDBC) and a MySQL connector jar file. By obtaining certificate data in JSON format from institutions and keeping it in a database for verification purposes, their suggested method sought to replace the conventional manual verification process. This method does away with the security hazards and mistakes made by people involved in manual verification. An SQL query was used to retrieve the necessary data from the database, and the GSON jar file and JSON library functions were used to parse and display the results in JSON format. The system's speed suffered, nevertheless, as a result of a significant limitation brought on by MySQL's use of NoSQL characteristics.

In their research, Tint and Win (2014) used the Secure Hash Algorithm-1 (SHA-1) and the Elliptic Curve Digital Signature Algorithm (ECDSA) to prevent false certificates. In addition to enhancing memory usage and computational performance, this combination offered good cryptographic security. The user's input message was hashed into a message digest as part of the procedure, and the message digest was then encrypted into a signature value using the ECDSA technique. A barcode was created by further converting the signature value. An electronic certificate was then produced using the barcode and the user's input message. New users had to register before using the system. They supplied their information and produced a public/private key pair during registration. Their electronic certificate was made using this data and the secret key. However, the system lacked a certification authority (CA) to develop a more secure client-server authentication system and to establish confidence between the user and the server. The system's overall security was compromised by the lack of a reliable third-party system.

In a university context, Adagunodo *et al.*, (2007) investigated the use of mobile devices to send exam results using Short Messaging Service (SMS). They discussed the security issues raised by the system's implementation while presenting it. Their method works as a dependent service, with a phone and a conventional SIM card connected to the server hosting the SMS application. Results can be delivered effectively thanks to its design.

Other higher education institutions (HEIs) have implemented a number of student result checking systems (SRCS). Nanyang Technological University, for instance, uses the NeXS (NTU eXpress SMS) system. Students who utilize NeXS Portal must register their cell phone number, which can be from any of the three network providers (Singtel, Starhub, or M1). After registering a mobile device, NeXS uses the assigned number to send SMS and access data. Users only need to text the keyword "NTU RESULT" to 74000 to get the most recent semester's exam results via NeXS. The main benefit of NeXS is the security it offers, which makes sure that only registered mobile phones can make requests for results. However, rather than being beneficial, the obligation to enroll particular cell phone numbers and restrict access has a big disadvantage. This limits the system's adaptability and raises questions about how to prove that the phone's owner is the real one who is asking for the data. For instance, NeXS cannot confirm that the request was made by the rightful owner when a user uses another user's phone to seek the results. Additionally, the user must go to the NeXS website to register a new phone if the registered phone is lost or stolen.

Similar to the previous example, SMS result verification also applies to the Malaysian University English Test (MUET). Users receive results when they send SMS with the following format to 39003: MUET IC Number (Famutimi *et al.*, 2015). However, the technology offers no security measures. Due of the ease with which students can seek one another's results just by knowing their registration number, it is now more open to security and privacy concerns. The system, like NeXS, only offers the most recent semester's exam results, rendering it unsuitable for usage at any time.

Abdullahi et al. (2022) developed a certificate verification system using QR codes and blockchain technology. For system modeling, iterative and incremental models were employed. Additionally, use case scenarios and data flow diagrams are employed to show how the web application functions. As a result, appropriate programming languages were selected to implement the system's suggested algorithm. The frontend and backend were implemented using Hypertext Preprocessor Pages (PHP) and Spring Boot (a Java framework), respectively. The system was assessed, and the results demonstrate that it is not only safe but also safeguards student identities by offering an anonymous verification environment. However, smart phones are needed to use this system which is not always available with most Nigerians especially from rural dwellers.

All across the world, USSD is widely used. The technology is appropriate for many corporate applications. Because it is session-based, it is also quite rapid! Phone menus are required in order for users to access USSD services straight from the home screen. Along with a number of additional benefits, these features have made USSD the most widely used protocol by GSM cellular telephone service providers to allow users to interface with their servers. Nigerian service companies like Airtel, MTN, Glo, and others use USSD codes as one of their main methods of getting their consumers' attention. Numerous additional for-profit service providers, like Barclays, Stanbic, Citi Bank, and others, have embraced the usage of USSD to give clients dependable, affordable access to their services. It's also important to keep in mind that most large-scale mobile financial services (MFS) deployments in the developing world use USSD as their primary mode of communication with their mobile payment platforms, with the notable exception of M-Pesa in Kenya. Examples include bKash in Bangladesh, Wing in Cambodia, EasyPaisa in Pakistan, Tigo and M-Pesa in Tanzania, and EcoCash in Zimbabwe, to mention a few (Michael, 2015). In Nigeria, the National Agency for Food and Drug Administration and Control (NAFDAC) established the Mobile Authentication Service (MAS) initiative in 2010 as one of its anti-counterfeiting strategies to detect subpar and fabricated (SF) medical products. With the help of scratch codes and SMS, the service enables customers to verify the legality of pharmaceuticals at the point of purchase.

There was no infrastructure in place at the time this study was put up for employing USSD codes to verify certificates. The verification of certificates has been the subject of several research. They are only present on the web versions, though. Srushti *et al.*, (2014) described a certificate creation system that would provide effective certificate administration with massive amounts of data and would produce mark sheets for credit-based grading systems (CBGS) in a very user-friendly way. The administrative staff inputs each student's grades into this system. The percentage and grade are manually determined and will be recorded in an internal collection information database. The technology used an encrypted QR code to insert the digital form within the mark sheet, preventing access by unwanted users. However, the system is ineffective because it is partially automated.

The advantages of the USSD capability, which is available on all mobile phones, will be similarly explored in this suggested system as it is used to implement an independent result checking system. However, we want to have a system that should be scalable, so it might not be based on the current architecture of a dedicated system with a modem and standard SIM card connected to it as specified in previous studies. Instead, the developed system combined this feature with the capability of using USSD to confirm the validity of a certificate that has been issued, which makes it different from any other existing works.

Materials and Methods

Software methodology used

Software methodology refers to the procedures used in the development, production, testing, deployment, and maintenance of software. It contains a set of guidelines for software development teams to follow across the whole software development life cycle, including concepts, best practices, and procedures. React.js, Spring Boot, and MySQL will all be used in the proposed system's implementation, with Mysql serving as the database, Spring boot used for the backend development and React.js for the front end. The USSD API used will be AfricasTalking. For this project, the RAD (Rapid Application Development) paradigm was applied. The rapid development of functional software systems (RAD) strategy focuses on iterative and incremental software development. Through active user interaction, prototyping, and iterative development cycles, the RAD

approach seeks to hasten the development process and deliver quick results.

The software tools utilized in the development process are;

i. Development environment: IntelliJ IDEA Ultimate 2022.3:
ii. Visual Studio Code
iii. WonderShare EDrawMax
iv. Java Development Kit (JDK)
v. Database: MySQL
vi. Device: AfricasTalking Emulator

Analysis of the Developed system

The USSD-based method for result checking and certificate verification offers an alternative to the flaws in the current system currently in use at the Federal University of Lafia in Nasarawa, Nigeria. The suggested solution uses USSD, a fast and affordable mode of communication between students, employers, institutions, and the university that relies on the telecommunications network provided by GSM providers. The suggested solution combines web and USSD technologies to provide quick and affordable ways to examine results and confirm the legitimacy of certificates issued by the Federal University of Lafia. This hybrid system combines methods for certificate verification with efficient result distribution as seen in Figure 1.

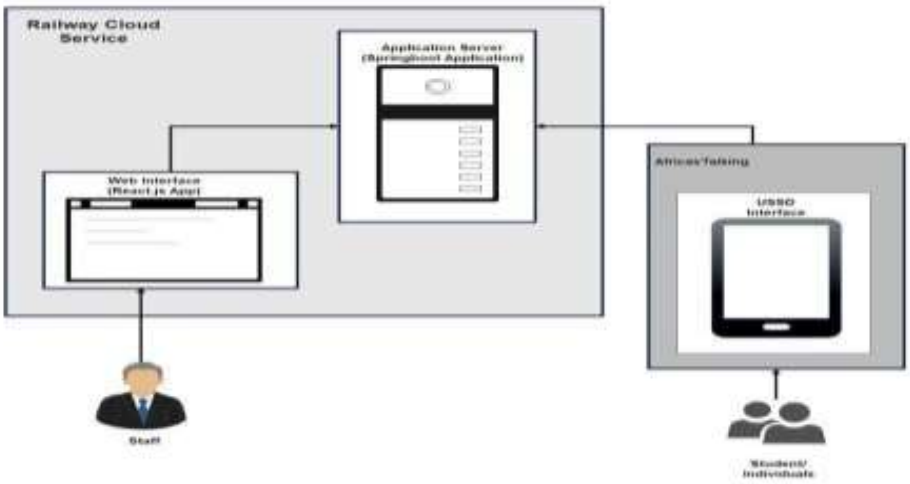

Fig. 1: High level model of the developed system

The suggested system's system architecture is depicted in the diagram in Figure 1. On their cell phone, the customer enters the USSD code. To the AfricasTalking server, the network provider forwarded the code along with the original phone number. After confirming the request, AfricasTalking establishes a session for this phone line with a special session ID. AfricasTalking then sends a request to the Fulafia Result Application USSD request handling endpoint that includes the dialed codes and the originating phone number. This request is verified by the Fulafia Result Checking and Certificate Verification Application, which decides what kind of reply to send to Africastalking, who then replies to the network provider and subsequently the user's mobile device.

Figure 2 and Figure 3 shows the use case and the class diagram description of the result checking and certificate verification system. The actors involved are the staff, students and other individuals. Staff can authenticate results, upload results, add courses, etc., students can check and authenticate results and other individuals too can authenticate results.

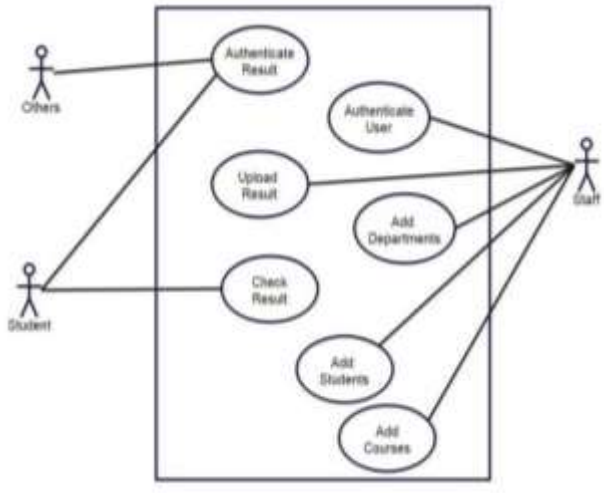

Fig. 2: Use case diagram of the developed system

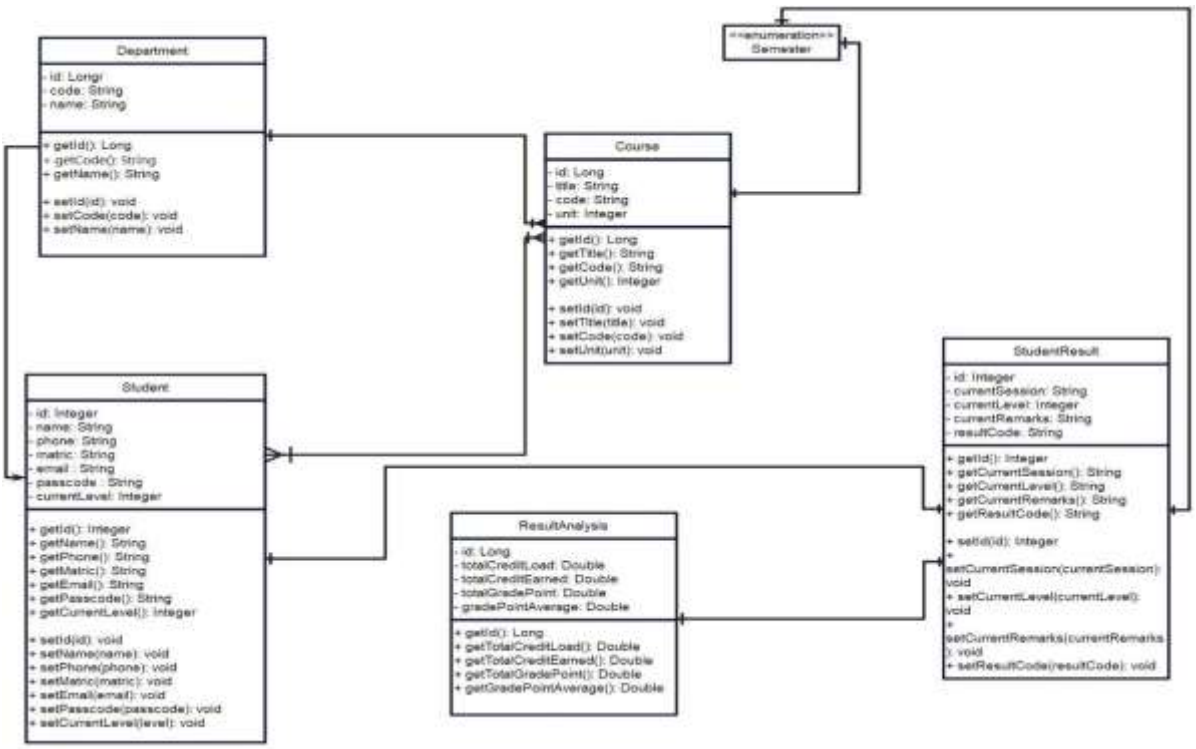

Fig. 3: Class diagram of the developed system

Results and Discussion

Programming languages and a range of tools were used to create the Result Checking and Certificate Verification System using USSD code. The Fulafia Student Management Information system is modeled after using the web portal as a dummy platform. Since the system is designed to smoothly integrate into the university's current infrastructure and provide USSD-based result checking and certificate verification capabilities, this technique was chosen to comply with organizational regulations. Several screenshots of sample outputs and findings are included in the section. The user dials the provided USSD code, in this case, *384*5047# as shown in Figure 4

Fig. 4: User dials code

He/she is presented with the option to either check the result or authenticate a result as seen in Figure 5.

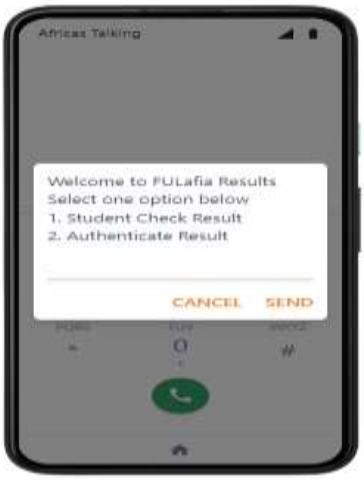

Fig. 5: Option to check result or verify certificate

For the students to check their results, they must provide a passcode (Figure 6).

Fig. 6: Student must provide a passcode to check result

Upon providing a valid passcode and using the associated phone number registered during the student's registration, the user is asked to provide the semester and academic session and the result is displayed to the student (Figure 7).

Figure 6: Result View of a student

Same procedure is followed to authenticate the certificate issued by the institution. Once the passcode is correct, the system displays the authenticity of the certificate as shown in Figure 7.

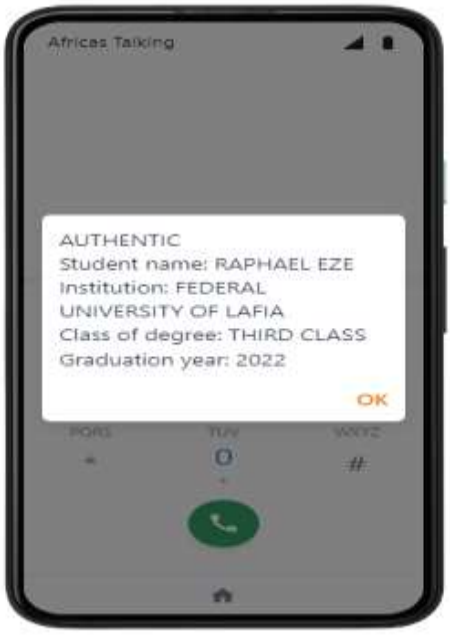

Fig. 7: Certificate Authentication View

Conclusion

In this work, we developed a Result Management System for tertiary institutions that leverage the USSD technology to provide a faster and easier means of accessing students' results and verifying the authenticity of issued certificates. A lot of work has been done to tackle this issue, however, the Result Checking and Certificate Verification System using USSD code differs significantly as hybridized result checking and certificate verification into one system harmonized by the USSD technology and secondly, provides a USSD system of authenticating certificates as opposed to existing web-based systems developed by other researchers.

The adoption of this USSD Student Information System is essential to all institutions of learning because it will promote easy access to information. The best way of accessing information is to make it easily available on mobile devices and that is what the system does therefore tackling an attempt to either falsify results or parade fake certificates.

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