Innovations

Improving Security Features of Traditional ATM-based Banking Services via Fingerprint Biometrics Scheme

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Abstract: *The obvious challenges faced by most commercial bank customers while using the services of the ATMs (Automated Teller Machines) across developing countries have triggered the need for an improved system with better security features. Current ATM systems are password based, and research has proved the vulnerabilities of these systems to heinous attacks and manipulations. We have discovered by research that security of current ATM-assisted banking services in most developing countries of the world is easily broken and maneuvered by fraudsters majorly because it is quite difficult for these systems to identify an impostor with a privileged access as against the authentic bank account owner. Again, PIN (Personal Identification Number) code passwords are easily guessed, just to mention a few of such obvious limitations of the traditional ATM operations. In this research work also,we have developed a new system of combined fingerprint biometric scheme with PIN code Authentication that seek to improve security features of traditional ATM installations as well as other Banking Services. The aim is to ensure better security at all ATM installations and raise the confidence of bank customers. It is hoped that our new system will overcome most of the challenges of the current password-based ATM operation if properlyapplied. The Researchers made use of the OOADM (Object-Oriented Analysis and Design Methodology), a software development methodology that assures proper system design using modern design diagrams. Implementation and coding were carried out using Visual Studio 2010 together with other software tools. Results obtained show a* *working system that provides two levels of security at the client's side using fingerprint biometric scheme combined with the existing 4-digit PIN code to guarantee confidence of bank customers across developing countries.*

Keywords:*Fingerprint Biometrics, Banking Operations, Verification, ATMs, PIN code.*

I. Introduction

The ATM (Automated-Teller-Machine) is a new banking technology used to dispense cash and carry out other banking services without the assistance of the bank personnel. Today, across nations, usage of the ATM services has advanced both in technology and in user experience. For instance, most of these systems now make use of the Microsoft O/S, Linux and other Embedded systems.

In the time past, Financial Institution, especially in the developing countriescarried out almost all their banking transactions manually, and as a result, there was obvious inefficiency, long queues in the banking halls, and a waste of time and efforts for bank customers. Following IT penetration across the global world, most financial institutions now make use ofseveral electronic devicesincluding the ATMs to improve daily transactions, of which the major advantage is that it does not require the physical presence of a bank official.

According to [9], an ATM installation, allows bank customersperform basic financial transactions such as fund withdrawals, electronic cash transfers, fund deposit, account balance enquiry, request for bank statements, and so on. As at today, the ATM has gained wide-spread acceptance in most nations of the worldfollowing the 24/7 operation of its services to the teaming customers of most commercial banks [9].

Today, it is more than a decade now after the herald of the ATM-assisted bank services in most developing nations, and most customer now prefer this approach to daily financial transactions. This acceptance level by the general public has also necessitated a need for an improved system that focuses primarily on the enhancement of its security features. It is obvious that impostors and robbers have infiltrated the banking industry with a view to defrauding users of the ATM machine. The PIN code password and current authenticated mechanism of the ATMs no more provide enough security for the system since it is now easy to steal the PIN codes of unsuspecting members of the public as well as their ATM cards to make withdrawals.

The use of PIN code alone has many other limitations, ranging from the fact that it cannot correctly verify the holder's identity, to its inability to protect the card against theft.

The above limitations make it necessary to think of more secured ways of authentication for users of the ATM services. Biometricauthentication systems can be deployed at this point in time for a more secured ATM use in the banking sector in most of these nations. Specifically, the fingerprint biometrics has proven to be a more matured type of biometric user identification.

Above all, biometric authentication systems can identify any customer despite the age bracket. The system can also be implemented easily on existing systems with very little modifications.

Finally, this identification approach is quite reliable since no two individuals have the same fingerprint anywhere in the world. These advantages clearly underscore the need for such system deployment to improve security of current ATM service operations especially among developing countries.

The fingerprint identification technique has been deployed to control access to restricted platforms and offices, control rooms, highly secured equipment apartments and other control centers. Our proposed system in this research paper will be a secure, simple and user-friendly initiative that will be of benefit to all bank account holders as well as all financial institutions.

Consequently, as a prototype system, this study will develop a simulator for an ATM installation that combinesa customer's personal identification number with his fingerprint to ensure a two-level authentication. We will critically explore the existing password-based system to identify the associated limitations. The identified limitation and system analysis will justify the development of the new system simulator that provides two levels of security at the client's side using fingerprint biometric scheme combined with the existing 4-digit PIN code.

The research paper is organized according to sections. Section II for instance, presents a reviewof some of the contributions made by other Authors in this research area. Sections III presents the methodology for this research work, while section IV presents the results and discussion of results.

II. Literature review

We have reviewed a good number of research works in the area of biometric authentication systems, and in the area of security for banking operations as it is carried out among the various nations of the world. Some of such literaturesare presented in this study.

Other theoretical frameworks were also reviewed in this study that underscores the operation and deployment of biometric authentication systems. According to [15], for instance, the ATM is usually deployed to mechanize the traditional work of the bank Tellers, and was designed to dispense cash to all identified bank customers. In some advanced countries, the ATM can take deposits of cash and cheques from customers as well as perform many other banking transactions such as paying of bills, cash transfer, recharge card purchases, and so on. It is therefore an important aspect of the entre banking sector and a very important phenomenon that has come to stay and cannot be ignored[15].

[4] in his research work, made a proposition for ATM operational model where the client will be made to accesshis account using a Bank Debit Card using his PIN code. This card, when read by the machine is further crosschecked for correctness of PIN by the ATM machine. This check is to be dome via a dedicated network linked to the bank's database server. According to the author, the bank's server will finally connectto an SMS messaging center with a randomly generated password. Then using a mobile phone network, as SMS is sent to Base Transceiver System (BTS) which subsequently forwards same to the client's cell phone. [4].

[3] identified some ways by which fraudsters get PIN numbers from clueless cardholders by creating deceitful websites in which they post some fictitious prize in order to lure greedy customers (www.interswitchatmcard.com). On such sites, for instance, they ask customers to submit vital information which may include their PIN number. The Researcher equally reported that handheld devices that can read card information are available and has been used on a victims. According to the Researcher, certain camerashave actually been installed to record PINs as they are typed by the consumers.

A good number of Researchers equally carried out some studies in the specific area of fingerprint-based identification and came out with the opinion that fingerprint biometrics if tactically deployed will be a reliable and highly secured technique of user authentication.

Furthermore, [13] proposed a biometric system as a more reliable option for improved security of banking services. They further advocated a total elimination of cards since, according to them, the finger can be used for both a password and a card.

Additionally, [1]presented a three-tier verification architecture using the fingerprint and the PIN code. The idea is also to ensure security enhancement and safety of the ATM machine users. The system equally presents a platform to streamline banktransactions including cash withdrawals account statement printout, as well as account balance enquiry. The system was developed using the .NET framework with the C# programming language. A simulated result from the system showed a 96% level of accuracy.

Finally, [8] proposed the deployment of a system focusing on ATM security applications. In his opinion, a dedicated database will be used to collect the individual's fingerprints as well as their mobile number during the account opening process. As the customer inserts hisATM transaction card into the machine, he will equally need to place a finger on the fingerprint platform to get a 4-digit PIN code generated and sent to his mobilephone. The PIN code that is received by the customer will then be entered into the system by pressing certain keys on the keyboard. After this verification, access will be granted to the customer to carry out bank transactions. If duly implemented, this particular system will help to solving most of the problems identified in our section I of this research paper.

III. Methodology

In this Research workwe adopted the Unified Modeling Language and the OOADM (Object-Oriented-Analysis-and-Design Methodology) in order to ensure an elaborate and consistent design approach. It is a popular approach for the analysis and design of software intensive systems by the application of object-based programming. It also entails the use of standardized UML component diagrams to model the system and for effective communication with other stakeholders in the system development process. Such an approach will evidently guarantee better software quality at the end of the day.

In this research paper also, we adopted the waterfall model, which ensures that the current stage of the software development process be fully completed before advancing to the next. With the waterfall model, the System Analyst is expected to be rigid and sequential in following the activities of the Software Development Life Cycle.

As can be seen from figure 3.1, sometimes, the OOADM methodology can follow an iterative and incremental approach.

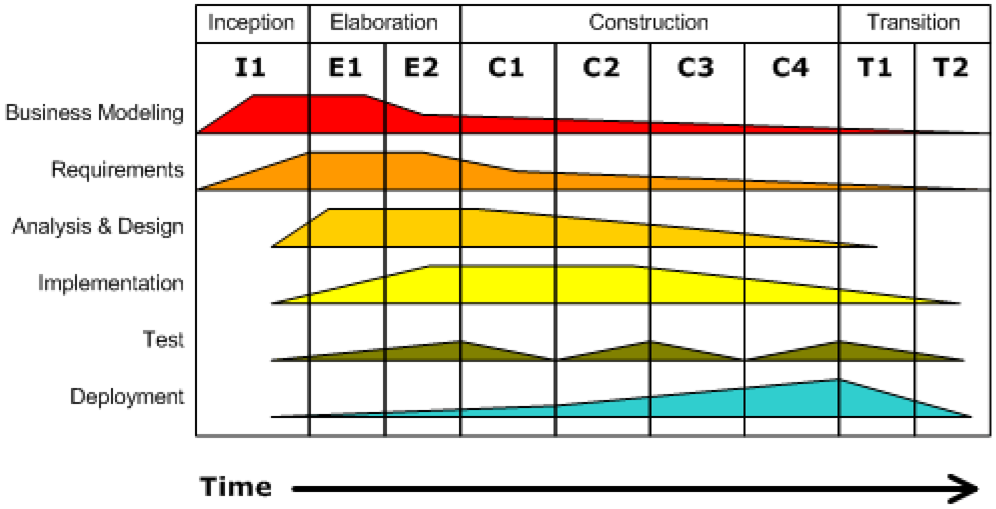


Figure 3.1. OOADM methodology and the Unified Modeling approach.

For this study, we made sure that each stage of the development process was first completed in its entirety before moving on to the next stage. Instead of following the model process in an iterative, or trial-and-error manner involving both the developer and the end users, which also allows testing to begin after the entire system development is completed, we decided to adopt the waterfall model which has a rigid and systematic approach. Our system was designed to ensure a secured and effective ATM transaction operations and instil the needed confidence among bank customers in developing countries of the world.

IV. System Analysis And Design

The ATM (Automatic Teller Machine) ensures that a customer easily and conveniently gains access to his bank account and performs any other monetary transactions on them without approaching the banking hall and beyond the normal banking hours. Most ATMs of different banks are linked up via the interbank system of networks which allows an individual to carry out banking transactions such as withdrawals and deposit at any ATM terminals without having to operate account with such banks. The card issuer must however give her permission before such authorization can be allowed by the authorizing financial institution via a communication network.

The customer's Personal Identification Number (PIN) is a paramount aspect for system security on all banking operations and is frequently used in protecting the financial records of the bank's customers. A comparison is made by the system on the PIN code as against a pool of official codes of passwordand user account kept away in the bank database.

Normally, the PIN code is a four-digit combination of numbers of desired choice which is chosen after the ATM card has been given to the client with a default PIN. Users are usually encouraged to change their PIN after issuance. There are frequently used codes which are mostly of 4-digit PIN numbers in the scope of 0000-9999 amounting to the total sum ofabout 10,000 conceivable numbers. This means that a fraudster would need to guess for about 5000 times to correctly get the approved PIN code. You type in your PIN via the keypad on the ATM machine. If the PIN code is legitimate, then the user automatically gains access to the platform to perform his/her desired monetary transaction with the system.

4.1. Implementation of the Proposed Solution.

In this section, we discuss some of the developmental tools employed in the design and implementation of our proposed system of combined fingerprint biometrics and the PIN code authentication for more secured ATM-based banking service operations.

4.1.1. Programming Language Platforms and Development Tools Adopted.

Below are the programming languages utilized for the purpose of our system implementation:

4.1.1.1 Visual Basic 2010

Visual Basic 2010 was utilized in executing the proposed system and it was utilized in generating programs that simulate the system. There are various reasons that enables Visual basic to be suitable for the design and implementation of the simulation software. Some of the reasons are:

1. Simple Structure: The Visual Basic 2010 has a simple structure for System Developers to adapt in the most convenient ways.
2. The platform has been optimized to give support to the RAD (Rapid Application Development).
3. Visual basic provides appealing graphical user interface for the management of the program structure which is very suitable for this project.
4. It contains a large deposit of readily-available COM (Component-Object-Model) which can be integrated for quite a number of purposes.

4.1.1.2. Microsoft.Net Framework

The Microsoft .NET framework was adopted in this research work and offers a lot of advantagesfor a seamless and user-friendly design. Some of the advantages are:

1. Consistency in the programming model: With the .NET framework data access from other programming language is quite easy.
2. Security Backing: The .NET framework empowers Software Developers and Administrators to identify the security strategy as well as the security level.
3. A simplified developmental effort: With the .NET framework, there is a direct support for software diagnosis, and Software Debugging is equally made simple.
4. Application Deployment and Maintenance made easy: With the adoption of the .NET framework, application deployment is made quite easy, and there is easy and efficient location and handling of the details of loading components.

4.1.1.3. Microsoft server 2008

The Microsoft Server 2008 is a compelling Relational-Database engine, generally utilized for keeping and maintaining data in different organization of various sizes: small, medium, or large. It is upgraded to provide a superior record keeping experience. It contains a rich set ofreporting features enabling easy creation and manipulation of data as in query management, database search, data analysis, data synchronization, report generation, and so on. Above all, the Microsoft server 2008 is a scalable and flexible database platform.

V. Results and discussion

In this section, the result obtained at different stages of this study is presented.The first is the output screen presented in Figure 5,1 which shows the results of our system implementation of the user interface.

i. System main Menu Implementation

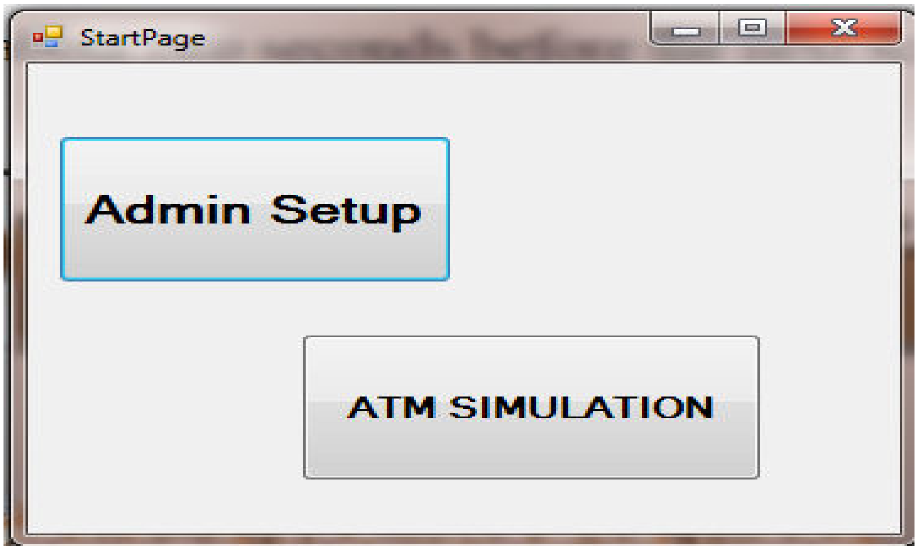
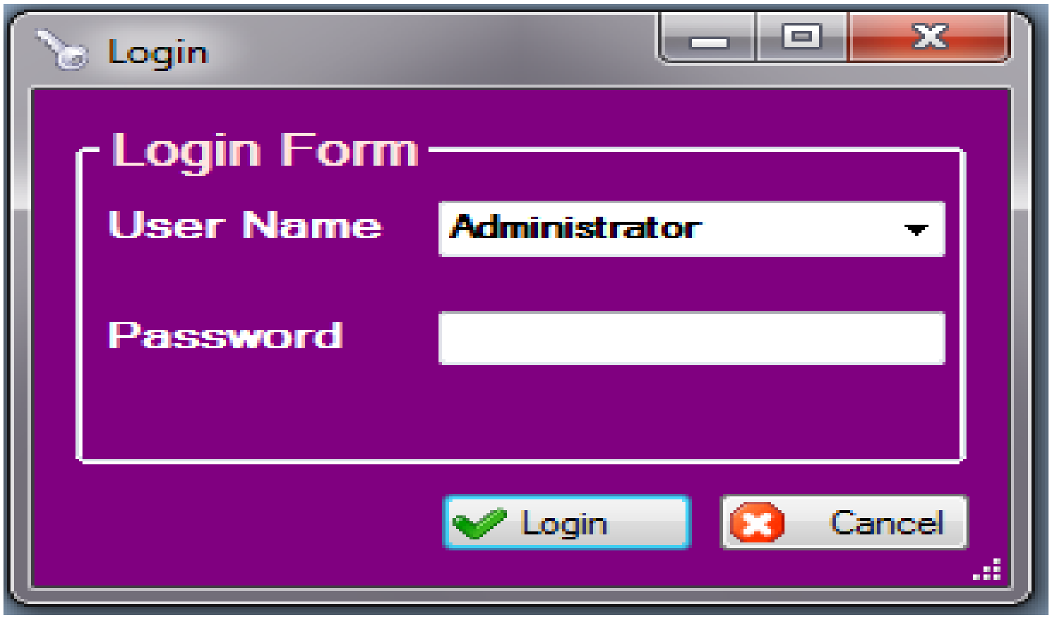


Figure 5.1. The Start page

Our new application was developed in such a way that the Start page shows two choices, the Admin and the ATM simulation. Clicking on the ATM simulation button leads to the simulated environment, while clicking the Admin button leads to the Admin end of the systemwhere the System Administrator can add new customers, as well as Edit their details.

ii. The Admin Login Interface.



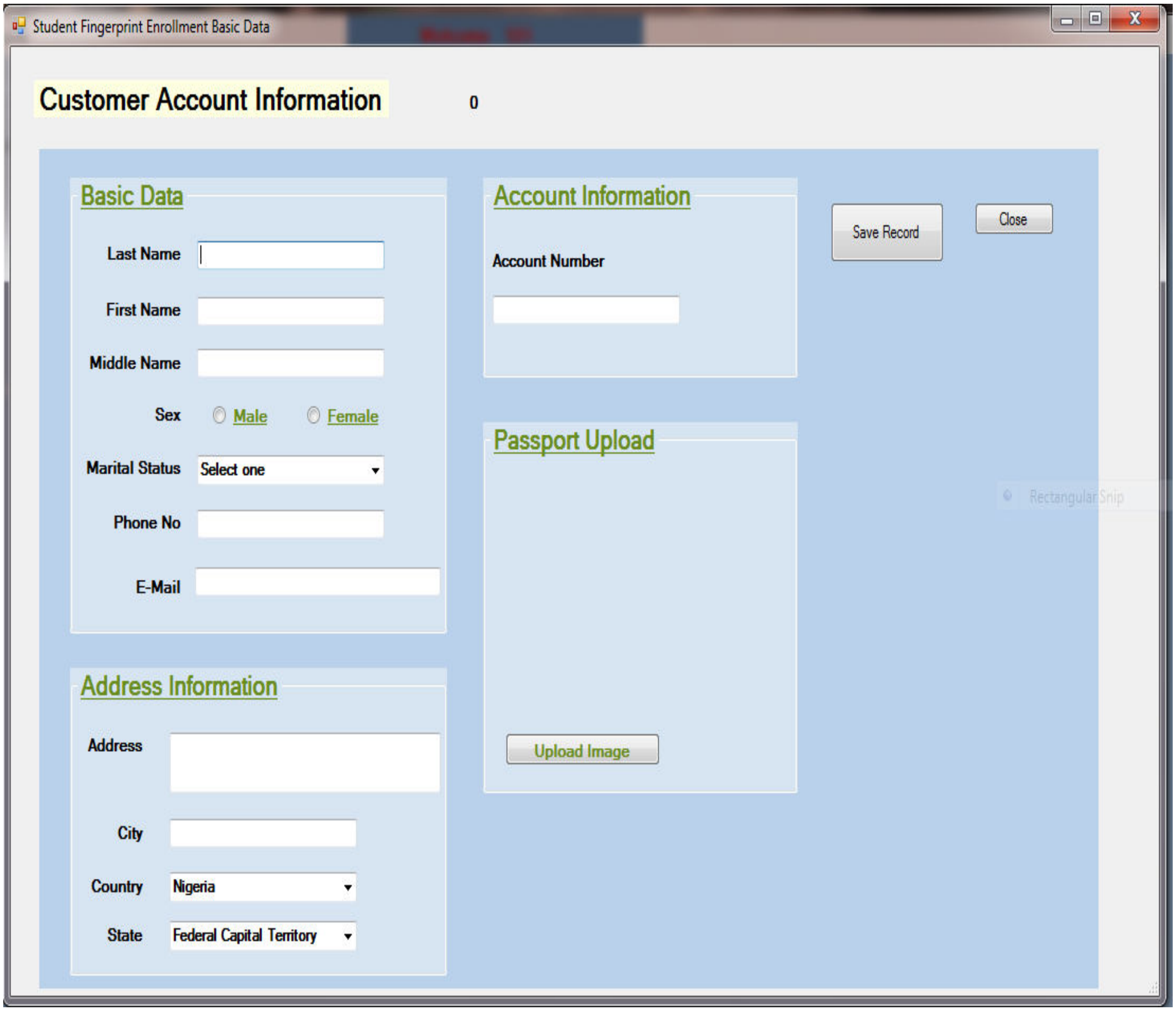
User Name Administrator

Password

Figure 5.2. The Admin Login

This Admin login page (Figure 5.2.) will be revealed when the user choses the Admin option, and will require the login details of the administrator. Access is granted if the details are correct and denied if they are not.

iii. New Account Opening Form



Student Fingerprint Enrollment Basic Data

Customer Account Information 0

Basic Data

Last Name

First Name

Middle Name

Sex ○ Male ○ Female

Marital Status: Select one

Phone No

E-Mail

Address Information

Address

City

Country: Nigeria

State: Federal Capital Territory

Account Information

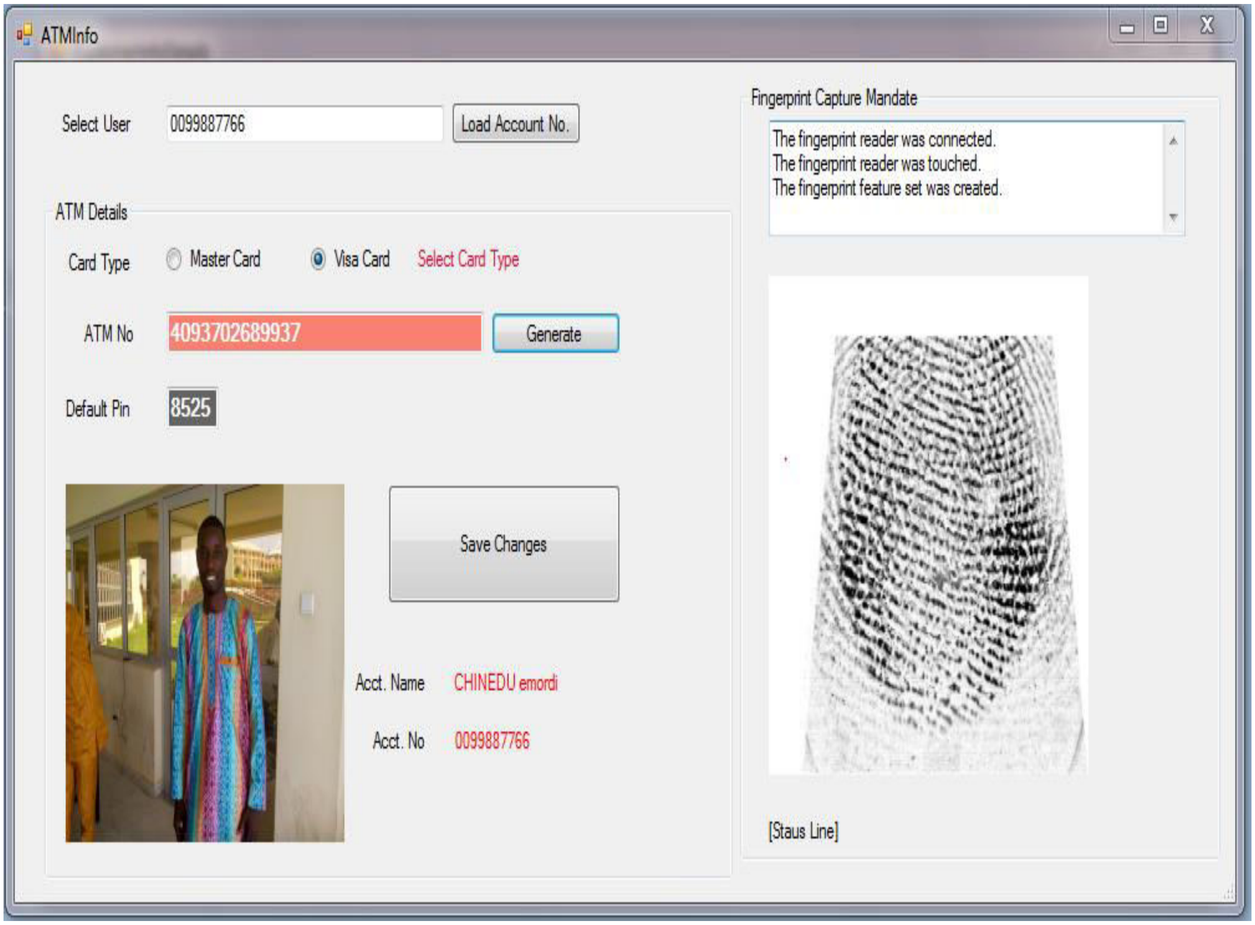
Account Number

Passport Upload

Figure 5.3. Account opening page

Figure 5.3 represent the interface for the enrolment stage, where customer template data is collected and stored into the database by the administrator. The new account form enables new customers to sign up in the application database. The passport photograph, thumb print information, customer names, address, phone number, marital status, email address, city, state, country and account number are submitted.

iv. Fingerprint matching



ATMInfo

Select User 0099887766

ATM Details

Card Type ○ Master Card ● Visa Card Select Card Type

ATM No 4093702689937

Default Pin 8525

Acct. Name CHINEDU emordi

Acct. No 0099887766

Fingerprint Capture Mandate

The fingerprint reader was connected.
The fingerprint reader was touched.
The fingerprint feature set was created.

[Staus Line]

Figure 5.4 Fingerprint matching

Generally, our new Simulated ATM interface is a friendly platform by which users can communicate with the system to process user inputs to produce the desired output.

VI. Conclusion

In this research paper, we have demonstrated that the Automated Teller Machine can be better protected against fraudulent activities and has the potential to trigger increased efficiency in banking operations if well managed. The fingerprint biometrics technology has been accepted as a more accurate way to verify authentic system users. This paper has made a proposition for adjustment in system security approach to utilize a combined fingerprint verification and a 4-digit PIN code verification to assure security of banking transactions in most developing countries. The Fingerprint mechanism has been used in this research paper to boast current security features of the traditional ATM terminals and to further encourage electronic banking ideology in these countries. This system, if fully deployed, will ensure a drastic reduction in the activities of fraudsters who currently take advantage of the one level security feature of the traditional ATM platform.

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