

Design and Implementation of a Fingerprint Based Identity Management System

Abioye, M.¹, Abioye A. E.², Omotehinwa O. T.³, Egonwa B. O.⁴, Oluwe M. O.⁵

¹*Department of Mechanical Engineering, Kogi State Polytechnic, Lokoja, Nigeria*

³*Department of Computer Science, Kogi State University, Anyigba, Nigeria*

^{2,4,5}*Department of Electrical/Electronic Engineering, Akanu Ibiam Federal Polytechnic, P.M.B. 1007, Unwana. Ebonyi State, Nigeria*

Abstract: - Fingerprint identification is one of the most well-known and common biometric identification systems. This research presents another sincere contribution made in Design and Implementation of a Fingerprint Based Identity Management System. This project is developed to keep daily attendance of students in class via their fingerprints. This is a unique identification which will prevent impersonation and errors in calculating attendance. Its purpose is to computerize the tradition way of taking attendance and generating of report automatically at the end or between of the session. A use case is the methodology is used in system analysis to identify, clarify, and organize system requirements. This project was carried out using the technique of Extreme Programming (XP) which is an offshoot of Agile software development methodology and developed as a standalone desktop application. Microsoft visual basic and Microsoft SQL was used in building the database and software for developing the graphic interface of student module. System testing of the software was done by deploying it to laptop device for testing purposes. The essence of the system testing is to show proper functionality with hardware components such as the fingerprint Scanner. Tests were also carried out to ensure proper and regular synchronization with the database server. In conclusion, the study shows that the integration of fingerprint biometric system in sensitive institution database can improve security of the organization and alleviate problem associated with traditional identity verification techniques.

Keywords: Biometrics, Fingerprint, Identification, Microsoft visual basic, Microsoft SQL

I. INTRODUCTION

Fingerprint identification is one of the most well-known and common biometric identification systems. Because of their uniqueness and consistency over time, fingerprint has been used for identification for many years, more recently becoming automated due to advancement in computing capabilities.

The fingerprint system seems to be the most cost effective and easy to use among all of the biometric system with no health side effects [1].

Biometrics, especially in information technology encompasses methods to analyze physical and behavioral Identities to extract unique features for identification or monitoring

purposes. Various physical features including faces, eyes, fingers, hands, veins, ears and teeth can be used by this technology, and characteristics such as gaits or voice patterns are still being investigated and analyzed as part of the wider biometrics field. However, fingerprint biometrics is more accurate, unique, Immutable and acceptable than any other biometrics system [2].

Fingerprint being the oldest and easily available trait of biometrics, offers infallible means of personal identification. The matching accuracy using fingerprint has been shown to be very high as compared to other existing biometric traits. Unlike face and voice patterns, fingerprints are persistent with age and can't be easily distinguished. Therefore, fingerprint is one of the most researched and matured field of biometric authentication [3].

According to [4], there are two different ways to resolve a person's identity: verification and identification. Verification is based on confirming or denying a person's claimed identity and answers question "Am I whom I claim I am?" In the case of identification one has to establish a person's identity answering the question "Who am I?"

A biometric system is essentially a pattern recognition system that compare unique physiological or behavioral characteristic possessed by the user with prerecorded data. As such it can be used in both approaches for identification. Identification is "one-to-many" process of determining a person's identity by performing matches against multiple biometric templates.

II. STATEMENT OF THE PROBLEM

The traditional system of identification usually signature on paper in institutions and offices has proved to have failed to achieve its major purpose which was to ensure that the right statistics of students that attended the class/sit for exams or staffs that come to work. The major reason for its failure among its short-comings is the ability for a student or staffs to sign in for another student/staff leading to falsification in attendance which is rampant in the traditional method.

According to [5] findings, the use of attendance sheets

becomes cumbersome and untidy as the population of students increases, is time consuming and a waste of human and material resources. The stress associated with manual calculation of student attendance rate has made it impossible to fully implement. Also, high level of impersonation has been known to characterize this method of attendance as students can cheat by asking their friends to write attendance for them.

Many educational institutions and offices are trying to identify accurate, safe, and reliable techniques to protect access rights to their existing services or operation. Since no two people have identical fingerprint in this world, Fingerprint based identity management system is an answer to these concerns. Hence the need to embark on this research, to implement a finger print-based identity management system that will provide high level of security whereby making it impossible for imposters and impersonators having their ways.

III. SYSTEM DESIGN AND IMPLEMENTATION

3.1 Use-Case Model

A use case is a methodology used in system analysis to identify, clarify, and organize system requirements. The use case is made up of a set of possible sequences of interactions between systems and users in a particular environment and related to a particular goal. It consists of a group of elements (for example, classes and interfaces) that can be used together in a way that will have an effect larger than the sum of the separate elements combined. The use case should contain all system activities that have significance to the users.

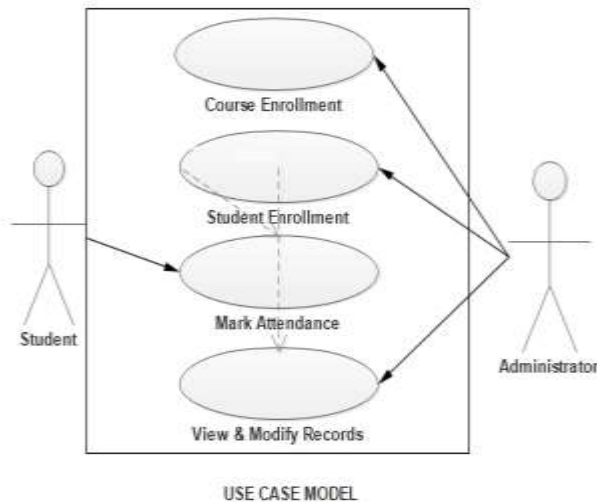


Figure 1: Use Case Model

3.2 UML Class Diagram

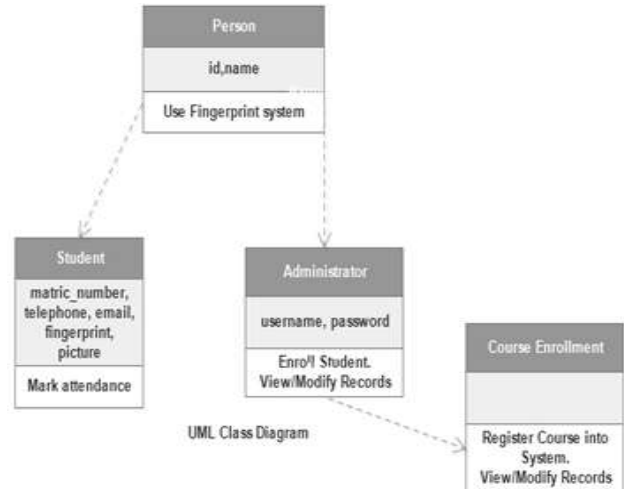


Figure 2: UML Class Diagram

Class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing, and documenting different aspects of a system but also for constructing executable code of the software application.

3.3 Flowchart

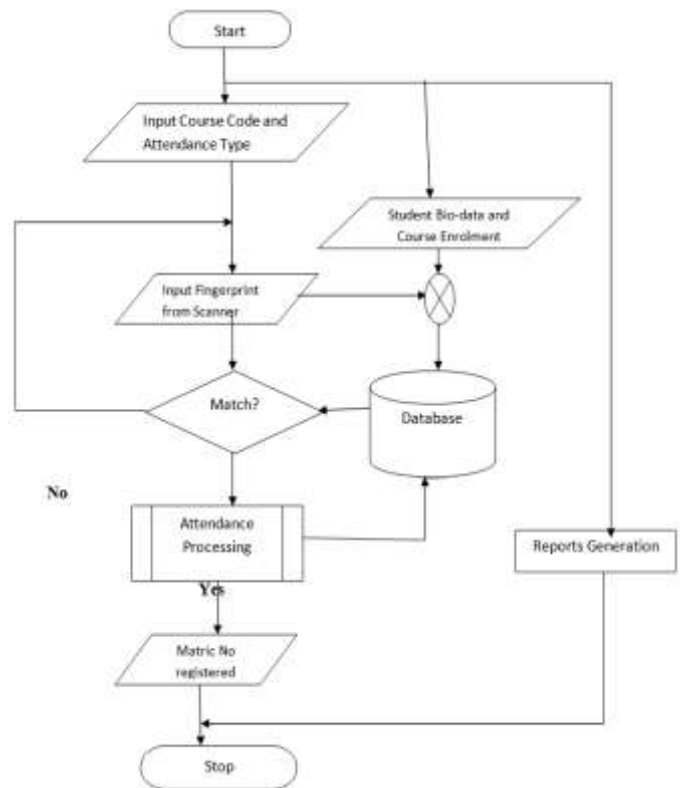


Figure 3: Flowchart for Student Attendance System

3.4 Algorithm

An algorithm for matching fingerprint datasets is presented below:

function MATCH-SETS(source-minutiae-list, target-minutiae-list)

returns success or failure

input:

source-minutiae-list, a list of minutiae

target-minutiae-list, a list of minutiae

source-pairs ?

GENERATE-PAIRS(source-minutiae-list)

target-pairs ?

GENERATE-PAIRS(target-minutiae-list)

SORT(source-pairs) ; sort by distance ascending

SORT(target-pairs) ;

next-source-pair:

for each x ? source-pairs

next-target-pair:

if exists y ? target-pairs and SIMILAR-PAIRS(x,y)

if tparams ? EXTRACT-TRANSFORMATION-PARAMS(x,y) succeeds

DO-ROTATION-ON-SOURCE-DATA(tparams.rotation)

DO-TRANSLATION-ON-SOURCE-DATA(tparams.translation)

if EXIST-SUFFICIENT-MATCHES(source-minutiae-list, target-minutiae-list)

return(success)

else

RESTORE-ORIGINAL-SOURCE-DATA()

goto next-target-pair

else

goto next-target-pair

else

goto next-source-pair

return failure

IV. OVERVIEW OF THE IMPLEMENTATION

This research centres on the use of Biometric Fingerprint Identification for managing student attendance in classes. This is aimed at improving student attendance record keeping, reducing the errors which manual systems are prone to, making data available on demand and ensure that students are properly monitored no matter their number.

4.1 System Requirements

This section describes the hardware and software tools used in the development and implementation of this application. The application is a laptop based application with real time connection to a database and connection to a Fingerprint Reader.

4.1.1 Hardware Requirements

- Personal Computer (Laptop or Desktop) with the following specifications:
- Processor with minimum clock speed of 1.0GHZ (Any recent 64-bit processor is recommended)
- 2 GB of RAM (4GB and above is recommended for maximum performance)
- USB 2.0 ports and Serial port.
- Minimum of 25GB available disk space.
- Digital Personal Fingerprint Reader

4.1.2 Software Requirements

- Windows Operating System (Windows XP and newer)
- Microsoft .NET Framework 3.5 SP1 (Service Pack One) or newer
- Microsoft Visual Studio 2012
- Digital Personal Fingerprint Software Development Kit
- Microsoft Access Database 2003 or newer versions

4.1.3 Choice of Integrated Development Environment

The fingerprint student attendance management system is implemented with Microsoft Visual Studio. The database was implemented with Microsoft Access database for ease of synchronization and deployment.

4.1.4 Tracerplus Desktop

Microsoft Visual Studio is an integrated development environment from Microsoft. It is used to develop computer programs, as well as web sites, web apps, web services and mobile apps.

4.1.5 Digital Person Software Development Kit

This software development kit enables integrators and developers to quickly add the power of fingerprint-based authentication to their Microsoft® Windows-based applications. DigitalPersonaU.are.U and TouchChip “Getting

Started Kits” contain everything a developer needs to begin using Crossmatch fingerprint biometrics.



Figure 4: DigitalPersona U.Are.U 4500 Available at:
<http://www.crossmatch.com/UareU4500Reader>

4.2 Application Modules

4.2.1 Home Screen

The splash screen is the interface shown to user immediately they launch the application. It contains the name of the application and allows users to select options.

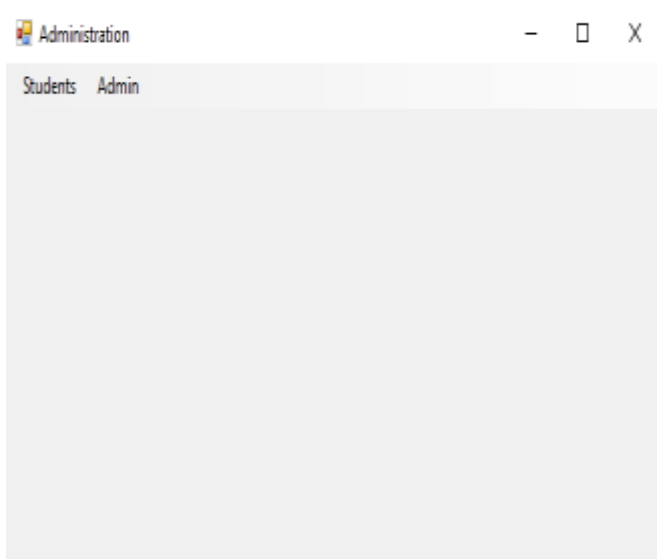


Figure 5: Home Screen

4.2.2 Student Registration

Students can be registered in this module with their details including picture and fingerprint.

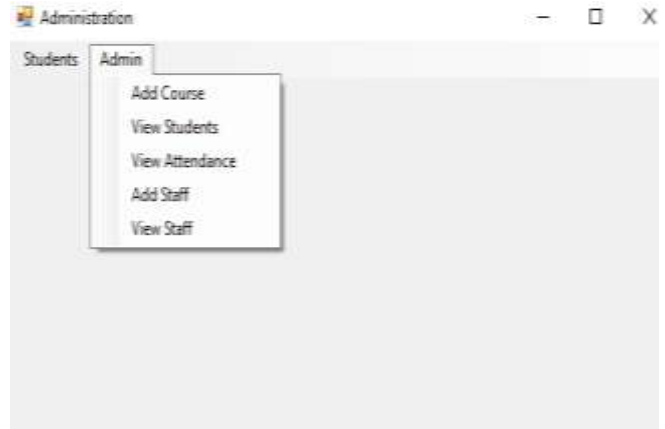


Figure 6: Student Registration

4.2.3: Students Registration

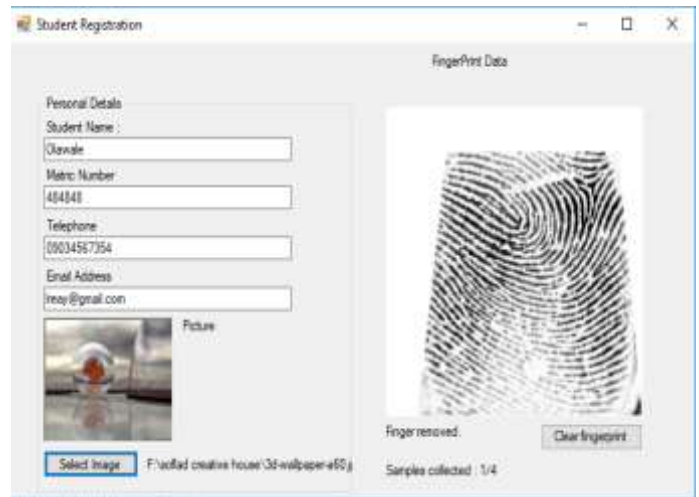


Figure 7: Student Registration

4.2.5 Attendance Verification and Savings

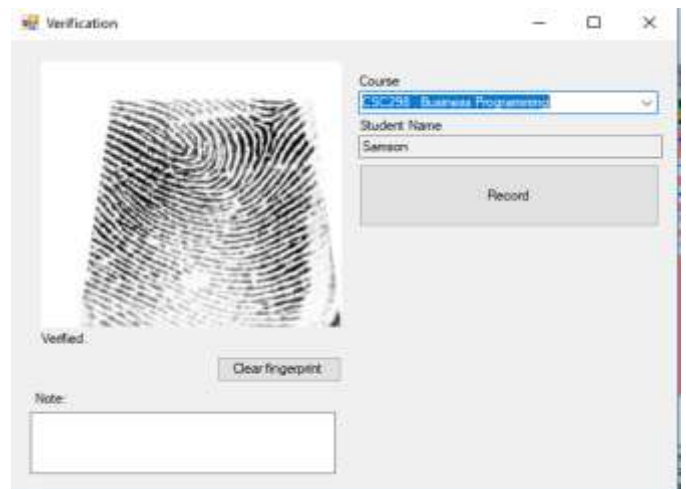
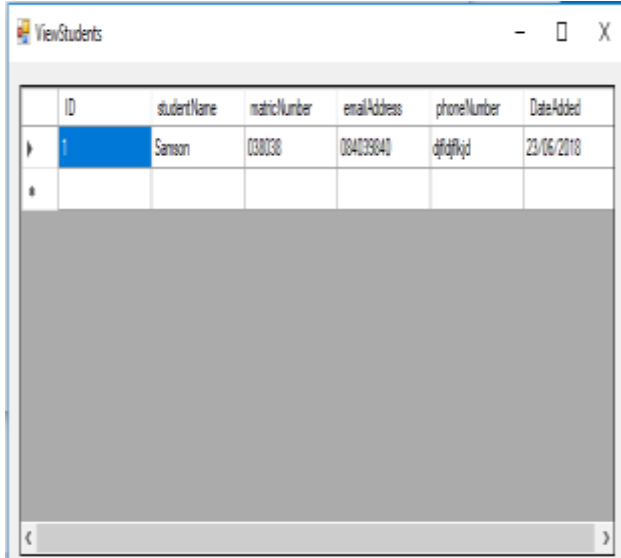


Figure 8: Attendance Verification

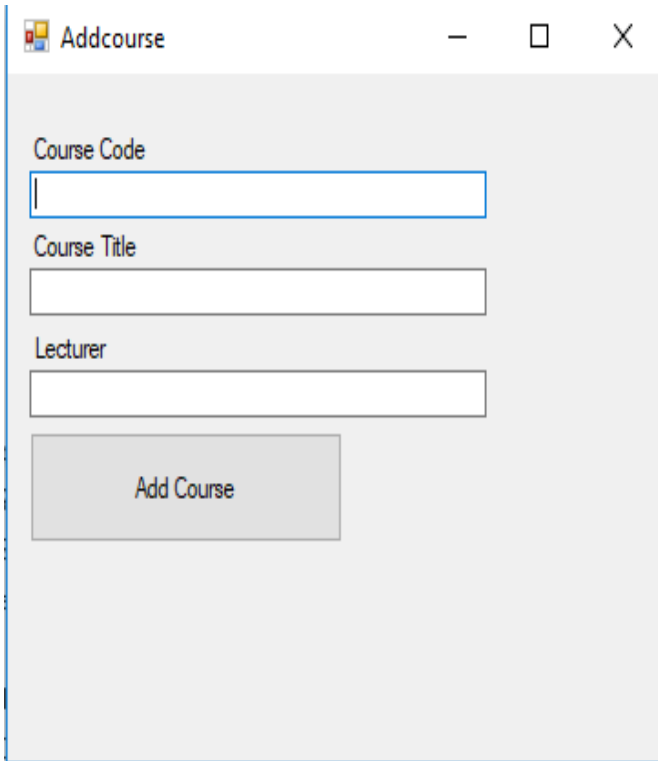
4.2.4: Student Records



ID	studentName	matricNumber	emailAddress	phoneNumber	DateAdded
1	Samson	038038	094039040	ajfd@kjd	23/06/2018

Figure 9: View Student Records

4.2.6 Course Registration



Course Code

Course Title

Lecturer

Figure 10: Course Registration

The figure 5 above shows the user interface, which allows either the students or Administrator to select their options. The figure 6 above shows the user interface options for the admin, which allows Administrator to select his options such

as Add course, view students, view attendance, add staff, view staff etc.

The figure 7 above shows the user interface options for the students, which allow students to register their personal details, upload their passport/photograph and their fingerprint.

The figure 8 above shows the attendance verification by comparing the newly scanned fingerprint with the one stored in the database.

Figure 9 shows the interface for Viewing Student Records while figure 10 is for student course registration.

V. CONCLUSION

Having an automated fingerprint attendance management system is a really good step forward for schools in Nigeria. It cannot be over emphasized that fingerprint is the best, most versatile, most unique and most applicable of all the identification and data capture media.

With its implementation in this project, it was clearly shown that fingerprint data can be used in any field/discipline and for a wide variety of purposes.

Fingerprint, as the key technology for this research, and also in its other application areas, it has been shown that: Fingerprint is efficient for monitoring humans.

- It is relatively cost effective compared to other data capture or monitoring methods.
- It is capable of being synchronized with many other platforms to create various hybrid application and implementation.
- It can be used in diverse even outdoors or hostile environment.
- Fingerprint Identification can be used in conjunction with other forms of Automatic Identification and Data Capture and also other electronic devices and platforms.

With the successful implementation of this research, the groundwork has been laid for fingerprint applications to become more widespread in all schools in Nigeria.

This research took advantage of fingerprint scanning technology to implement an application for managing student attendance.

This research could be further extended in future by extending some of its functionalities, expanding its application areas and also adding some new functionality based on new requirements and usages.

5.1 Recommendation

In this study, the immense advantages of fingerprint technology were combined with access to databases to

provide a software that makes student identity management much easier and effective.

This study therefore, recommends the adoption of this application for the effective management of students' identity in Nigeria's tertiary institutions.

REFERENCES

- [1]. Shila S., (2011). A DoG based approach for fingerprint Image enhancement, Ph.D Thesis, Department of Computer Science and Engineering, NIT Rourkela.
- [2]. Caldwell O. (2015). Market report: "border biometrics", Biometric Technol. Today, vol.2015, No.5, pp.5-11.
- [3]. Jyoti R. & Gupta, P.C. and Sharmarvind C. (2016). Fingerprint-based Identification System-Asurvey. *International journal of Computer Technology and Electronic Engineering*, Vol. 1 Issue 3.
- [4]. Chaudhari, A.S. Patnaik, G.K. and Patil, S.S. (2014). Implementation of Minutiae Based Fingerprint Identification

System Using Crossing Number Concept, Inform. Econ., vol. 18, no. 1/2014, pp. 17–26.

- [5]. Ikuomola A. J. (2015). Fingerprint base authentication for time and attendance management. *British Journal of mathematics & computer science* available via www.sciencedomain.org
- [6]. <http://www.crossmatch.com/UareU4500Reader>
- [7]. <http://logo-kid.com/microsoft-visual-studio-2013-logo-png.htm>

AUTHOR'S PROFILE

Abioye Mayowa is an academic staff at Kogi State Polytechnic, Lokoja, Kogi State. He holds a Postgraduate Diploma (PGD) in Information Technology at the National Open University of Nigeria (NOUN). He is also graduated from The Petroleum Training Institute, Effurun, Warri, Delta State. Nigeria.