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# Enhanced attendance Management System: A Biometrics System of Identification Based on Fingerprint

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**Abstract**—lately, there has been a high level of impersonation experienced on a daily basis in private and public sectors. Biometrics is anything and everything that can be measured in a human being. Fingerprints are a form of biometrics identification which is unique and does not change in one's entire lifetime. This paper presents an enhanced attendance management system using fingerprint system in a university environment. It was developed using the waterfall methodology. This system consists of two procedures; enrolment and identification. During the enrolment, the fingerprint of a person is captured and its unique features extracted and stored in the database along with the user's data as template for the subject. During identification, the fingerprint of the person is again captured and the extracted feature is compared with the template in the database in a ratio 1: N-templates, to identify a match (a user) before attendance is made. The enhanced attendance management system was implemented with Java programming language on a Net Beans IDE framework. The identification mode operates each day of attendance, the fingerprint image is extracted from an individual and the system conducts a one-to-many comparison to establish an individual identity (or fails if the subject is not enrolled in the system database) with the subject having to claim an identity. The results of the system show that the proposed method is secured, reliable, and capable of averting impersonation.

**Keywords**— *Biometrics, fingerprint, waterfall, attendance management, enrolment, identification*

## I. INTRODUCTION

The word 'biometrics' comes from a Greek language and is derived from the words bio (life) and metric (to measure) [1]-[2]. It is used to measure and analyze personal characteristics, both physiological and behavioral. These characteristics include: fingerprints, voice patterns, hand measurement, irises and others, all used to identify human characteristics and to verify identity. These biometrics or characteristics are tightly connected to an individual and cannot be forgotten, shared, stolen or easily hacked [3]. Since biometrics can better solve the problems of access

control, fraud and theft, more organizations are considering biometrics a solution to their security and attendance problems [4]-[5]. Biometric recognition is based on two fundamental premises about body traits; distinctiveness and permanence [6]. The applicability and identification accuracy of a specific biometric trait essentially depend on what extent these two premises hold true for the population at hand [7]. In the past, static password authentication methods are mostly adopted for security system due to its effectiveness to easily recognize the user identity to some degree. But, the method has few disadvantages such as data hacking, password guessing and dictionary attack [8]. Currently, dynamic password authentication is widely used. The dynamic password authentication methods are based on time stamps, uncertain factors such as random number [9]. The time synchronization and dynamic password system is kept during authentication process based on password sequence. It is well known that smart card, palm print, iris, fingerprint and face are physical characteristics of identity authentication [10]. These technologies are convenient, accurate and highly secured. Fingerprint identification is considered to be the most developed technologies [11]. This technology can efficiently prevent information tampered and forgery [12]. Fingerprint identification authentication has forward secrecy [13]. Fingerprints, face and iris are amongst the most popular physiological characteristics used in commercial biometric system, with fingerprint alone capturing over 50% of the civilian market share [14]. Distinctiveness as well as permanence of many of the behavioral characteristics (such as signature, gait, and keystroke dynamics) is weak [15]. As such, very few operational systems based on these traits have been developed so far. This paper proposes an enhance attendance management system based on a biometric fingerprint system of identification. The choice of a specific biometric modality typically depends on the nature and requirement of the intended identification application.

### A. System Analysis

System analysis and design involves studying a problem area and constructing an improved way of handling it. In order to design and deliver better information system, three main activities are involved; a thorough analysis of information requirements, development of an effective manned or computer-based system to meet the conditions efficiently as well as the successful performance of the system in the user's environment [16].

### B. Analysis of the Existing System

Organizations of all sizes use time and attendance systems to record when employees start and stop work, and the department where the work is performed [17]. It enables an employer to have full control of all employees' working hours. Companies with larger number of employees might need to install several time clock stations in order to speed up the process.

#### 1) Manual Method

This manual attendance system involves daily sign-in and sign-out using the book (register book). It is time wasting and as same time accommodating cheating and scamming. It relies on highly skilled people laboriously adding up names and date from the book which have time-stamp onto them. This manual system is cumbersome for large companies due to the so many papers at the end of each month and it is prone to error, inaccuracy, and loss of data [18].

#### 2) Automated System

The computer may be employed to perform all the necessary calculations to generate employee's timesheets which are used to calculate the employees' wages. This system (automated system) reduces the risk of errors that are common in manual systems, and allows the workforce to be more productive instead of wasting time on tedious administrative tasks [19]. In some automated systems, the employee will need to tick-in and tick-out his/her name directly on the monitor of a PC after which at the end of the working day, the total will be calculated. This system is good, but still gives room for fraud. This automated system can only reduce the problem but cannot solve the pressing need, which is to checkmate absenteeism and improve employee/staff productiveness. Some of the limitations of the existing system include:

- The use of paper work in the existing system is too cumbersome especially for large companies with much staff/employees
- Is inaccurate, prone to error, and sometimes loss of data is involved
- The frequent loss of data (damage of old register books) will result to mismanagement of attendance policies.

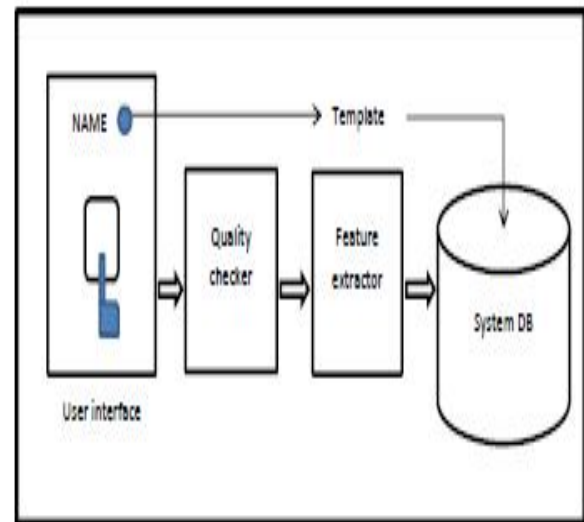
In order to meet up with the trending conditions in attendance management, this paper proposes a new method called the Enhance Attendance Management System based on fingerprint.

## II. PROPOSED SYSTEM MODEL

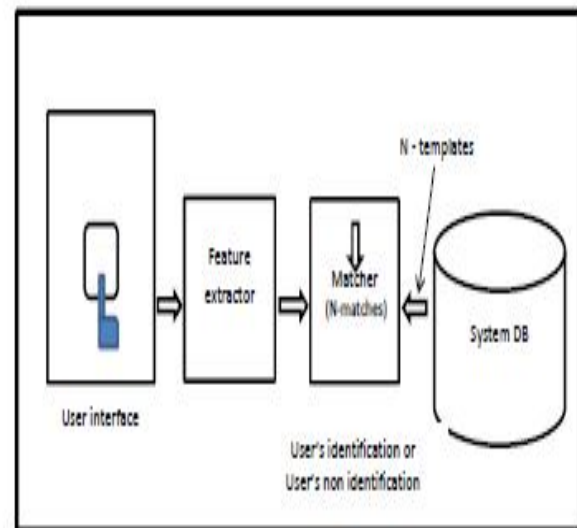
This system operates by acquiring biometrics data from an individual, extracting a feature set from the acquired data, and comparing this feature set against the template set

in the database. A biometric system may operate either in verification mode or identification mode. The proposed system will operate on the identification mode.

Figure 1 shows the logical design of the new system, they includes; the enrolment stage: at this stage a user's fingerprint image is extracted and stored into the system database as a template. The identification mode operates thus, for each day of attendance, the fingerprint image is extracted from an individual and the device conducts a one-to-many comparison to establish individual identity (or fails if the subject is not enrolled in the database of the system) with the subject having to claim an identity.



a)



b)

Fig. 1. Logical Design of the Proposed System (a) Enrolment Phase (b) Identification Phase

## III. DATAFLOW DIAGRAM OF THE PROPOSED SYSTEM

Data flow diagram is a means of representing a system at any level of detail with a graphical network of symbols showing data flows, data stores, data process and data

sources/distributions. This is to provide a semantic bridge between users and system developers and for a clear user understanding and reviewing. The fingerprint is taken as an input for the attendance management and it is organized into the following modulus; pre-processing, minutiae extraction, reconstruction, fingerprint recognition, report generation. Figure 2 illustrates the data flow diagram of the proposed system.

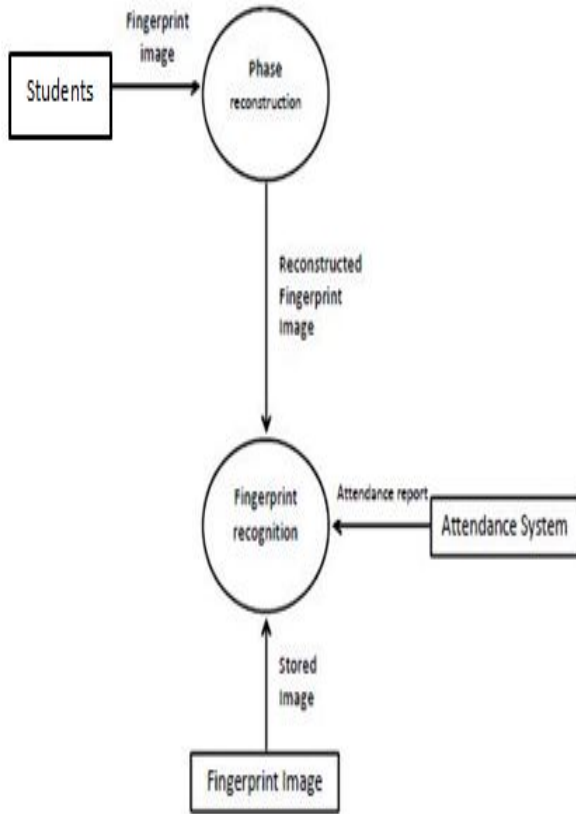


Fig. 2. Data flow of the proposed system

#### IV. METHODOLOGY

The methodology applied here is the Waterfall methodology, which describes a linear development method that is mostly used. Figure 3 shows the waterfall model

##### A. Waterfall Methodology

In this methodology, each phase is completed before the next phase begins.

- Requirement Analysis
- System Design
- Testing
- Deployment
- Maintenance

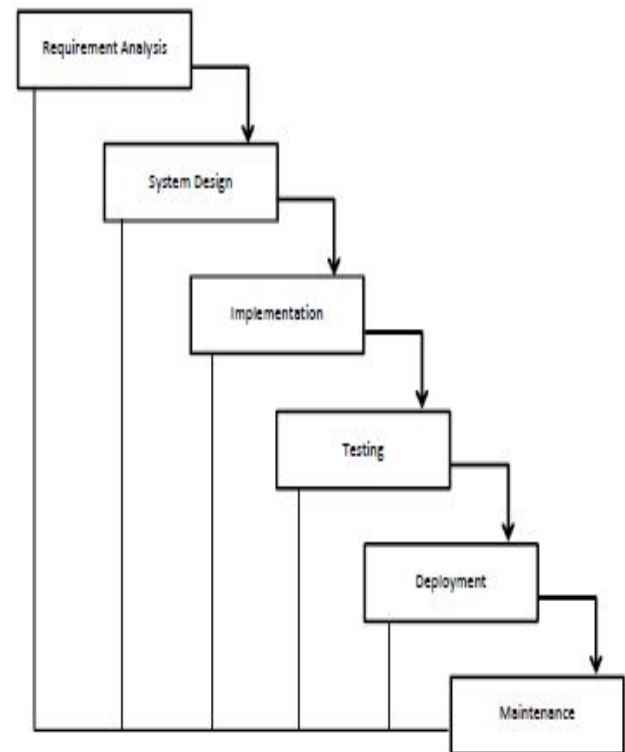


Fig. 3. Waterfall Model

#### V. DESIGN TOOLS

Various tools were adopted in this proposed method. These tools range from the IDE (Integrated Development Environment), Java SDK, Griaule Biometrics SDK, and SecuGen SDK.

##### A. The IDE (Integrated Development Enviornment)

NetBeans IDE 7.0.1 was the IDE adopted. NetBeans is the official IDE for Java 8. With its editors, code analyzers and counters, one can quickly and smoothly develop his application. It integrates a text editor, file manager, debugger, compiler, project manager, etc. into single software. It is widely used to develop java applications due to its simplicity. With its constantly improving java editor, many rich features and an extensive range of tools, templates and samples, it sets the standard for developing with cutting edge technologies out of the box. Keeping a clean overview of large applications, with thousands of folders and files, and millions of lines of code, is a daunting task. NetBeans IDE provides different views of One's data, from multiple windows to helpful tools for setting up your applications and managing them efficiently, lets you drill down into your data quickly and easily.

##### B. The SDKs (Software Development Kit)

1) *Java SDK*: Java SDK is also called JDK (Java Development Kit) which has a collection of programming tools as its primary components. Some are as follows;

- Applet viewer – used to run and debug java applets without a web browser
- Java – the loader for java applications. This tool interprets the class files generated by the javac compiler.

- Javac – The java compiler, which converts java source, codes into java byte codes.
- Java doc – the documentation generator, which automatically generates documentation from source code contents
- Jar – the achiever, which packages related class libraries into single JAR file. This tool also helps in managing jar files. The JDK also comes with a complete JRE (java runtime environment), usually called private runtime. It is separated from the 'regular' JRE and has extra contents.

2) *Griaule Biometrics SDK*: This provides a flexible platform for the development and programming of biometrics fingerprint recognition into any application for authorization systems, transaction systems, time and attendance, and any other application that can benefit with the convenience of biometric identification. Griaule Biometrics SDK is designed for applications on standalone PCs, client server web based applications and any other computer scenarios. It supports dozens of programming languages and can run on Windows, Linux, and Android OS. It contains the API required to access data from the fingerprint reader.

### C. *SecuGen Hamster Fingerprint Reader*

SecuGen Hamster Fingerprint Reader is the improved version of secugen's popular and versatile fingerprint reader product line, with auto-on and smart capture packed in a comfortable, ergonomic design, and advanced optical sensor using patented SEIR biometric technology. Auto-on is an automatic finger placement detection technology that automatically checks for the presence of a finger. When used with auto-on compatible software, the Hamster will turn on and scan the fingerprint as soon as the sensor is touched without having to prompt the System. Smart capture ensures quality fingerprint scanning of difficult fingers, by automatically adjusting the brightness of the sensor. SecuGen Hamster is used for authentication, verification and identification functions that let the fingerprint act like digital passwords that cannot be lost, forgotten, or stolen. This fingerprint reader works seamlessly with;

- Griaule fingerprint recognition SDK
- SecuSearch SDK

## VI. SYSTEM ARCHITECTURE

This fingerprint-based attendance management system is made up of the following:

- Enrolment phase
- Identification phase
- The system database

### A. *Enrolment Module*

Users are enrolled and their fingerprints captured into the system's database. During enrolment, the fingerprint and other bio-data of the user are captured and the unique feature are extracted from the fingerprint image and stored in a database as a template for the subject along with the user's ID. The staff bio-data captured includes; first name, last name, sex, rank, unit, SP/JP Number.

### B. *Identification Module*

This to identify a user's captured data. Each day of attendance, the fingerprint image is extracted from an individual, and the system conducts a one-to-many comparison to establish an individual identity (or fails if the subject is not enrolled into the database) with the subject having to claim an identity.

### C. *The System Database*

The system database consists of tables that stores records, each of which corresponds to an authorized person that has access to the system. Each record may contain the minutiae template of the person's fingerprint and user's other details. The database was implemented using Java DB. Figure 4 shows the sketch of system architecture of the proposed model.

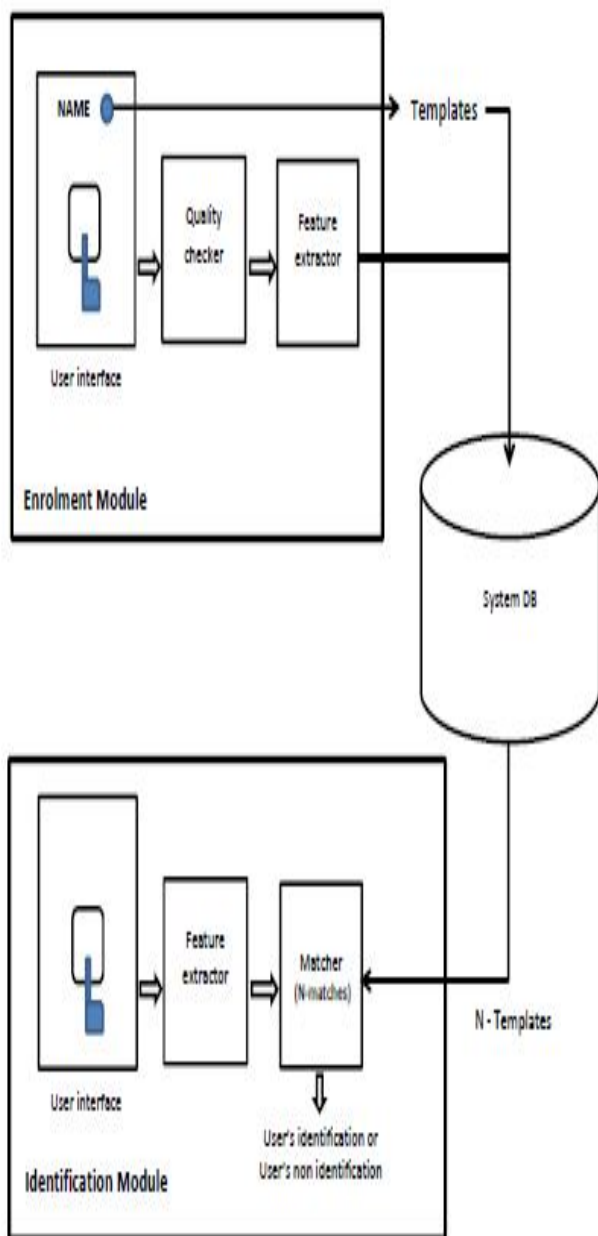


Fig. 4. Architecture of the proposed model

## VII. SYSTEM FLOWCHART

A flowchart is a step by step representation of a logic sequence, work or data flow process. Flowchart uses geometric symbols and arrows to define relationships. A process is represented by a rectangle, a decision is represented by a diamond and an I/O process is represented by a parallelogram. Figure 5 shows the system flowchart of the proposed system.

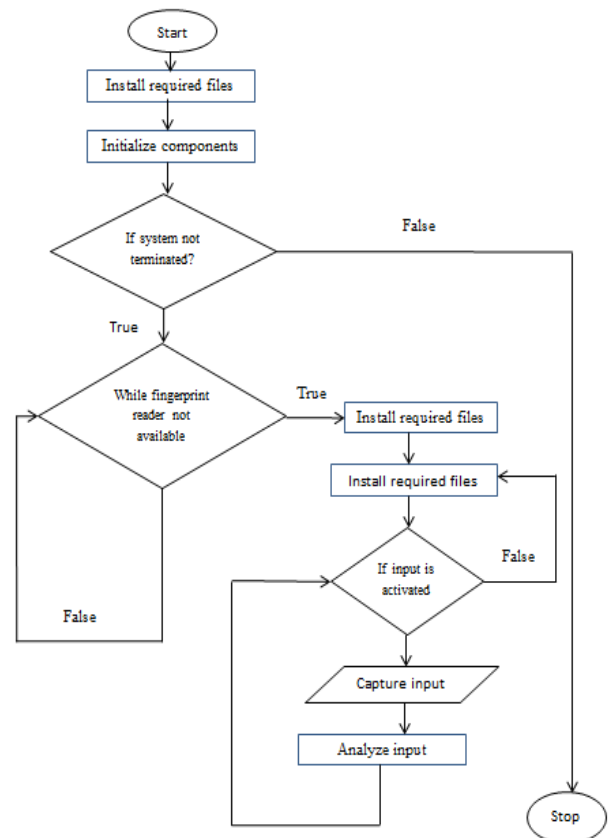


Fig. 5. Flowchart of the proposed system

## VIII. TESTING AND RESULTS

At the end of the design implementation, a system test was conducted on the proposed system to check whether it meets up with the required specifications, the aims and objectives, which were earlier stated. The system was tested on a Compaq Presario CQ56 Windows 8 laptop with java virtual machine installed, and also the various aforementioned SDKs and APIs. The application (Enhanced Attendance Management System), which has '.jar' as its extension was opened and the fingerprint reader was plugged to the USB port of the laptop. In the application, there is Register, Start Attendance, Print, about and exit. The register is to add new user, the start attendance is for daily attendance, print is for report generation, and exit is to logout of the environment. Users were enrolled and their fingerprints captured into the system database. During enrolment, the fingerprint and other bio-data of the user are captured and the unique feature are extracted from the fingerprint image and stored in a database as a template for the subject along with the user's ID such as first name, last name and sex. The user's claimed identity is identified each day of attendance, the fingerprint image is extracted from an individual, and the system conducts a one-to-many comparison to establish an individual identity (or fails if the subject is not enrolled into the system database) with the subject having to claim an identity. The results show the reliability of the proposed system. The development of an enhanced attendance management system was successful. The methodology used was thoroughly and sequentially followed. Research on the existing system, data collection, research on fingerprint technology all served as the system specifications. The aims and objectives aforementioned was



achieved and the usability and integrity test were also conducted which turned out to a successful result. Figure 6 shows the sample output result.

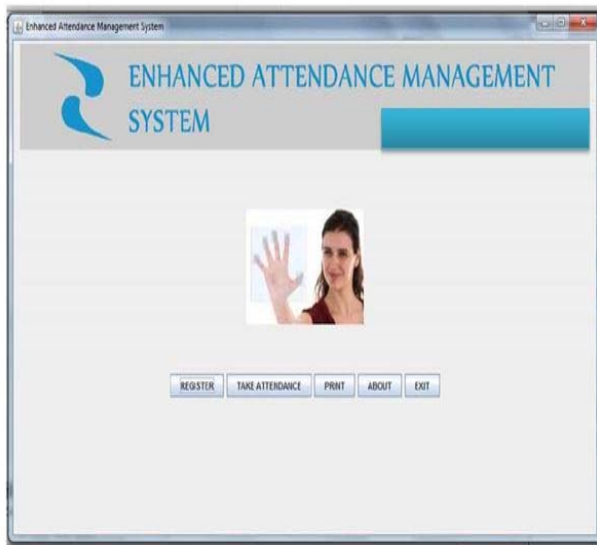


Fig. 6. Sample output

## IX. CONCLUSION

In this paper, a fingerprint attendance management system is presented. The system extracts the local characteristics of fingerprint which is minutiae points in template based. Templates are matched during both enrolment (registration) and identification processes. The developed system is very helpful in saving valuable time of students, paper and generating reports at required time. The system can record the clock-in and clock-out time of students in a very convenient manner using their fingerprint to prevent impersonation and reduce the level of absenteeism as well as to update and maintain attendance records.

## X. FUTURE WORK

The paper has a very vast scope. In the future, the project can be implemented on intranet as it can incorporate a larger body. I strongly endorse the future development of this work.

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