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# The attendance alert based biometric system for employees using fingerprint: a case of hope Africa university, Bujumbura-Burund

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NM-AIST

# THE ATTENDANCE ALERT BASED BIOMETRIC SYSTEM FOR EMPLOYEES USING FINGERPRINT: A CASE OF HOPE AFRICA UNIVERSITY, BUJUMBURA-BURUNDI

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**A Project Report Submitted in Partial Fulfillment of the Requirements of the Award the Degree of Master of Science in Embedded and Mobile Systems of the Nelson Mandela African Institution of Science and Technology**

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# ABSTRACT

Attendance has been used as a key to success in all disciplines worldwide. Most institutions' officers make efforts to monitor the attendance of their employees in their daily activities. However, most of the applied attendance systems used in the institutions are manual. The manual system-based attendance management has a lot of limitations such as masquerades, hard-to-access data, no data centralization. Automated systems-based attendances have been developed and used in many institutions around the world. Regardless of the capability of the automated based system to provide unique identification, the alert subsystem for the late employees is still missing. This project developed the Attendance Alert Based-Biometric system for Employees using Fingerprint to improve the recognition accuracy of automated attendance systems. To use this developed system all users must be registered and then scan their fingers on the sensor in reporting time and leaving time. This system has increased the accuracy of the institution and allows human resource managers to know and track all employees' attendance and get an alert if an employee late has been detected. It also helped to automate the processes of attendance making and make recorded data to be accessible.

# DECLARATION

I, Salama Ndayisaba, do hereby declare to the Senate of the Nelson Mandela African Institution of Science and Technology that this project report is my original work and that it has neither been submitted nor being concurrently submitted for a degree award in any other institution.

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Prof. Anael Sam
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# COPYRIGHT

# CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by The Nelson Mandela African Institution of Science and Technology, a project report titled *"Development of Attendance Alert Based Biometric System for Employees using Fingerprint: A Case Study of Hope Africa University, Bujumbura-Burundi"* in partial fulfillment of the requirements for the degree of Master of Science in Embedded and Mobile Systems of the Nelson Mandela African Institution of Science and Technology.

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May the peace of God fill you.

# DEDICATION

I devote this work to my esteemed wife for her dedicated time and encouragement which strengthened me during the entire academic journey.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| CENIT@EA | Centre of Excellence for ICT in East Africa |
| COVID-19 | Corona Virus Disease 19 |
| CSS | Cascading Style Sheets |
| H.A.U | Hope Africa University |
| HR | Human Resources |
| HTML | Hypertext Markup Language |
| I/O | Input/output |
| JS | JavaScript |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| MVC | Model View and Controller |
| MySQL | My Structured Query Language |
| NFC | Near Field Communication |
| NM-AIST | The Nelson Mandela African Institution of Science and technology |
| RFID | Radio Frequency Identification |

# CHAPTER ONE

# INTRODUCTION

## 1.1    Background of the Problem

An attendance management system refers to an organization's approach to tracking employee time and attendance information. An accurate attendance and time tracking system helps to calculate and employees working that conduct to good enterprise performance.

The attendance management system is an important activity, which is used in many institutions for different purposes such as record keeping and assessing the punctuality of employees or students (Ramakrishnan & Ramakrishnan, 2012).

Often, it exists two types of methods are used in attendance management such as manual systems and computerized systems. The manual system-based attendance management involves the use of pens and register and employees are requested to sign at reporting and leaving time (Adewole *et al.,* 2014). However, this system encompasses a lot of disadvantages such time consuming, hard to access data, masquerades (Elmi *et al.,* 2016).

Computerized systems have been used to overcome the challenges and problems observed in manual systems. This technology involves the use of computers and software (Shoewu & Idowu, 2012).

Currently, computerized systems exist in different types of technology such as biometric using fingerprints, face recognition. Radio Frequency Identification (RFID), Q-R code, NFC technology, web-based attendance management. In most cases, more than one technology can be combined in a single system for attendance management for instance bimodal fingerprint and RFID (Mshelia *et al.,* 2017).

The commonly used computerized system is fingerprint identification, which is of the most reliable and efficient biometric approaches. The fingerprint identification becomes popular because of its high qualification by considering time, low cost, but also the truth in employee attendance monitoring by signing in and signing out (Ramakrishnan & Ramakrishnan, 2012). This technology is used in many institutions/companies as an innovation in their business processes.

Fingerprint identification system covers the requirements of the personnel department in terms of day-to-day monitoring of employees, calculation of overtime, and transfer of relevant information to the payroll system and manpower analysis. Hence, employee attendance is an important issue and every organization must take into consideration in order to be productive (Shoewu & Idowu, 2012).

The use of information technology in different institutions became solution to automating their tasks. With the different challenges caused by the old ways of attendance that many institutions/companies are facing, most of them shifted to automated system. The human resource manager gets each day messages from employees who made late without checking the report.

The purpose of using the new system is to end up the system manipulation, minimize and if possible, eliminate the impersonation problems. In biometric fingerprint-based attendance new technology, employee's data are registered and stored in the database that is used to recognize easily and exactly the employee during attendance task. In this case, the fingerprint of each employee is taken by the system.

## 1.2 Statement of the Problem

Hope Africa University is an academic institution that counts a big number of students and staff. As institutions track the attendance of their employees, it is the same as Hope Africa University where the manual method which involves the use of pen and register has been used since its creation. Often, this method encompasses several limitations such as the time-consuming, difficulty of accessibility, presentation of masquerades, and lucky of data security. Moreover, the manual method is vulnerable to human error due to the requirement of manual typing, to address the listed challenges, an automated system-based biometric attendance using fingerprint will be developed and implemented. This system will help the university's administration to automate all the processes based on attendance monitoring, reduce the time to be used, and put at the end the masquerades observed in manual method.

## 1.3 Rationale of the Study

Companies or institutions with a very huge number of employees have the problem of following the attendance of their employees. Sometimes, some employees reported to their offices, they worked a few hours and after a while, they went out for their own business. The

system used for recording the attendance is manual, when the registers are lost, all records are lost. With that, the attendance alert using the biometric system is needed in an institution or industry with a large number of employees. This will improve the performance of the attendance and also the human resource will be helped by the system when it comes to the payroll preparation.

## 1.4 Objectives of the Study

### 1.4.1 General Objective

To develop the Attendance Alert Based-Biometric system for Employees using Fingerprint.

### 1.4.2 Specific Objectives

The study aimed to achieve the following specific objectives:

(i)     To identify the requirements of developing an Attendance Alert Based Biometric System for Employees using Fingerprint.

(ii)    To design and develop an Attendance Alert Based Biometric System for Employees using Fingerprint.

(iii)   To validate the developed system.

## 1.5 Research Questions

The study intended to answer the following questions:

(i)     What are the requirements for developing a biometric attendance system using fingerprints?

(ii)     What are the right methodologies to develop biometric attendance using fingerprints?

(iii)    Did the developed system meet the end-user's requirements?

## 1.6 Significance of the Study

Attendance is a very important criterion that is used for different purposes such as records, assessment, promotion, and attendance for employees and students in different institutions. The developed system brought the easiest way for attendance tracking of employees such as alerting

employees and the human resource officer of late and absence of employees. It helped to automate all the processes of attendance, reduce staff stress, and put at the end of the masquerades mostly found in manual attendance systems. Staff and employees were only asked to scan their fingers in the reporting and leaving time. The system recognized the person's fingerprints and make attendance including the attendance time. An email has to be sent automatically to the employee as a notification for his/her late. The human resource director got a notification about employees' status related to their attendance time. If late, email to ask why the late has to be sent.

## 1.7    Delineation of the Study

The project delineated how institutions or industries with a huge number of employees can manage the attendance of their employees. The choice of attendance alert using a biometric system was based on how each employee will enroll his/her fingerprint in the database and use that fingerprint when it comes to attendance. In addition, the project focused on the education institution because that is what the case studies, the Hope Africa University.

## CHAPTER TWO

## LITERATURE REVIEW

According to Mshelia *et al.* (2017) and Moth *et al.* (2015) attendance is a very important criterion that is used for different purposes such as records, assessment, promotion, and attendance for employees and students. Arulogun *et al.* (2013) explained that student manual attendance has been utilized in the past and has played a significant role in educational institutions, but it has not been used in recent years due to its limitations such as being time-consuming, exposed to human error, a lot of manipulation.

Nandhakumar *et al.* (2020) developed an attendance system using RFID technology to replace the manual attendance system. The system automated the attendance system processes. Each concerned had a smart card to use for attendance. Student or employee has to scan the smart card containing their personal information. However even these smart cards have the unique Id, students or employees can borrow and make attendance for absent students or employees.

Naidu *et al.* ( 2017) developed a web-based attendance management system that is compatible with any computer system. Different programming tools and languages like MYSQL as the back end, JAVA, HTML, and CSS have been used during the development of that web-based. The system sent notifications to the parent via their mobile phone when their children arrived at school. However, this system required the call of name, it was exposed to the mistake. The lecturer can point the presence sign on the place of absent student reason the use of the biometric system is still very useful compared to this.

Singh *et al.* (2019) developed an application which used to collect attendance online, and the attendance records are saved in a database. Model, View, and Controller (MVC) architecture were used to develop the system, which was then implemented using the Laravel Framework. To increase the system's usability, JavaScript is being added to the application. The created system can analyze data and show attendance statistics for students, as well as print reports on absence rates and student warnings for the chosen time. However, in this system, there is uniquely found in a biometric system.

Kommey *et al.* (2018) explained that the benefit of an attendance system in educational institutions is over the word. With empirical data demonstrating a link between students' academic achievement and attendance, parents, guardians, lecturers, and school

administrations make an effort to track students' attendance in classrooms and at academic activities. The system has been designed to manage growth and was developed on the idea of modularity, allowing other applications, such as mobile apps, to tap into the system ecosystem. However, it is difficult to avoid mistakes due to the miss of technology which can avoid the mistake that can happen in name-calling.

Referring to works done by different authors, the advantages have been remarkable. However, weaknesses and limitations are still there. Lack of notification to the student, employee, and to the human resource office of the institution, masquerades that remarked on RFID System, mistake based on name-calling, etc. To come up with the problem, a Late Attendance Alert Based Biometric system for Employees using Fingerprint has been proposed to alert both human resources and the employee responsible for the late.

# CHAPTER THREE

# MATERIALS AND METHODS

## 3.1     Research Design

Attendance is a very important criterion that is used for different purposes such as records, assessment, promotion, and attendance for employees and students in different institutions. Employees or students must obey the reporting time because is one of the points to be considered in institution life. Some institutions are using manual systems-based attendance management which encompasses a lot of limitations. Automated systems have been used even though manual systems still exist, to make attendance well managed and avoid masquerades. However, these systems cannot alert human resources directors or other concerns. This system aims to develop a biometric-based attendance system by using a fingerprint sensor that enables the concerned to receive a notification when an employee late has been remarked by the system. Each employee was requested to scan the finger during reporting and leaving time. The system compared the expected time for reporting and leaving, if they matched no notification unless they were not matched.

## 3.2     Sample Size and Sampling Technique

During data collection, a random technique has been adopted. This technique involves choosing randomly the participants to be interviewed. The involved participants were employees of Hope Africa University whereby a total of 120 persons have been counted that they have been interviewed.

## 3.3     Case Study

This study was carried out in Burundi specifically at Hope Africa University (HAU) located in Bujumbura town. The HAU is a bilingual university with undergraduate and postgraduate, it has been chosen in this study because it is the one of areas, they were using manual system-based attendance management, and my internship area was in the Department of Information and Commination Technology (ICT).

### 3.4    Data Collection Methods

To conduct this study, data was gathered employing an assortment of strategies and methods such as observations, documentation, interviews, questionnaire, and experimentation. Interviews and group discussions were used to contact the employees and staff while documentation and observation have been used to see what other researchers did regarding the attendance system. A qualitative research method that is exceptionally vital in educational research because it addresses the "how" and "why" research questions empower a more profound understanding of encounters, phenomena, and context has been used (Arulogun *et al.,* 2013; Creswell & Miller, 2000). Qualitative research allows asking questions that cannot be easily put into numbers to understand human experience (Creswell & Miller, 2000). In addition, a quantitative method was also used to identify and draw data representation.

A questionnaire method has been used to identify the importance of the biometric system and other aspects. The questions were dressed to employees, students, and staff. which seem to be secret will be tended to the human asset supervisor who is the last person to give out the report of attendance of employees. Finally, an unstructured interview was conducted with the principal ICT manager and human resources director to identify and gather the requirements to develop this new system.

### 3.5    Data Analysis

To identify the requirements of this system and its efficacy, the collected data were analyzed by the SPSS software. This software allows representing data in form of graphics that help to analyze and identify if the system meets the requirements or client's needs. The descriptive analysis method was also adopted to be used for data analysis in this study. This technique allows learning from past behaviors and finding out how they might influence future performance.

**3.6 System Requirements**

**3.6.1 Software Requirements**

**(i) Arduino IDE**

The Arduino Integrated Development Environment is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino-compatible boards, but also, with the help of third-party cores, other vendor development boards.

**(ii) MySQL**

MySQL is open-source, reliable and compatible with all major hosting providers, and cost-effective (Čapligins & Ermuiža, 2016). It is easy to use and has been known as the best tool for relational database management systems (RDBMS) and is based on structured query language reason why it has been chosen to be used in this project. It will enable users to request information by simply typing the specified SQL statement on MySQL.

**(iii) The XAMPP Server**

The XAMPP is a free and open-source cross-platform (compatible with all types of computer hardware and software) web server solution stack package. Developed by Apache Friend, consists mainly of the Apache HTTP server, Maria DB database, and interprets for scripts written in the PHP and Perl programming languages. It is known as a local web server that provides a suitable environment for PHP, SQL. In this system, the XAMPP server hosts locally all data entered in the system.

**(iv) Hypertext Markup Language**

Hypertext Markup Language (HTML) is a standard for document design that is displayed in a web browser. It can work together with Cascading Style Sheet which deals with the appearance of the web page and scripts languages.

**(v) Cascading Style Sheets**

Cascading Style Sheets (CSS) is a programming language used in web page design and website. Its functions are based on the appearance of a web page.

**(vi)      Java script**

JavaScript is high-level, often just-in-time compiled, and multi-paradigm. It has curly-bracket syntax, dynamic typing, prototype-based object orientation, and first-class functions.

**3.6.2   Hardware Requirements**

**(i)      Fingerprint module**

The FPM10 fingerprint module scanner (Fig. 1) is an integrated fingerprint processing module that integrates optical path and fingerprint processing parts. It has high reliability, fast recognition, good adaptability to dry and wet fingers, and finally, it has a working voltage of 3.3 V to 5.5 V DC. It uses USB and UART as communication interfaces and acts as slave and master devices for sending a relevant command to control it.



**Figure 1:     The FPM10 fingerprint module**

**(ii)     Arduino Uno**

Arduino Uno as shown in Fig. 2 is the central element of this system. It has 28 pins and a working voltage of +1.8 V to +5.5 V. It can be programmed by using Arduino IDE and other types of programming languages. Arduino Microcontroller has "I/O" (input/output) capabilities built-in. As a result, it can read and write digital and analog values/states, as well as a link to the "real world". Unlike a microprocessor, a microcontroller may connect to switches, buttons, LCD screens, LEDs, relays, and serial ports directly.

**Figure 2:   Arduino Uno microcontroller**

**(iii)   Liquid Crystal Display**

A liquid-crystal display (LCD) (Fig. 3) is a flat-panel display or another electronically controlled optical device that employs liquid crystals and polarizers to modify light. Liquid crystals do not directly generate light; instead, they need a backlight or reflector to create color or monochrome pictures.



**Figure 3:   Liquid crystal display**

**(iv)   Buzzer**

The buzzer (Fig. 4) is an electrometrical device with two pins and a DC operating voltage of 5 V used for sending an alarm.  In this system, it produced a sound when an attendance rate is found.

**Figure 4:    Buzzer**

**(v)    Potentiometer**

The potentiometer as shown in Fig. 5 is a variable resistor with three pins and a DC operating voltage of 5 V. This device is used to adjust the brightness of the LCD.



**Figure 5:    Potentiometer**

**(vi)    Computer**

During the development and testing process of the developed system, a computer of P6100 @ 2.00 GHz with a windows operating system of 64 bits and Linux operating was used. These are the minimum requirements to be considered for the computer the system can be installed.



**Figure 6:    Computer requirements**

### 3.7    Block Diagram of the System
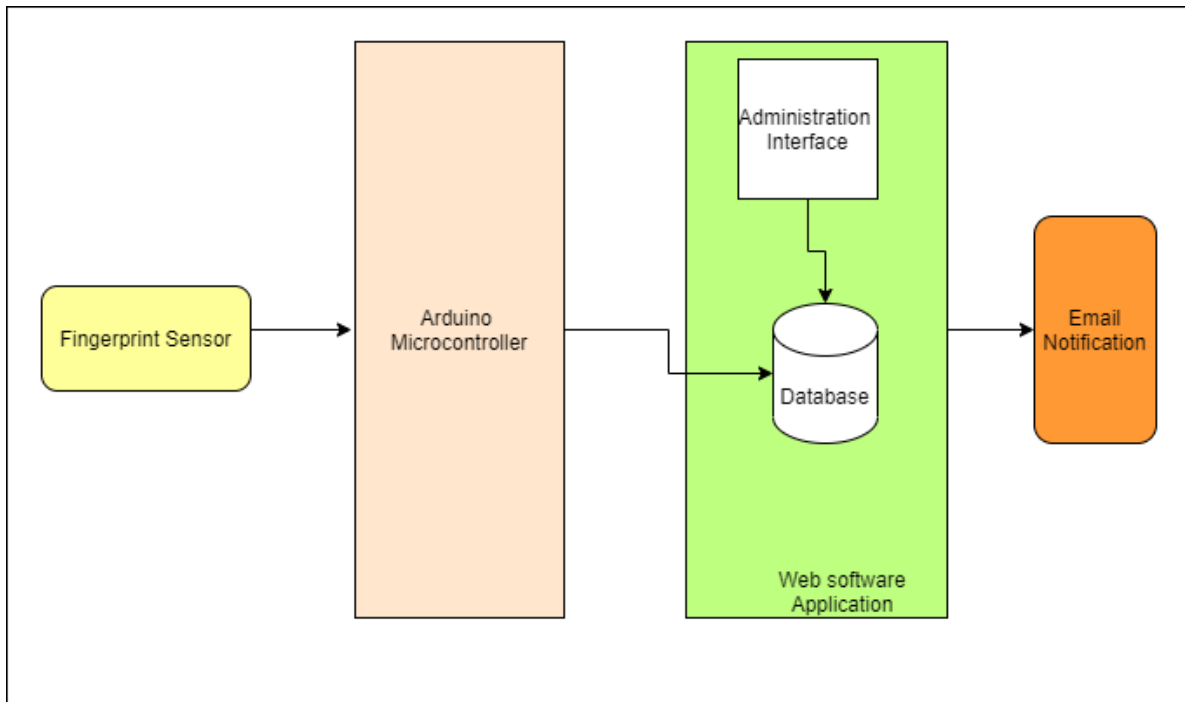


**Figure 7:    Block diagram of the project**

As shown in Fig. 6, the Arduino microcontroller is the central element that coordinates all the processes based on attendance monitoring. A fingerprint sensor connected to the microcontroller was used to scan employees' fingers and send data to the microcontroller which by the end was sent to the database then a message was displayed on the LCD. The administrators via their interfaces can visualize all employees' attendance and can generate a report in different formats such as pdf, word. Amdmins receive also an email to notify that the employee was rated even if are not in their office.

### 3.8    System Development Approach

In this project, the Agile-based SDLC functionalities have been adopted to be used in this system due to their flexibility, it is easily and quickly adapted to modification. It gives good project control and good visibility into project performance. Figure 7 demonstrates the combination of interactive collaborative and incremental process models.
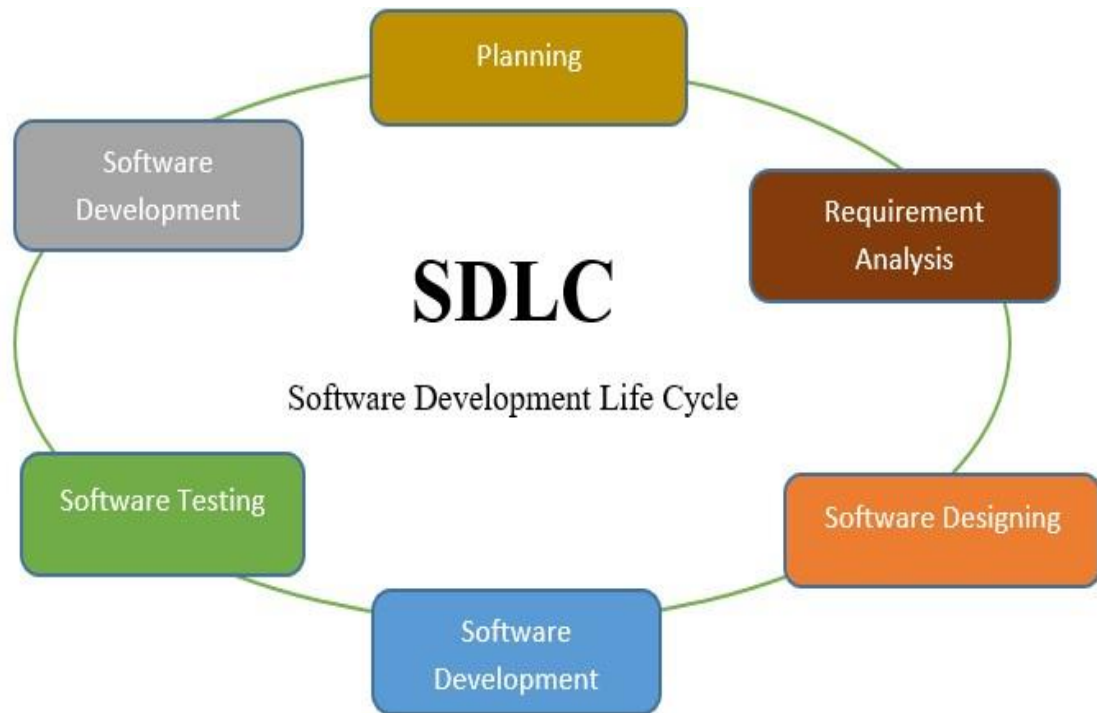
**Figure 8:    Software development life cycle**

These phase of SDLC methodology are described as follow:

**(i)    Planning phase**

Every system development starts with planning on how to do the requirement gathering and how to design the project. The feedback from users will be used to plan for the system development and improvement.

**(ii)    Requirement and analysis phase**

At this step, the detailed definition of system requirements is set. We will discuss with system stakeholders and supervisors by determining detailed requirements of the system which will help us to determine the best way to achieve and implement this project.

**(iii)    Designing phase**

The design shows how functions work with the employees as users and the way it is going to be applied in the existing systems. In this project, the block diagram and the flow chart diagram have been drawn for showing how the system will work.

**(iv)    Development phase**

This phase of system development involves coding and developing the system according to the design of the detailed requirements. We will verify to ensure all defined requirements are included in the development.

**(v)    Testing phase**

Different tests will be done to ensure the best results and state of the system are achieved. We will test to be sure that the system is running well.

**(vi)    Deployment phase**

After the testing, the project will be implemented to be used by the users (employees).

**3.9    Data Flow Diagram**

Figures 8 and 9 demonstrate how data were processed from scratch to the end. Employees were requested to be registered first and scan their fingers at reporting and leaving times. When they are scanned, the system makes their attendance if and only if the reporting and leaving were matched to the one set in the system.
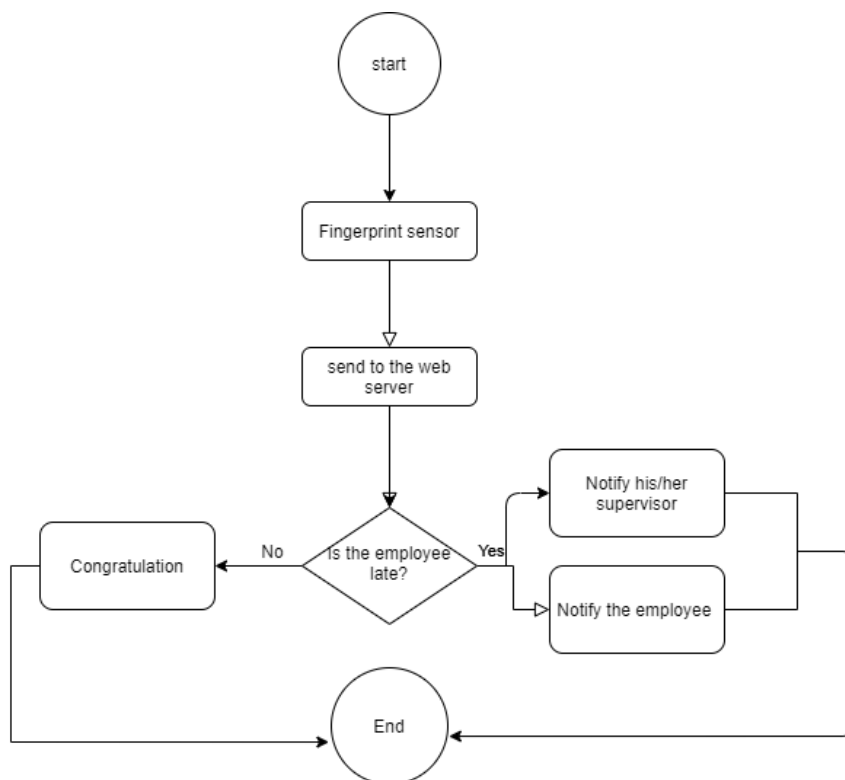


**Figure 9:    Data flow diagram for sign in**
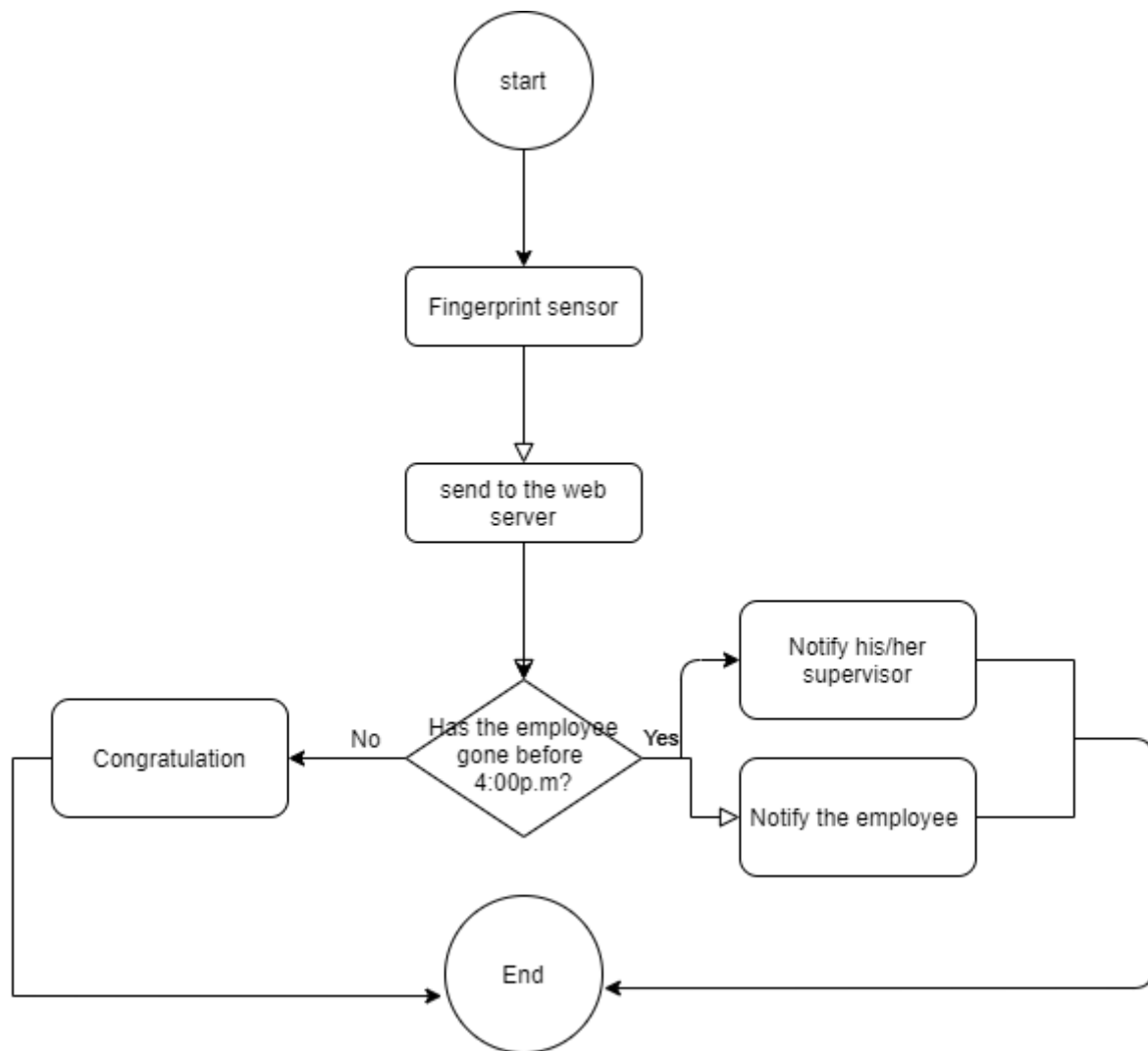
**Figure 10:   Sign-out data flow diagram**

# CHAPTER FOUR

# RESULTS AND DISCUSSION

## 4.1 Results

### 4.1.1 Demographic Characteristics

In this study, a demographic assessment of respondents was very inevitable to analyze and evaluate the attitude toward computerized attendance monitoring through the use of Information and Communication Technology (ICT). Ages and gender were the factors used in the demographic examination. Table 1 demonstrates the socio-demographic details of each category of respondents. A total of 120 respondents were examined with many males greater than the number of female respondents.

**Table 1:    Demographic Characteristics of Respondents**

|          | Demographic features | Respondents | Percentage % |
|----------|----------------------|-------------|--------------|
| Gender   | Male                 | 75          | 62.5         |
|          | Female               | 45          | 37.5         |
| Age      | 25-35                | 57          | 47.5         |
|          | 36-40                | 41          | 34.67        |
|          | 41-60                | 22          | 18.33        |

### 4.1.2 Attendance Monitoring in Institutions

Figure 10 shows that attendance monitoring is a preoccupation of institutions where 67% of respondents agreed that their institutions were doing attendance monitoring while 33% denied it.

DOES YOUR INSTITUTION MAKE EMPLOYEES ATTENDANCE MONITORING?
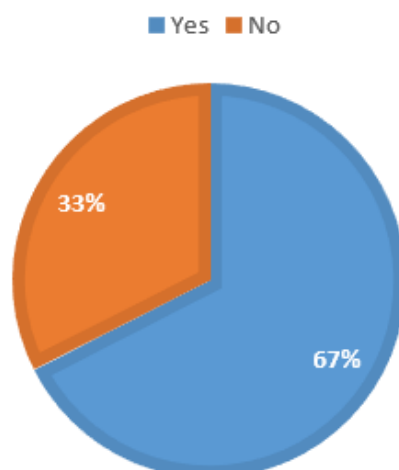
**Figure 11:   Proportion of attendance monitoring in institutions**

**4.1.3   Methods Used for Attendance Monitoring**

Figure 11 shows that attendance monitoring was done in two ways manual and computerized way. Seventy five percent (75%) of respondents agreed the institutions were using a manual method while 25% said that attendance was done using Information and Communication Technology. As there are many methods used in computerized, attention was taken to know which kind of technology was most used. Figure 12 shows that fingerprint was used at 47% while other systems, not such web-based were used at 12%.
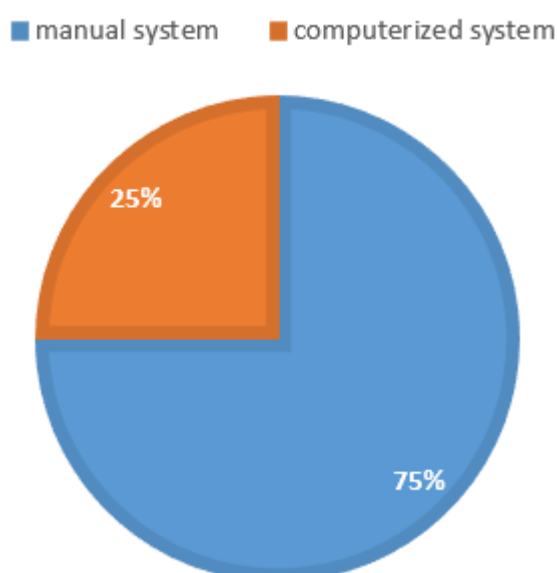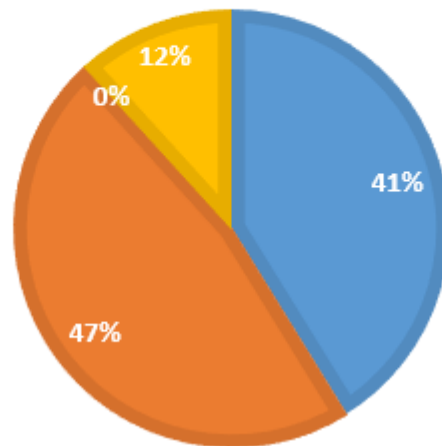


**Figure 12:   Types of methods used**

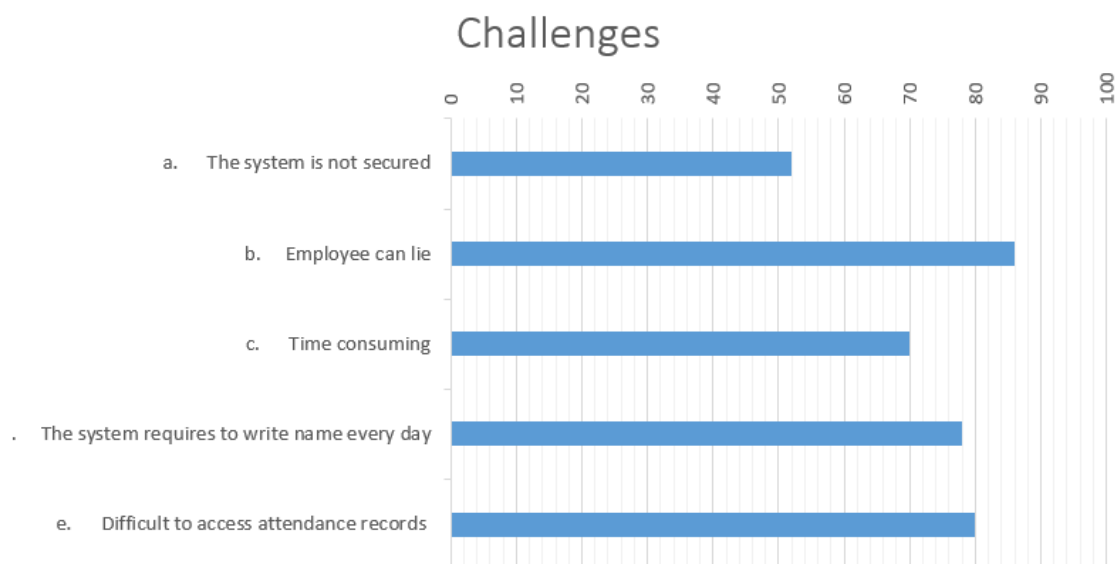**Figure 13:** **Kind of computerized system used**

### 4.1.4 Challenges Observed in Existing Systems

Figure 13 shows the list of challenges observed in manual attendance monitoring. Based on obtained data, they proved that employees presented masquerades during attendance making. The reporting time is 0730h, employees were required to indicate the arrival time in the attendance book which becomes very difficult for being sincere. It was observed for instance when an employee arrived at 830h and mentioned that he arrived at 0730h. The task of making attendance using a pen and register required a lot of time more than 5 min because it required to be lineup when employees arrived in the group.



**Figure 14:** **Challenges in the manual system**

Computerized systems such as fingerprint sensors were used at 25% according to collected data. The system presented the solution to the most listed challenges. However, the admin or human resource manager cannot be alerted when employees made a big late which can induce him or her to take a quick reaction. The developed system has the aim of increasing security and accuracy in attendance monitoring where the employee was required to scan her /his finger and the system verification started by looking if the employee was registered and comparing his/her reporting time to the fixed one. When an employee is made, a notification message has to be sent to the person in charge.

## 4.1.5 Findings for Developed Application

### (i) Login Interface

This interface allows all registered to type their personal information such as email and insert a credential word to access the system (Fig. 14). The system also gives the ability to users to recover password in case it has been forgotten.
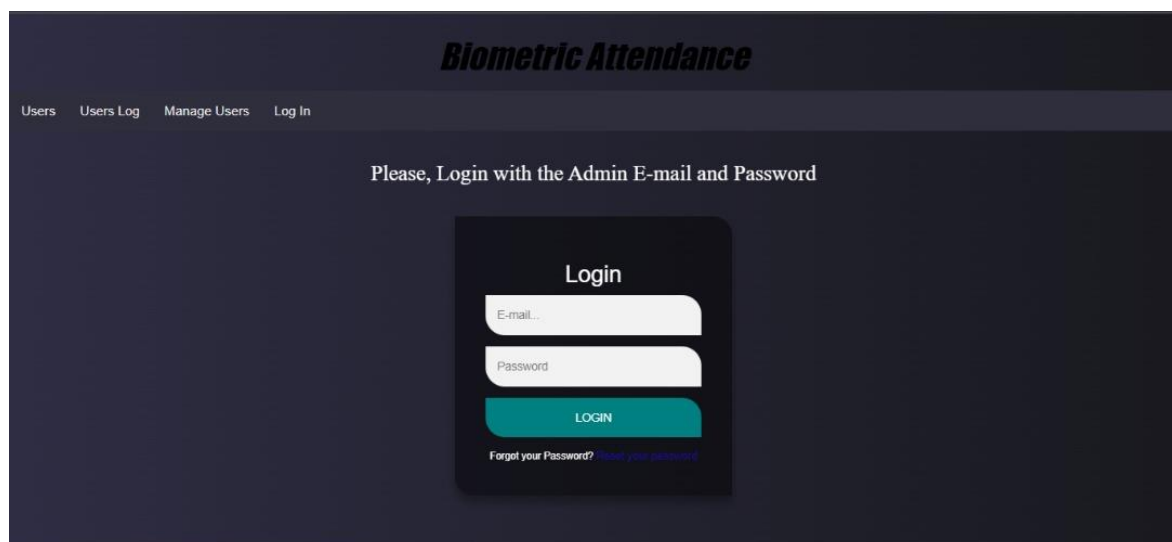


**Figure 15:  Login panel**

### (ii) Admin interfaces

The developed web-based has an interface that is reserved only for admin who has the capacity of managing users such as adding users, editing, deleting, and seeing all records as shown in Fig. 15 and Fig. 16. Figure 17 demonstrates the right given to admin to track all users that accessed the system at the desired date while Fig. 18 shows that in any time admin can generate the report in different format such as pdf, word.

**Figure 16:    Interface for admin**



**Figure 17:    User's addition**



**Figure 18:    Report generation**

## 4.2    Discussion

The primary goal of this project was to improve the attendance management system that will allow an interactive flow of employees, human resources, and the entire management of the university. The system conceptualization provided in this project report was implemented and evaluated in the study. The developed system has a high potential for usage as a dependable

instrument for collecting the attendance of all employees at Hope University while reaching out to target groups: employees and university management.

The developed system contains the web application which is managed by the institution via the administrator. The web contains the user interface which allows the employees to log in and the admin interface which allows the admin to manage the employees' records.

# CHAPTER FIVE

# CONCLUSION AND RECOMMANDATIONS

## 5.1    Conclusion

Attendance Alert Based Biometric System for Employees using Fingerprint provides the ability to companies to easily manage employees and hence increasing productivity. In this system, all employees must be registered and all information has to be stored in the database of the company or organization, otherwise, the system cannot provide results. The system sent an email notification if employees sign in on time, and an email for late justification if employees late have been detected.  This system minimizes queries between employees and organization management, increased data security, and accessibility, and provides accuracy in the company. Furthermore, the proposed system is expected to increase productivity due to the regular attendance of the employees. It also helped to safeguard carefully data of employees' attendance compared to the old system used by a register and a pen and centralized data. This system has the main task of the management of attendance of employees during their signing in and signing out.

## 5.2    Recommendations

This technology recommends the following:

(i)      The organization's management is required to organize seminars for employees to have a clear service orientation.

(ii)     The management is recommended to ensure that all employees are registered in the database and to be sure that sanitizer is fixed.

(iii)     The administrator is recommended to ensure that the system is updated on time (to register the new employee and to remove the left). But also, to verify if the notifications sent to the late employees are replied to.

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**APPENDICES**

**Appendix 1:   Data Collection Form**

A.  Questionnaire for employees

1.   What is your gender? Male ☐                    Female ☐

2. What is your age? 25── 35 years old ☐

   36 ── 40yrs old ☐

   41 ── 60 years old ☐

3. Are you an employee of HAU? Yes ☐                    Non ☐

4. What is the reporting time at HAU? 7:00 AM ☐      7:30 AM ☐      8:00 AM ☐

5. Is your institution attendance monitoring at reporting and leaving time?

6. Which method is used here for attendance making? manual ☐      compute ☐

7.   If computerized, which one?

   ☐ RFID
   ☐ Fingerprint
   ☐ Face Recognition
   ☐ Software based
   ☐ Other System
   If other, put the name here ──────────────────

8.   What time do you use in attendance making?
   ☐ 2minutes
   ☐ 4minutes
   ☐ More than 4 minutes

9.   What challenges did you remark on?

a. The system is not secured

b. Employee can lie

c. Time-consuming

d. The system requires to write a name every day

e. Difficult to access attendance records

10. What do you suggest?

a. To continue with the same system

b. System to be changed

c. Other alternatives_____

11. |Did you see where the technology is used for attendance management

☐ Yes

☐ Non

12. I propose to use fingerprint technology here, where you will be registered first and scan your finger at reporting time or leaving. Do you think it will be more advantageous?

☐ Yes

☐ Non

☐ None

B. Questionnaire for administration

1. What is your gender? Male; ☐ Female ☐

2. What is your age?

☐ 25 —— 35 yrs old, ☐ 36—— 40 yrs old ☐ 41—— 60 yrs old

3. Are you a Staff of HAU? ☐ Yes, ☐ Non

4. What is the method used here for attendance monitoring?

☐ Manual system

☐ Computerized system

5. What time do you use for making attendance?

☐ 2minutes

☐ 4minutes

☐ More than 4 minutes

6. Is it easy to make an attendance report ☐ Yes, ☐ Non

7. What challenges did you remark on? Tick all correct answers.

   a. Data is not secured

   b. Presence of lies

   c. Difficult to access

   d. Data is not centralized

   e. Requires to write names every day

8. Are satisfied with the currently used system?

☐ Yes ☐ Non

9. How do you monitor employees' presence?

   a. Using a daily report

   b. Monthly report

   c. Other ——————————————————

**Appendix 2:   Programming Codes**

```
//Salama project biometric Attendance
#include <SPI.h>
#include <Wire.h>
#include <WiFiClient.h>
#include <ESP8266WiFi.h>
#include <SoftwareSerial.h>
#include <ESP8266WebServer.h>
#include <ESP8266HTTPClient.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include <Adafruit_Fingerprint.h>
#define Finger_Rx 0 //D3
#define Finger_Tx 2 //D4



#define OLED_RESET     0
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);
SoftwareSerial mySerial(Finger_Rx, Finger_Tx);
Adafruit_Fingerprint finger = Adafruit_Fingerprint(&mySerial);
const char *ssid = "JustDoElectronics";
const char *password = "prateek";
String postData ;
String link = "http://192.168.0.108/biometricattendance/getdata.php";
int FingerID = 0;
uint8_t id;
#define Wifi_start_width 54
#define Wifi_start_height 49
const uint8_t PROGMEM Wifi_start_bits[] = {
  0x00,0x00,0x00,0x00,0x00,0x00,0x00
```

```
#define FinPr_failed_width 64
#define FinPr_failed_height 64
const uint8_t PROGMEM FinPr_failed_bits[] = {
0x00,0x00,0x3f,0xe0,0x00,0x00,0x00,0x00
,0x00,0x01,0xff,0xfe,0x00,0x00,0x00,0x00
,0x00,0x01,0xff,0x80,0x3f,0xff,0xff,0xff
,0x00,0x00,0x3f,0x80,0x1f,0xff,0xff,0xfe
};
#define FinPr_scan_width 64
#define FinPr_scan_height 64
const uint8_t PROGMEM FinPr_scan_bits[] = {
  0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00
,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00
,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00
};
//-------------------------------------------
//Didn't find the scanner or there an error

int httpCode = http.POST(postData);   //Send the request
String payload = http.getString();    //Get the response payload

Serial.println(httpCode);   //Print HTTP return code
  Serial.println(finger);    //Print fingerprint ID

if (payload.substring(0, 5) == "login") {
  String user_name = payload.substring(5);
//  Serial.println(user_name);

  display.clearDisplay();
  display.setTextSize(2);            // Normal 2:2 pixel scale
  display.setTextColor(WHITE);       // Draw white text
  display.setCursor(15,0);           // Start at top-left corner
  display.print(F("Welcome"));
```

```arduino
  else if (payload.substring(0, 6) == "logout") {

    String user_name = payload.substring(6);
//_ Serial.println(user_name);


    display.clearDisplay();
    display.setTextSize(2);           // Normal 2:2 pixel scale
    display.setTextColor(WHITE);          // Draw white text
    display.setCursor(10,0);            // Start at top-left corner
    display.print(F("Good Bye"));
```

```arduino
//*******************Get the Fingerprint ID******************
int getFingerprintID() {
  uint8_t p = finger.getImage();
  switch (p) {
    case FINGERPRINT_OK:
      //Serial.println("Image taken");
      break;
    case FINGERPRINT_NOFINGER:
      //Serial.println("No finger detected");
      return 0;
    case FINGERPRINT_PACKETRECIEVEERR:
      //Serial.println("Communication error");
      return -2;
    case FINGERPRINT_IMAGEFAIL:
      //Serial.println("Imaging error");
      return -2;
    default:
      //Serial.println("Unknown error");
```

```
postData = "DeleteID=check"; // Add the Fingerprint ID to the Post array in order to send it
// Post methode

http.begin(client.link); //initiate HTTP request, put your Website URL or Your Computer IP
http.addHeader("Content-Type", "application/x-www-form-urlencoded");    //Specify content-type
header

int httpCode = http.POST(postData);    //Send the request
String payload = http.getString();    //Get the response payload

if (payload.substring(0, 6) == "del-id") {

  int httpCode = http.POST(postData);    //Send the request
  String payload = http.getString();    //Get the response payload


  if (payload.substring(0, 6) == "add-id") {
    String add_id = payload.substring(6);
    Serial.println(add_id);
    id = add_id.toInt();
    getFingerprintEnroll();
  }
  http.end(); //Close connection
}
//******************Enroll a Finpgerprint ID*****************
uint8_t getFingerprintEnroll() {

  int p = -1;
  display.clearDisplay();
  display.drawBitmap( 34, 0, FinPr_scan_bits, FinPr_scan_width, FinPr_scan_height, WHITE);
```

```
    display.print(F("scanning"));
    display.display();
    break;
  case FINGERPRINT_PACKETRECIEVEERR:
    display.clearDisplay();
    display.drawBitmap( 34, 0, FinPr_invalid_bits, FinPr_invalid_width, FinPr_invalid_height, WHITE);
    display.display();
    break;
  case FINGERPRINT_IMAGEFAIL:
    Serial.println("Imaging error");
    break;
  default:
}

display.clearDisplay();
display.setTextSize(2);            // Normal 2:2 pixel scale
display.setTextColor(WHITE);       // Draw white text
display.setCursor(0,0);            // Start at top-left corner
display.print(F("Remove"));
display.setCursor(0,20);
display.print(F("finger"));
display.display();
//Serial.println("Remove finger");
delay(2000);
p = 0;
while (p != FINGERPRINT_NOFINGER) {
  p = finger.getImage();
}
Serial.print("ID "); Serial.println(id);
p = -1;
```

```
display.clearDisplay();
  display.drawBitmap( 34, 0, FinPr_scan_bits, FinPr_scan_width, FinPr_scan_height, WHITE);
  display.display();
  while (p != FINGERPRINT_OK) {
   p = finger.getImage();
   switch (p) {
   case FINGERPRINT_OK:
    //Serial.println("Image taken");
    display.clearDisplay();
    display.drawBitmap( 34, 0, FinPr_valid_bits, FinPr_valid_width, FinPr_valid_height, WHITE);
    display.display();
    break;
   case FINGERPRINT_NOFINGER:
    //Serial.println(".");

}
//******************Check if there a Fingerprint ID to add******************
void confirmAdding(){

WiFiClient client;
  HTTPClient http;   //Declare object of class HTTPClient
  //Post Data
  postData = "confirm_id=" + String(id); // Add the Fingerprint ID to the Post array in order to send it
  // Post methode

  http.begin(client,link); //initiate HTTP request, put your Website URL or Your Computer IP
  http.addHeader("Content-Type", "application/x-www-form-urlencoded");    //Specify content-type header

  int httpCode = http.POST(postData);   //Send the request
  String payload = http.getString();    //Get the response payload
```

```cpp
display.clearDisplay();
display.setTextSize(1.5);            // Normal 1:1 pixel scale
display.setTextColor(WHITE);         // Draw white text
display.setCursor(0,0);              // Start at top-left corner
display.print(payload);
display.display();
delay(1000);
Serial.println(payload);


http.end();  //Close connection
}
//********************connect to the WiFi******************
void connectToWiFi(){
    WiFi.mode(WIFI_OFF);      //Prevents reconnection issue (taking too long to connect)

WiFi.mode(WIFI_STA);
Serial.print("Connecting to ");
Serial.println(ssid);
WiFi.begin(ssid, password);


display.clearDisplay();
display.setTextSize(1);              // Normal 1:1 pixel scale
display.setTextColor(WHITE);         // Draw white text
display.setCursor(0, 0);             // Start at top-left corner
display.print(F("Connecting to \n"));
display.setCursor(0, 50);
display.setTextSize(2);
display.print(ssid);
display.drawBitmap( 73, 10, Wifi_start_bits, Wifi_start_width, Wifi_start_height, WHITE);
display.display();


while (WiFi.status() != WL_CONNECTED) {
```

**Appendix 3: Internship Offer Letter**

**Université Espoir d'Afrique**

*Face aux Réalités d'Afrique*

B.P. 238 Bujumbura, Burundi Tél. +257 22 23 7973 +257 79 987 324
Site Web : www.hopeafricauniversity.org E-mail: info@hopeafricauniversity.org
Agréée sous l'Ordonnance Ministérielle n°610/1379 du 26 Septembre 2003
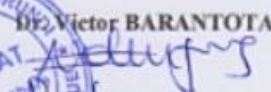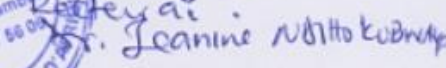
May 21, 2021

Ref. N: HAU/442/2021

To

Mr. Salama Ndayisaba

Master's Student at The Nelson Mandela African Institution

Of Science and Technology (NM-AIST)

    Arusha-Tanzania

Program: Embedded and Mobile Systems

Specialization: Embedded Systems

E-mail: ndayisabas@nm-aist.ac.tz

**Object**: Your request for internship place

Mr. Salama,

Referring to your correspondence of May 1, 2021, which reached us electronically and in which you request the place of internship that you want to do from June 8 up to August 8, 2021;

I have the honor to inform you that I agree.

In wishing you a good reception, please accept, Mr Salama, the expression of my high consideration.

**The Rector of HAU**

Dr. Victor BARANTOTA

« La protection qu'offre la Sagesse est comme celle que procure l'argent, mais la Sagesse a un avantage : elle fait vivre ceux qui la possèdent » (Ecclésiaste 7:12)

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## Appendix 4:   Poster Presentation



**THE ATTENDANCE ALERT BASED BIOMETRIC SYSTEM FOR EMPLOYEES USING FINGERPRINT: A CASE STUDY OF HOPE AFRICA UNIVERSITY**

1.   Salama Ndayisaba     2 . Dr.  Ramadhani Sinde     3. Prof. Anael Sam

### Introduction

Attendance has been used as a key to success in all disciplines worldwide. Most institutions' officers make efforts to monitor the attendance of their employees in their daily activities.

The manual system-based attendance management involves the use of pens and registers and employees are requested to sign at reporting and leaving time However, this system encompasses a lot of disadvantages such time-consuming, hard to access data, masquerades. The commonly used computerized system is fingerprint identification, which is of the most reliable and efficient biometric approaches. Therefore this study aims at developping Attendance Alert Based Biometric System For Employees Using Fingerprints to enhance attendance management.

### Problem Statement

Hope Africa University is a large academic institution with a significant student and staff population. Like many institutions, it currently relies on a manual attendance tracking method using pen and register, which has proven to be time-consuming and challenging in terms of data accessibility, security, and accuracy. To overcome these limitations, the university aims to develop and implement an automated biometric attendance system using fingerprints. This new system is expected to streamline attendance monitoring processes, saving time, and eliminating the issues associated with manual methods, such as data manipulation. The implementation of the automated system is anticipated to improve overall attendance management and efficiency at Hope Africa University.

### Block Diagram



### Results



### Conclusion

The Attendance Alert Based Biometric System for Employees using Fingerprint streamlines employee management, improves productivity, and ensures accurate attendance records. It requires employee registration in the company's database and sends email notifications for on-time sign-ins and justifications for late arrivals. The system minimizes communication issues, enhances data security, and centralizes attendance records. By promoting regular attendance, it is expected to increase overall productivity and efficiency within the organization.