DIGITAL ATTENDANCE CONTROL SYSTEM USING TECHNOLOGY OF BIOMETRIC FINGERPRINT

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for the award of the degree of
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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion, this project is adequate in terms of scope and quality for the award of the degree of Master of Engineering in Department of Information and Communication Engineering of Noakhali Science and Technology University.

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STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. This project report has not been accepted for any degree and is not concurrently submitted for the award of other degrees.

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ABSTRACT

Student's academic performance primarily depends on the attendance and participation of the class. The paper-dependent conventional attendance management for students in institutions is time-consuming and laborious work for the educators. Sometimes students get the opportunity for proxy attendance. Also, Students have no idea about the attendance percentage which is mandatory for attending the semester final examination. The world is turning towards automation for reducing human efforts and is striving to make the process smart and reliable. There are many smart systems to optimize attendance. Each system has some shortcomings and unable to achieve our requirements completely. In this project, a novel system is developed which used the technology of biometric fingerprint to control academic attendance. The device includes a fingerprint collection terminal and attendance control module in a computer website and database, designed as the transmitter and receiver node with the Arduino microcontroller, fingerprint sensor, display, and Wi-Fi unit. This method deals with the control of the student's attendance information. It generates attendance of students based on class presence. It publishes an attendance excel sheet and percentage for every course of the semester. The developed system monitors attendance without allowing students any chance of proxy attendance. The system can be installed at any spot. This system saves time, minimizes the volume of work that educators have to do, and replace the stationery material with a computer system by eliminating the boring old form. Apart from these, we strongly believe that this project makes us more competent for similar future tasks and enhance our technical abilities.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF SYMBOLS

Symbol	Meaning
™	Trade Mark
®	Registered
©	Copyright
Π	Pi

LIST OF ABBREVIATIONS

DACSTBF	Digital Attendance Control System Using Technology Of Biometric Fingerprint
PHP	Hypertext Preprocessor
CSS	Cascading Style Sheet
OS	Operating System
SQL	Structured Query Language
SDLC	Software Development Life Cycle
LSM	Linear Sequential Model
IDE	Integrated Development Environment
PC	Personal Computer
GUI	Graphical User Interface
ER	Entity Relationship
CCD	Charge Coupled Device
API	Application Programming Interface
OLED	Organic Light Emitting Diodes
IDE	Integrated Development Environment
SDLC	Software Development Life Cycle
FAR	False Accept Rate
FRR	False Reject Rate
DBMS	Database Management System

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

As the world is growing with advanced technology, the way of recording student's attendance is getting more practical. Many new technologies have been introduced to make documenting attendance quicker and easier. The biometric attendance system is one of them. Attendance in many universities and research institutions is a very significant criterion that is used for different purposes. These objectives include the record-keeping of student assessments and continuous class attendance. The developed system considers as an alternative to the traditional one, it is easy, fast and reliable than the traditional one, especially after the development of information technology and its usage by educational institutions. The design of the Digital Attendance Control System using the Technology of Biometric Fingerprint has a significant reality meaning. The system is a Website based application developed for regular student attendance in departments within the university. It facilitates the control attendance of a student in a class. The system is not only improving the work efficiency, students' study and development, but also can save human and material resources.

1.2 PROPOSED SYSTEM

There are two parts of the proposed scheme, one portable biometric unit, and a Wi-Fi-connected host computer. A hand-held computer that can be taken to the classroom is a biometric fingerprint device. A host machine graphical user interface program allows the teachers to control the system. It may achieve results such as taking attendance, class declaration, database management, and participation sheets for exporting. Teachers will

take the tool to the classroom after taking the student list to the unit. From a menu, a teacher can approve and choose the session and course code. In the first lesson, by choosing the roll number and putting their finger, students have to record their fingerprint image. They will mark their attendance from the second class onwards. After a class hour, a teacher can export the attendance and it can be linked to the computer. It is possible to update the attendance information using the GUI program. Any form of school, college, organization, or company organization where computers with a functioning internet connection are available may include more applications of this method.

1.3 MOTIVATION OF THE STUDY

Schools and Universities continue to use attendance records for student attendance control. During the lecture time, the teacher has to call out names. An excessive number of students from the important lecture time allows a large amount of time to be wasted. To save this time, by signing on a paper which is passed to the class during the lecture time, some teachers adopt the method of assessing students. There is a risk here of cheating by placing the signature of an absent person on the classmates. The creation of a new system is inspired by these problems.

For marking the attendance of their workers, many companies use a fingerprint attendance scheme. They are network-connected devices in which the employee database is stored on a computer and fixed at a particular location. But the classroom scenario is different. To mark attendance in a classroom, students cannot come near the unit. According to the flourishing development of world education, higher education has become mass higher. The student attendance check is one of the complicated works. Attendance check system based on fingerprint sensor is in successful use in different places now. Because the classroom for students changes according to the courses in the institution, so the best method is designing small terminal equipment. Then the teachers can easily take it to the classroom where their students have the course and examination.

1.4 PROBLEM STATEMENT

All is digitalized in today's world and paper is used less and less every day. In a university environment where the teacher calls out the name of each student and marks

the presence causes wasted time during lecture sessions, the traditional attendance system followed. In the present case, where the number of students in a class is very high, this becomes more and more serious. It's also very tough to control the attendance data of such a big community. The ability of the learner to mark fake attendance is another drawback of the conventional system. Lecture time is limited, if the educator spends most of the lecture time to evaluate the attendance then the student gets less time for their lesson. Some educator uses printed attendance sheet to collect the student's signature to evaluate the attendance. But the student used it as a way of fake attendance. When the number of students is large then the work becomes more difficult to do. We can't escape this attendance management process because it is the main criteria to evaluate the ability of a student. Attendance plays an important role in every institution and organization.

In professional situations, fingerprint based systems are being used. So, a fingerprint-based system can be the ultimate solution to the present problems. To store and check fingerprints, these systems use a computer. It can be ported to the education area with improvements.

1.5 OBJECTIVES

From the previous description, we can say that we need a novel system that can overcome all the drawbacks of the present system. This project is to create and develop a user-friendly attendance monitoring system using feedback from fingerprints that can track the attendance of the student in a more proper and structured way. This project's key contributions are:

i. We have built an Attendance System Website that controlled the entire process and generates the trusted result.
ii. Biometric Fingerprint Technology has been used to authenticate the user, so there is no way to fake attendance.
iii. Arduino based microcontroller has managed the sensors for that the module is very fast, handy and can manage a large number of users.
iv. The database has ensured data safety and proper management with the Archive system.

v. Allocate various levels of users and have proper authentication
vi. User-friendly interface anyone can operate easily.

1.6 CONCLUSION

There are many proposed and implemented methods that can be used for controlling the attendance system. But we need a specific way that can fulfill our all kinds of institution need and remove all the drawback of the present problems. So, we need a noble attendance control system. For many kinds of gadgets related to this field, we need a perfect one that is low-cost, fast, easy to maintain, and simply done our all work. For that, we choose this project that is microcontroller and biometric-based. Fingerprint sensors are low-cost compare to all other biometric devices. It is portable and can be maintained with a computer. Here we used a microcontroller that is Arduino based and easy to code and run. The used sensor is so first that it can scat a finger within 0.3 sec. and can recognize a saved data within 0.2 sec. This total project produces a report which is 98% correct. This project is a low power consuming and handheld. We can show the present percentage at any time, individually for a class or all of the class and semester. It produced an excel sheet as output that contains the Name, Roll, Registration, Date, Time, Course Code, Session, Number of class, and Percentage of Attendance.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The identification system in which the identity of individuals is determined based on their genetic features provided by the person is a biometric system. In several sectors, such as the financial and government sectors, biometric authentication is now commonly used. Inputs such as fingerprints, iris, ears, the geometry of the palm, and voice are called identification of biometrics. The fingerprint is commonly used by all biometrics in access control systems because the algorithm for the processing of fingerprint data is not difficult, the price is cheaper than that of other biometric technology, and it is also easy to recognize the input data. Recognition of fingerprints works by distinguishing individuals using their physical structure via the impression created by the patterns of the minutiae ridge found on each individual's fingertips. The picture at the hands of an individual is given by this finger pattern, which then records the characteristics.

2.2 THE MANUAL ATTENDANCE SYSTEM

All work is performed on paper in the present method. The entire attendance of the session is stored in a register and reports are produced at the end of the semester and it takes more time to measure. By the way, at the end of the semester we are not interested in creating the study, but during the semester for the student to take notice of his case, and the department to know what action to take even before the exam on students with low attendance. So, because of having a very time-consuming process, we are unable to get student regularity report and take required action on students whenever we want.

2.3 LIMITATION OF THE PREVIOUS WORK

Bad rates of university absenteeism have poor academic student accomplishments. This can lead to a more serious issue, such as social issues. Faking the signature of others has become a trend among university students to boost their records of attendance. Through using attendance management records using sheet papers, the actual attendance record used by most universities is rather repetitive.

Not User Friendly: Since data storage is very slow and data is not stored effectively, the current system is not user friendly.

Difficulty in report generating: To produce the report, we need further estimates so that it is produced only at end of the course. And the learner doesn't have a single chance to boost their attendance.

Manual control: All calculations are performed manually to produce reports, so there is a greater risk of errors.

Lots of paperwork: A bunch of documentation is required for the current scheme. The loss of even a single register/record led to a difficult situation because to produce the reports, all the papers are needed.

Time consuming: Every job is performed manually, so at the end of the lesson we need a lot of time to produce a study, and it takes a lot of time.

There are two types of attendance systems are used in our educational institutes one is the traditional paper method and another is the technology based attendance system. There have been so many suggestions to improve the student's enrollment process in educational institutions. However, each method has pros-and-cons, we have not yet found the ultimate solution. There is a reasonable need for a well-designed attendance monitoring system to effectively manage the records of their presence, especially in the case of a large number of students in the class. Therefore, many systems to optimize the student's attendance management so far have been proposed. Most of them are digital systems and also there is some analog system. Some systems are so high technology based that is impossible to implement in our country now. Here are some existing system and their Limitations shows in Table 2.1

Table 2.1: Table for the Existing System and There Limitations

S.I. No.	Author	Title	Year	Name of the Journal	Method/ Process	Limitations
01	Lixiu MA, Jinfeng PAN, Lijun CAO, Jin SHEN	The Design of Wireless Students Management System based on Fingerprint Sensor.	2010	*COMPUTER SOCIETY IEEE*	Fingerprint Sensor FPS200 and wireless communicatio n module nRF903.	These systems have disadvantages such as uneasy for taking data, saving only a little data.
02	Shota Noguchi, Michitoshi Niibori, Erjing Zhou, Masaru Kamada	Student Attendance Management System with Bluetooth Low Energy Beacon and Android Devices.	2012	*CPS IEEE*	Scanning student ID cards over their Android Devices and use BLE Beacon.	Incorporating this system with an existing learning Management system.
03	Tsai-Cheng Li, Huan-Wen Wu, Tiz-Shiang Wu	The study of Biometrics Technology Applied in Attendance Management System.	2012	*CPS IEEE*	Hand geometry capturing into the attendance management system.	Hygiene issues are the largest difficulty encountered in introducing technology.
04	Jun Iio	Attendance Management System using a Mobile Device and a Web Application.	2016	*Network-Based Information Systems IEEE*	A novel framework for attendance management is proposed, which consists of a mobile device and a web application.	According to the result of the trial experiment, there is no increase in the feedback comments.
05	Joke A. Badejo, Chinonso C. Eke, Segun I. Popoola, Tiwalade O. Odu, Aderemi A. Atayero.	Integrating Automated Fingerprint-based Attendance into a University Portal System.	2017	*CSCI IEEE*	An integrated portal system was developed to automate attendance management.	This project will be to test this system on large scale across multiple lecturers, students, courses and locations.

06	Lia Kamelia, Wahyudin Darmalaksana, Eki Ahmad Dzaki Hamidi, Afit Nugraha.	Real-time Online Attendance System Based On Fingerprint and GPS in the Smartphone	2018	*ICWT IEEE*	The ZFM-20 fingerprint module is used as the system's main GPS module is applied to determine the user's location and sends it to the smartphone.	All of these component modules operate according to the initial scenario.
07	Mohamed Basheer K P, Raghu C V	Fingerprint Attendance System for classroom needs	2012	*3INDICON IEEE*	One portable device and a host computer.	The current fingerprint module uses a unique protocol and hence cannot be replaced with similar modules from different companies.
08	Zhang Yongqiang, LIU Ji	The Design of Wireless Fingerprint Attendance System	2006	*ICCT IEEE*	A wireless fingerprint attendance management system is designed and implemented.	Bad quality transmission Channel.
09	Fahad-Bin-Mazhar, Oli Ahamed, Md.Raseduj jaman	Biometric Smart Attendance Kit with Fingerprint Scanner by Using Microcontroller	2015	*ICEEE IEEE*	The register based conventional attendance system for the students.	The student can have information regarding his/her personal information, course grades, CGPA etc.
10	LI Jian-po, ZHU Xu-Ning, LI Xue, ZHANG Zhi-ming, Ji-sheng SUI	Wireless Fingerprint Attendance System Based on ZigBee Technology	2010	*IWISA IEEE*	A design method of wireless fingerprint attendance system based on ZigBee technology	Low-rate and short-distance characteristic of ZigBee technology
11	Nur Izzati Zainal, Khairul	Design and Development of Portable	2014	*ICT4M IEEE*	A biometric fingerprint based system	Battery life indicator and additional

	Azami Sidek, Teddy Surya Gunawan, Hasmah Mansor, and Mira Kartiwi	Classroom Attendance System Based on Arduino and Fingerprint Biometric			is encrypted which preserves data integrity.	security enhancement and backup system.
12	Hitesh Walia, Neelu Jain	Fingerprint Based Attendance Systems-A Review	2016	*IRJET*	GSM and ZigBee	Complex software system architecture.
13	Rasika Naik, Maumita Mal, Shweta Koli, Aakash Karnani, Bhavesh Chetwani	Smart Attendance Management System (SAMS)	2016	*JETIR*	RFID Technology	For time and date, you have to process the data.
14	Monica. C, Nithya. R, Prarthana.M , Sonika. S.V, Dr.M.Rama krishna	Attendance Management System	2017	*IRJCS*	SMS Broadcasting Technology	Time consuming then RFID Technology.
15	K.Jaikumar, M.Santhosh Kumar, S.Rajkumar, A.Sakthivel	Fingerprint Based Student Attendance System With SMS Alert To Parents	2015	*IJRET*	Fingerprint based student attendance with help of GSM	The authentication can also be made more secure by using human odor for Security purposes.

2.4 CONCLUSION

From this Literature study, we can say that there are a large number of Digital Attendance System developed previously. Some of them are wired, IoT, GSM, and ZigBee based but we need a novel one that can use the latest technology, fulfill our all needs, and easy to use in the classroom environment. For that, we used Computer Website, Arduino Microcontroller, Sensor, Display, Biometric, and Wi-Fi Technology.

CHAPTER 3

SYSTEM DESIGN & EXPERIMENTATION

3.1 INTRODUCTION

The system is designed with the help of standard System Architecture that describes software and electronics system in terms of their hardware and software components and their interactions. The Incremental model has been deemed the best suited for the Software Development Life Cycle (SDLC) process and shall be followed. Using this model will have the benefit over the Linear Sequential Model (LSM) in the sense that it will inherit the quality of the LSM but exclude the rigidity. Furthermore, the feedback process of the Process Iteration model will also be available in the incremental model. Another contributing factor in choosing this model is the short time available to make a working initial version of the system. Figure 3.1 shows the Incremental Process Model.

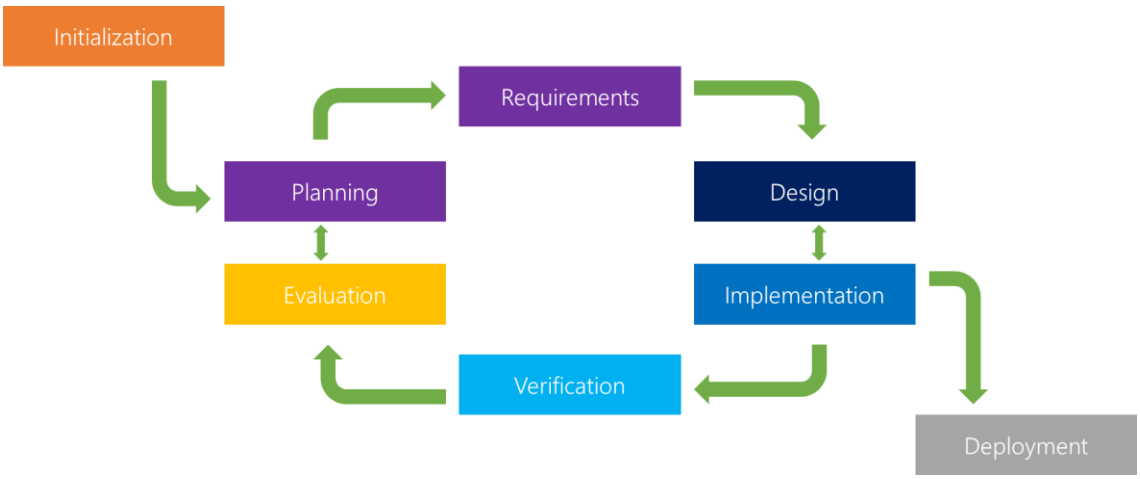


Figure 3.1: Incremental Process Model

3.2 DESIGN

The proposed method utilizes an automated technique for taking attendance that incorporates fingerprint authentication into the attendance project plan. It consists of two processes: registration and authentication. The individual's biometrics are captured during enrollment and stored in a flash memory along with the ID of the person. The enrollment device aims to enroll the user after feature extraction using his/her id and fingerprints in a memory card. The user's biometrics are collected during authentication and are matched to all those that already exist in the flash memory to determine a match. If a match is found, then participation is marked against the ID of the person. The flash memory contains the individual's fingerprint template and other data.

3.2.1 General Block Diagram

The fingerprints are gathered from various users by the fingerprint module. For example, we are taking the samples of three or four fingerprints and they are enhanced using several image enhancements. After that, the edges along the image are identified using the edge detection function. For finding the edges, we use the predefined operator here. We use an algorithm based on Gabor Filters to match fingerprint images. We used the Fingerprint Module instead of performing all these image processing tasks (R307). The circuit is turned to ON and all configuration procedures are performed. You must display the "Welcome" greeting in the OLED Display. No fingerprints should be kept for scanning until that person. The "Fingerprint Icon" will be shown on the screen after that. The fingerprint to be tested is already registered in the fingerprint module's storage. The fingerprint module can store about 120 images in the built-in memory. The fingerprints are now kept within a stipulated period for scanning. The fingerprint module has started comparing the results and provides the microcontroller with the hex codes for further operations. The microcontroller begins sending the data to a web-based fingerprint module.

But the microcontroller only has one pin in it for the transmitter. We have to deal with both the fingerprint module and the machine at a time. For that, to switch between the device and the fingerprint module, we use Relay. Commands for holding and comparing fingerprints are also available. The person whose enrollment is matched by

the fingerprint is recorded. If an unidentified user's fingerprint is retained for scanning, then the scanning will not take place. If the fingerprint of an unknown individual is retained, then the message "Not Identified" is shown. Fingerprints are one of the largest identification schemes that cannot be forged very quickly by students. By extending the time, this can be practically applied and the attendance of students can be controlled. Figure 3.2 shows the General Block Diagram

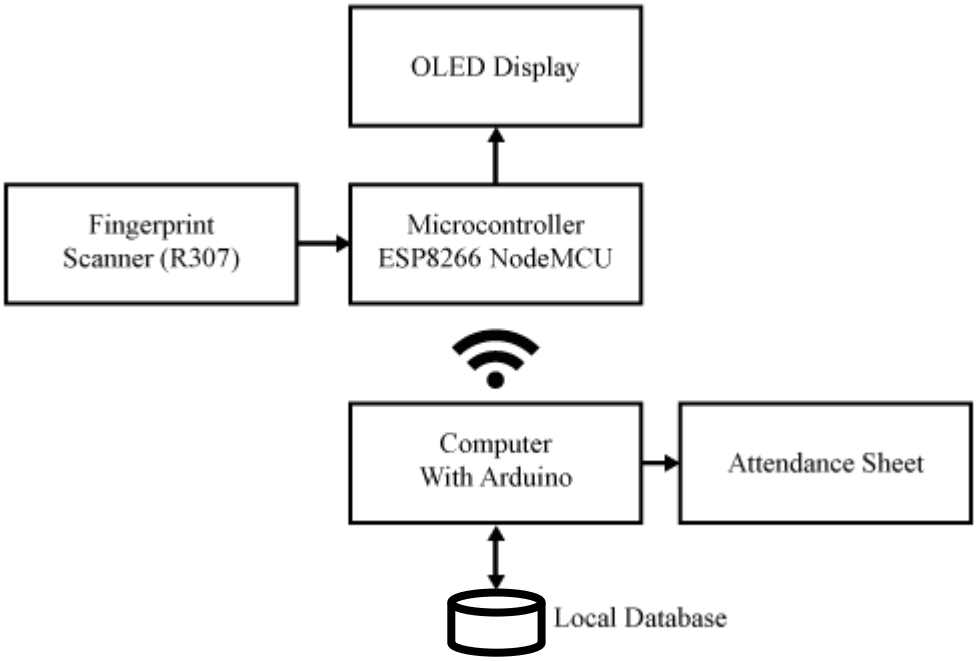


Figure 3.2: General Block Diagram

3.2.2 Working Flow Diagram

Fingerprint recognition is used by the recommended attendance monitoring system. The system can recognize a person in the identification process by matching his/her biometrics with each record in the database. Biometric recognition usually consists of three steps.

i. Enrolment
ii. Authentication and
iii. Identification

The user's biometric data (using a fingerprint reader that is likely to be an optical, solid-state, or ultrasonic sensor or other appropriate devices) are collected during enrollment and the specific features are extracted and stored as a prototype for the subject along with the student ID in a database. After extracting features, the goal of the enrollment system is to add a student to a database using his/her ID and fingerprints. These characteristics form a prototype that is used to establish the student's identity, formulating the authentication procedure. An operator in the attendance tracking system performs the enrollment process. Here figure 3.3 shows the Flow Diagram of the working system

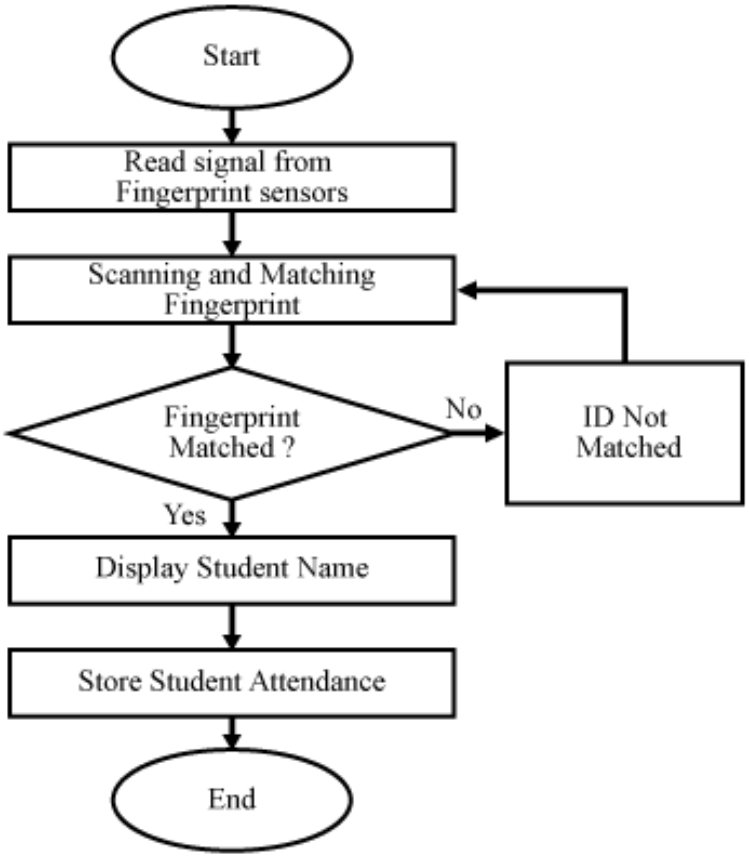


Figure 3.3: Flow Diagram

3.2.3 Circuit Diagram

To connect the hardware that is the Microprocessor, Fingerprint Sensor and the OLED Display, we create a Circuit Diagram. To connect the system readily, we are using a breadboard and jumper wire. For the power source, we use a USB cable. This diagram

representing the electric circuit that is a schematic diagram of the system and its elements using specifically chosen symbols. The Fingerprint Sensor has four +5V, GND, RX, and TX links. There are the seventies to the OLED display, which are GND, VDD, SCK, SDA, RES, DC and CS. Figure 3.4 shows the Circuit Diagram

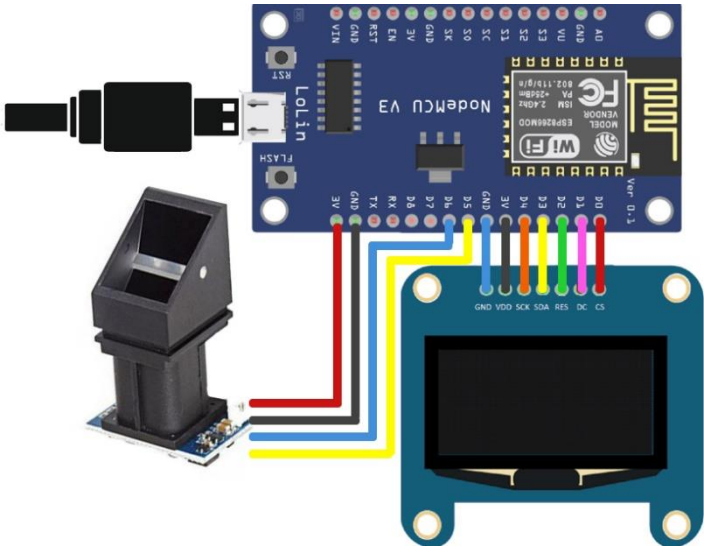


Figure 3.4: Circuit Diagram

3.2.3 Hardware

The current system takes time and makes it impossible to communicate almost immediately to many users about any case, lecture, or seminar. The biometric method is a tool of physiological biometric features to identify a person. Biometric details, such as odor, fingerprints, iris, retinal, voice and face geometry [8], are distinct and special. To get personal information, biometric models cannot be duplicated. Today, the essential biometric characteristics of the human, fingerprint, or iris are some of the unique and advanced methods to identify a specific person. The fingerprint scanner is the best discovery in science and bioelectronics. Ten fingers have ten fingerprints in our hands that are distinct from each other. Fingerprints play a large role in advanced biometric technology of their uniqueness.

A fingerprint sensor gets from the fingertip a picture of the marks and crosses it with the previously saved image. On the top of the finger, a fingermark is made of a

sequence of 'ridges' and 'valleys.' It contrasts these 'ridge' and 'valley' trends. Then access is provided if the two patterns match.

The scanner for fingerprints is predominantly optical. It has a camera, a charge-coupled system (CCD). By emitting from the ridges, the CCD takes the picture of the fingertips and produces an inverted image. Some unique areas of fingerprints called' minutiae' are compared by the scanner. Any collection of minutiae to verify and examine are stored by the scanner. So with this information available, it is nearly hard to replicate a fingerprint image. Fingerprint scanners are techniques that are more reliable than any other authentication or identification tool. An authentication process with a fingerprint scanner was suggested by the authors. But the procedure is a little intricate. By making our system easier, we've tried to solve uncertainty. The authors have also mentioned the fingerprint scanner as a further attendance method. But here, to update the database, the data move to a computer. But the database is automatically modified in our system and written on a memory module [9].

The components used in the proposed system are as follows:

3.2.3.1 Microcontroller ESP8266 NodeMCU

ESP8266 NodeMCU is an open source development device that combines GPIO, PWM, I2C and ADC all into one board, based on the ESP8266-12E chip and NodeMCU firmware. There are 10 GPIOs, and each GPIO can be PWM. It has Arduino like IO hardware, which can effectively decrease the extravagant hardware setup and manipulation function. It helps to prototype an IoT device effectively due to its low cost, compact nature, and wireless connectivity. By using the Lua script, NodeMCU can be programmed. NodeMCU firmware software with Lua script has some drawbacks, such as the need to learn a new language, decreased pinout, and minimal information. Since the board has Arduino like hardware IO, it can be configured directly by deleting NodeMCU firmware using Arduino IDE. Arduino IDE is more familiar and has an extensive community of information and resources. A versatile 32-bit microcontroller with embedded Wi-Fi and a complete internet access TCP/IP stack, the ESP8266. Ten L106 Diamond series 32-bit silica processors and SRAM on-chip processors. Figure 3.5 shows the Microcontroller ESP8266 NodeMCU

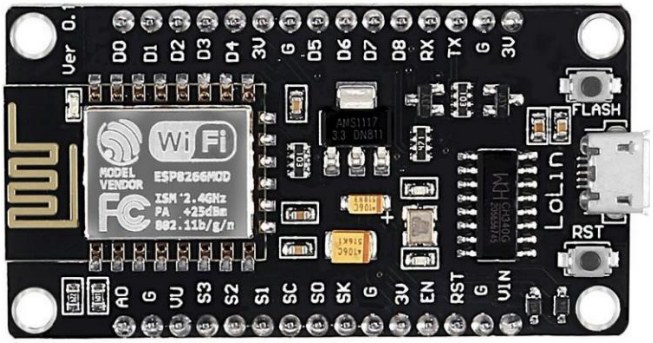


Figure 3.5: Microcontroller ESP8266 NodeMCU

3.2.3.2 Bread Board

A breadboard is a building foundation for electronics development and testing. It was a breadboard, a flat piece of wood used for bread slicing. The solder-less breadboard became popular in the 1970s and today the word "breadboard" is often used to refer to it. "Breadboard" is also a "prototype" synonym. Since the solderless breadboard needs no soldering, it is reusable. For making temporary prototypes and playing with circuit design, this makes it simple to use. For this purpose, for students and in technical education, solder-less breadboards are also extremely common. It is quick to use a breadboard and we can link the wires as we want to. In the primary phases, a breadboard is normally used for creating a module. In the realistic world, if we use this module, then we must use soldering and the proper structure. Figure 3.6 shows the Breadboard.

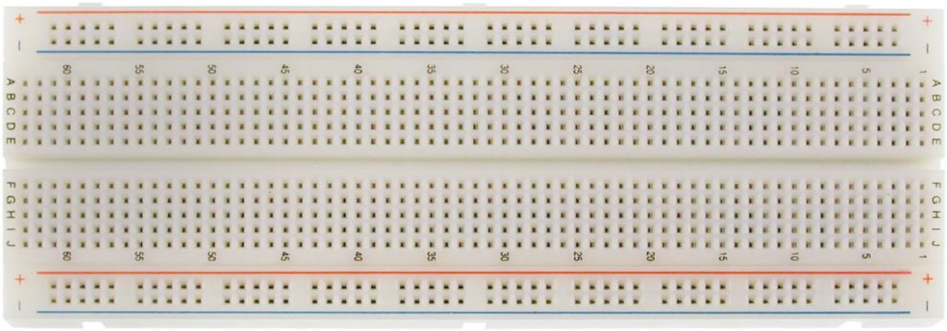


Figure 3.6: Breadboard

3.2.3.3 Connecting Wires

The wires are used to connect the Arduino and Arduino fingerprint scanners to the breadboard. The power is transmitted to the system only via these circuit components, and concurrent operations are carried out.

3.2.3.4 Optical Fingerprint Sensor (R307A)

This is a TTL UART device fingerprint reader device for direct connections to the UART or PC microcontroller through the MAX232 / USB-Serial adapter. The server store the biometric data in the device and can enable it to identify the person in a 1:1 or 1: N mode. The FP module can communicate directly with a 3v or 5v microcontroller. To interface with a PC USB monitor, a standard converter (like MAX232) is required. There are strong features of the optical biometric fingerprint reader that can be integrated into some end items, such as access control, attendance, safety deposit box, car door locks. Figure 3.7 shows the Optical Fingerprint Sensor (R307A)

Figure 3.7: Optical Fingerprint Sensor (R307A)

3.2.3.5 OLED Display

The term OLED refers to "Organic Light-emitting diode," using the same system which is used in most of our TVs, but similar to them, it has fewer pixels. It's very fun to

connect these cool-looking screen devices with the microprocessors, as it will make our prototypes look cool. Figure 3.8 shows the OLED Display

Figure 3.8: OLED Display

3.2.4 Software

We used many forms of software in the software segment to monitor hardwires. We write code in Sublime Text to design and build the website, which is a cross-platform shareware code editor is used with a scripting language for the Python framework. Run the site on a web browser that uses xampp, the local database program, to build a database. We used the Arduino software for the microcontroller and uploaded the code to NodeMCU, which has an integrated Wi-Fi facility.

3.2.4.1 Software Process

The project is web-based. For web-based coding, we used PHP for back-end programming, for a database storing MySQL. Another side, for design purposes, we use HTML, CSS, Bootstrap and JQuery.

a. Determining the database's function - This helps to plan for the following phase
b. Find and arrange the necessary information - Collect all sets of data to be registered in the database, such as the name of the service and request number.
c. Divide the data into tables - Divide the data, such as goods or orders, into major bodies or topics. Each topic becomes a table then.
d. Turn items of information through columns - Determine what information is needed for each table to be processed. Each object is translated into a field and

depicted as a table column. For example, fields as the last name and hire date may be included in a student table.

e. Define primary keys - Select the primary key for every table. The unique primary key is called or a column collection is used to select each row individually. Student ID may be an example.
f. Established the relationships of the table - Look for each table to determine how to link data in a table to the data in other tables. If required, add fields to tables or generate new tables to explain the relations.
g. Optimize the design - For defects, evaluate the design. Build tables and add a few of the sample data records. As planned, check if the results come from the tables. Make modifications, as needed, to the design.
h. Apply normalization rules - Apply rules for data normalization and see whether tables are correctly organized. Give the tables changes.

3.2.4.2 Design Approach

A design methodology is a general theory and it may not even involve particular techniques as a reference. Some are intended to direct the overall purpose of the design. Other techniques are to direct the designer's preferences. If they don't clash, a mixture of methods can be used.

3.2.4.3 Function Oriented Design Approach

The function-oriented design concept divides a structure into components and modules, each of which performs one or more operations. Compare with object-oriented architecture, data-structure-oriented architecture.

This framework project uses a design concept that is function-oriented. Based on their features, each module and sub-modules are generated. Such modules are individually developed and constructed and then combined to shape the application.

3.2.4.4 Database Design

The method of creating a comprehensive object model of a database is the design of the database. This logical design includes all the logical style choices and information storage parameters required in a data description language to produce a design.

You may use the phrase database design to define several different aspects of an overall database system's architecture. It can be conceived of as the conceptual design of the core data structures used to secure the information, mainly and most accurately. These are the tables and perspectives in the relational data model. The entities and relationships in an entity database map explicitly to object classes and defined relationships. However, the term database design refers not only to the base database structures, but also the sub-category and queries used in overall database implementation within the database management system to the overall design phase (DBMS).

The process of doing database design generally consists of several steps which will be carried out by the database designer. Usually, the designer must:

i. Determine the relationships between the different data elements.
ii. Superimpose a logical structure upon the data based on these relationships.

3.2.4.5 Normalization

Normalization is an approach of arranging the information in a database to prevent data duplication, an exception of addition, an exception of update & an exception of deletion. Database normalization is an approach for the development of a data structure by which an existing schema is updated to eliminate data redundancy and dependence. Normalization is a comprehensive way to ensure that a database layout is appropriate for general querying and it also free of addition, modification, and deletion anomalies of any unwanted features that could contribute to losing data.

A basic piece of advice for database design is that a completely normalized design should be produced by the designer; specific demoralization can consequently be done, but for performance purposes only. However, non-normalized designs, i.e. designs that free to 3NF in a great portion, are specifically suggested by some modeling disciplines, such as the methodological approach to data system development.

3.2.4.6 Arduino

Arduino is an organization, user community of open-source computer software and hardware that designs and produces modules for building digital devices and interactive items that can feel and monitor the material reality. Arduino boards are two types, you can be bought pre-assembled or assembled by yourself; documentation on the hardware design is available at the same time for those who want to assemble an Arduino from start. The current work is focused on a family of micro-controller board designs produced primarily in Italy by Smart-projects, as well as by several other suppliers, using various 8-bit Atmel AVR or 32-bit Atmel ARM processors. Such devices include digital and analog I/O pin sets that can be attached to different extension boards and other circuits. For burn project code from our personal computers to the hardware, the boards have serial communications connection lines, like USB on some models. The Arduino platform offers an integrated framework for programming, micro-controllers, and the Arduino platform provides an integrated development environment (IDE).

3.2.4.7 Internet of Things

Internet of Things is a circumstance in which physical objects are supplied to objects, environment, or humans and the ability to transfer information over a network by needing contact between humans and humans or between humans and computers [10]. IoT focuses on increased contact between two machines (M2M) and includes interactive multimedia sensors and actuators that help users remotely and efficiently track and control devices [11]. The incorporation of electronics into everyday physical objects would lead to this breakthrough, enabling us to integrate seamlessly with the current infrastructure.

3.2.4.8 Languages, Tools and Technologies

The vocabulary, tools, and techniques we use in our project are presented here. The basic markup language for Web page creation is HTML.

i. HTML stands for HyperText Markup Language;

ii. Using markup, HTML defines the layout of Web pages;
iii. HTML elements are the building blocks of HTML pages;
iv. HTML elements are represented by tags;
v. HTML tags label pieces of content such as "heading", "paragraph", "table", and so on;
vi. Browsers do not display the HTML tags but use them to render the content of the page [12].

CSS stands for Cascading Style Sheets;

i. CSS describes how HTML elements are to be displayed on a screen, paper, or in other media;
ii. CSS saves a lot of work. It can control the layout of multiple web pages all at once;
iii. External style sheets are stored in CSS files [13].

Java Script is an object-oriented, cross-platform scripting language used to render webpages responsive (e.x. having complex animations, clickable buttons, popup menus, etc.). There are more specialized JavaScript server-side versions, such as Node.Js, that allow you to add more features to a website than just downloading files (such as real-time collaboration between multiple computers). JavaScript can be linked to the objects of its context within a host environment (for example, a web browser) to provide programmatic control over them [14].

PHP is a language for server scripting and a useful tool for creating highly dynamic Web pages. For rivals such as Microsoft's ASP, PHP is a commonly used, open, and powerful replacement. The PHP frame was first used by Rasmus Lerdorf in 1994, is now developed by The PHP Community.

For storing and controlling databases, SQL is a common language. It stands for Language of Organized Query. SQL provides access to databases and manipulates them. In 1986, SQL has become an American National Standards Institute (ANSI) standard, and in 1987, the International Organization for Standardization (ISO) [15].

3.2.4.9 Coding Standards of Language Used

Coding Standards of Java are used in the whole project. This standard includes the following:

1. No wildcard imports.
2. Consecutively, overloads occur
3. And when the body is empty or contains a single sentence, braces are used.
4. Two space indentation
5. The column limit can be 75 to 100 characters.
6. No C-style array declarations.
7. Default statements are required in switch statements.
8. Constants use CONSTANT CASE. Note that every constant is a static final field, but not all static final fields are constants.
9. The class name should start with an uppercase letter.
10. The function name should start with a lowercase letter.

3.3 BIOMETRIC

A biometric identification device is provided that includes a double input reader, inputs consist of a user's existing physiological data on a smart card chip, and a fingerprint scan to compare the stored data with it. The device is self-contained so that the biometric data is matched instantly onboard the reader with the stored data on the chip without depending on interactions to or from an external source to authenticate the person. The invention often precludes contact with external sources to prevent user data from being stolen or manipulated before confirmation of user authentication [16]. Biometric methods introduced are:

1. Fingerprint recognition
2. Face recognition
3. Signature dynamics
4. Palm or hand geometry
5. Typing rhythm
6. Voice recognition
7. Eye Scans.

a. The universality of face recognition and eye scans is high and low for signature dynamics but medium for fingerprint recognition and palm or hand geometry.
b. Uniqueness for face recognition, voice recognition and signature dynamics is low, medium for palm or hand geometry but high for fingerprint recognition.
c. Performance of face recognition, voice recognition and signature dynamics is low, medium for palm or hand geometry but high for fingerprint recognition and eye scans.
d. Acceptability of face recognition, voice recognition and signature dynamics is high, medium for fingerprint recognition and palm or hand geometry but low for eye scans.

3.3.1 Fingerprints as a Biometric

A fingerprint mostly on top of the finger is made of multiple ridges and valleys. Ridges are the sections of the outer skin surface of the finger and the lower sections are valleys. So-called minute points are formed by the ridges: ridge endings (in which a ridge ends) and ridge bifurcations (where a ridge splits in two). There are several types of minutiae, including dots (very tiny ridges), islands (crests slightly longer than dots, holding a middle space between two temporarily divergent ridges), ponds or lakes (empty spaces among two temporarily divergent ridges), spurs (a notch protruding from a ridge), bridges (small ridges connecting two longer adjacent ridges), and cross-sections (two ridges which cross each other). A fingerprint's characteristics can be determined by the pattern of ridges and valleys as well as the points of intricacies. As shown in Figure 3.9, there are five simple fingerprint patterns: arch, tense arch, left loop, right loop and whorl. Loops make up 60% of all fingerprints, whorls account for 30%, and 10% for arches. Typically, fingerprints are considered distinctive, with no two fingers having the same dermal ridge features. Over other biometrics, fingerprints have some benefits, such as the following:

1. High Universality: a large majority of the human population has legible fingerprints and therefore be easily authenticated. This exceeds the extent of the population who possess passports, ID cards or any other form of tokens.

2. Easy to collect: the process of collecting fingerprints has become very easy with the advent of online sensors. These sensors are capable of capturing high-resolution images of the finger surface within a matter of seconds [17]. This process requires minimal or no user training. In contrast, other accurate modalities like iris recognition require a considerable learning curve in using the identification system.

3. High Performance: fingerprints remain one of the most accurate biometric modalities available to date with jointly optimal FAR (false accept rate) and FRR (false reject rate). Forensic systems are currently capable of achieving FAR of less than 5% [18]. 4. High Permanence: the ridge patterns on the surface of the finger is formed in the womb and remain invariant until death except in the case of severe burns or deep physical injuries.

5. High distinctiveness: even identical twins who share the same DNA have been shown to have different fingerprints since the ridge structure on the finger is not encoded in the genes of an individual. Thus, fingerprints represent a stronger authentication mechanism than other types of biometrics. Some mathematical models justify the high distinctiveness of fingerprint patterns.

Other benefits of using fingerprints provide general recognition and reliability by the public. With a fingerprint identification system, it requires little time and effort to obtain one's fingerprint, and thus fingerprint recognition is considered among the least invasive of all biometric authentication techniques. Thousands of years ago, ancient authorities used thumbprints to sign records, and since the late 1800s, government agencies have been using fingerprint recognition. Fingerprints have been used so widely and for so long, the belief that no two fingerprints are identical, i.e. have the same dermal ridge features, is confirmed by a vast accumulation of scientific evidence. Figure 3.9 shows the five types of fingerprints.

(a) (b) (c) (d) (e)

Figure 3.9: Fingerprint Classes: (a) Tended Arch (b) Arch (c) Right Loop (d) Left Loop (e) Whorls

3.3.2 Fingerprint Scanner

Everybody has markings on their fingers in this world. These symbols have a pattern and the pattern is called that fingerprint. They have become the perfect means of biometric authentication because they are unique and cannot be removed or modified. A fingerprint scanner takes an image of the user's fingerprint. It's called a live scan for this captured image. To create a biometric prototype (a list of some extracted features) which is stored and used for matching [19], the live scan is processed digitally. Fingerprint recognition of people is performed based on both hardware and software techniques.

3.3.3 Fingerprint Processing

Fingerprint processing has three primary functions: enrolment, searching and verification. Out of these, enrolment plays an important role. It involves capturing an image of the user’s fingerprint. Searching involves sifting through a set of stored fingerprints and comparing them with the input fingerprint. Verification involves acknowledging a match between the input fingerprint and one already present in the stored fingerprints.

3.4 ALGORITHM

Here we use the Fingerprint feature extraction using the Gabor filters Algorithm. A Gabor filter-based method for directly extracting fingerprint features from grey-level images without pre-processing is introduced. The proposed method is more efficient and suitable than conventional methods for a small-scale fingerprint recognition system. Experimental results show that the recognition rate of the k-nearest neighbor classifier using the proposed Gabor filter-based features is 97.2%. The block diagram shown in Figure 3.10 demonstrates the two-stage processing (shown within the dotted box). For fingerprint image enhancement and efficient Gabor Filters based method is adopted [20]. Also, thinning is performed for the binary image [21]. To refine the ridges three stages of Morphological filtering are performed. Most methods for fingerprint identification use minutiae as fingerprint features. The main steps for minutiae extraction are smoothing, local ridge orientation estimation, ridge extraction, thinning, and minutia detection. For a

small-scale fingerprint recognition system, however, it would not be efficient to process all the steps and the recognition result will be heavily dependent on the accuracy of each step. Gabor filter-based features have been successfully and widely applied to texture segmentation, face recognition, handwriting recognition and fingerprint enhancement. This is because the characteristics of the Gabor filter, especially the frequency and orientation representations, are similar to those of the human visual system. The process of image orientation, enhancement, core detection, and process of finding the region of interest are as given below.

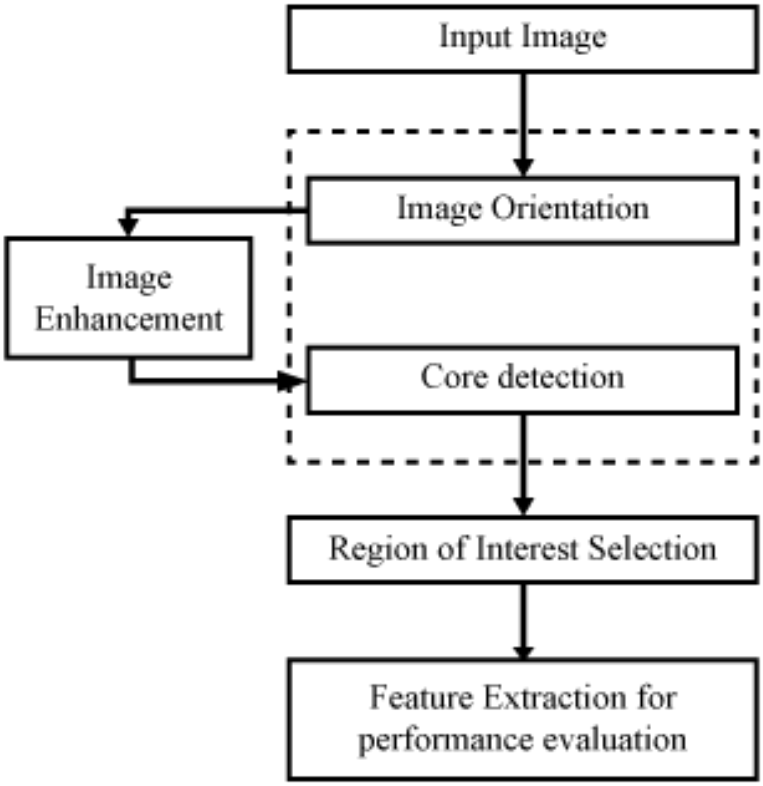


Figure 3.10: Image Orientation and Core Detection Process Flow Chart

Image Orientation: An input image is read from the graphics file. Bilinear interpolation is adopted to resize the image into a standard or assuming constant size. Let I(x, y) denote a two-dimensional grey-scale image, Figure 3.11 explains the steps involved in the fingerprint rotation process.

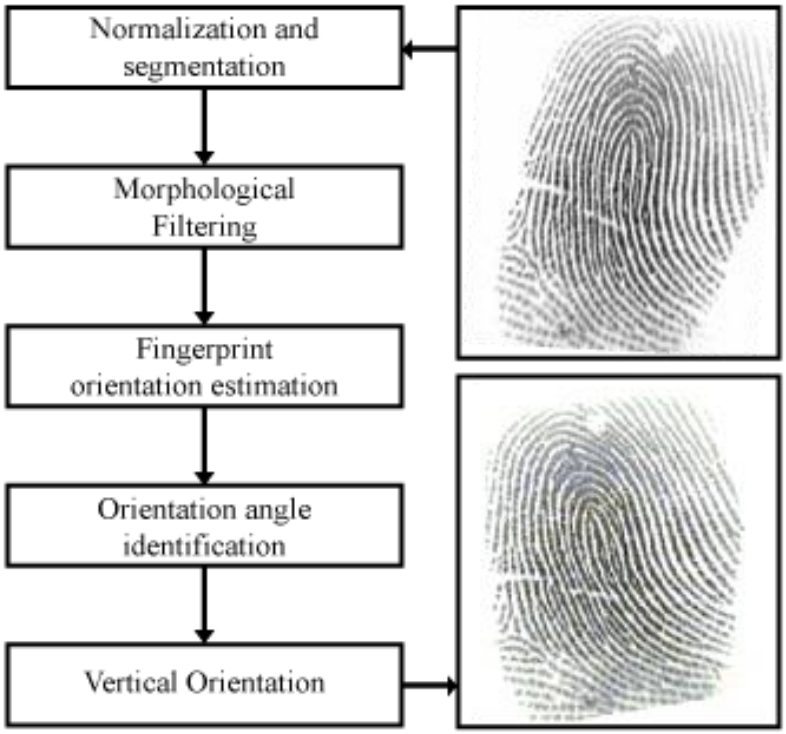


Figure 3.11: Fingerprint Rotation Process

Normalization and Segmentation: This process identifies the ridge region of the input image. The given input image is segmented into blocks of size n x n and the standard deviation (STD) in each region is evaluated. If the standard deviation is above the threshold it is marked as part of the fingerprint. The image is normalized to have zero mean, unit standard deviation before performing this process so that the threshold specified is relative to a unit standard deviation. MASK image IM_1 is obtained using equation (3.1), (3.2) and (3.3)

$$I(x,y) = I(x,y) - \text{mean}(I) \quad (3.1)$$

$$I(x,y) = I(x,y)/\text{STD}(I) \quad (3.2)$$

$$I_1(x, y) = RM + I(X, Y) \times \text{SQRT}(RV) \quad (3.3)$$

Where, RM is the required mean and RV is the required variance.

Morphological Filtering: Morphological filtering is based mainly on some mathematical morphology transformations. Here we perform morphological closing on the normalized

and segmented grayscale image I_{M1} (equation 3.3) to obtain the closed image, I_{M2}. The structuring element (SE) must be a single structuring element object, as opposed to an array of objects. The morphological close operation is a dilation followed by erosion, using the same structuring element for both operations. This fills the image regions and holes.

Dilation of a MASK image $I_{M1}(x, y)$ by a structuring element SE (m, n) is denoted by $I_{M2}(x, y)$

$$I_{M2}(x, y) = D(I, SE)(x, y) \max\{I(x - m, y - n) SE(m, n)\} \quad (3.4)$$

Erosion of $I_{M2}(x, y)$ by a structuring element SE (m, n) is denoted by $I_{M3}(x, y)$

$$I_{M3}(x, y) = E(I_{M2}, SE)(x, y) = \min\{I_{M2}(x+m, y+n) - SE(m,n)\} \quad (3.5)$$

Fingerprint Orientation Estimation: Taking the MASK image as input, the orientation or the angle between the x-axis and the major axis of the ellipse bounding the MASK IM3 image that has the same second-moments as the region is calculated. Normalized second central moments of a pixel with the unit length for the region 1/12 is calculated.

$$G_{XX} = \sum \frac{x^2}{N} + (1/12) \quad (3.6)$$

$$G_{YY} = \sum \frac{y^2}{N} + (1/12) \quad (3.7)$$

$$G_{XY} = \sum \frac{xy}{N} + (1/12) \quad (3.8)$$

If $G_{YY} = G_X$

$$\text{Num} = G_{YY} - G_{XX} + \sqrt{(G_{YY} - G_{XX})^2 + 4 \times G_{XY}^2} \quad (3.9)$$

Den = $2\times G_{XY}$

Else

Num = $2\times G_{XY}$ (3.10)

Den = $G_{XX} - G_{YY} + \sqrt{(G_{XX} - G_{YY})^2 + 4 \times G_{XY}^2}$ (3.11)

End

If Num == 0 & Den == 0

$$\text{Orientation} = \frac{180}{\pi} \tan^{-1} Num/Den \quad (3.12)$$

End

Orientation Angle Identification: If orientation obtained in equation (3.12) is less than zero, the orientation angle is negative and if the orientation is greater than zero, the orientation angle is positive. This is done to ensure whether the rotation should be clockwise (negative) or counterclockwise (positive).

If Orientation < 0

A = - (90 Orientation) (3.13)

Else

A = (90 Orientation) (3.14)

End

Vertical Orientation: Calculated angle of rotation is used to rotate the whole image. Nearest neighbor interpolation is used to set the values of pixels in the rotated image. Obtain the mask for the rotated image by slightly shrinking the mask using morphological erosion with a SE 'disk' of radius 3. Finally, by converting the values of the region outside the mask to the maximum value (255), the final rotated image is obtained. Figure 3.12 shows the results of the rotation process.

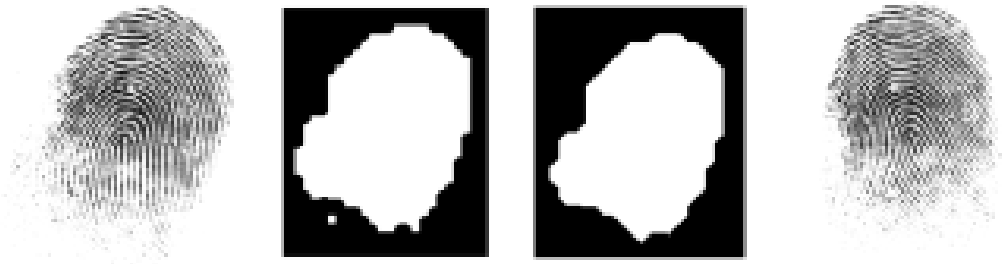
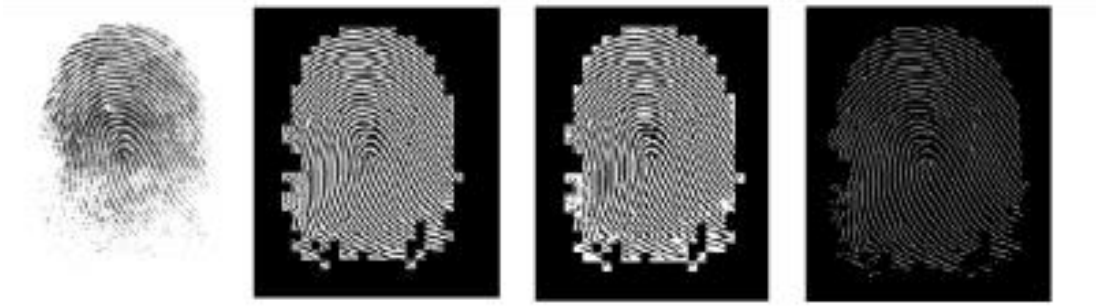


Figure 3.12: Results After Rotation (A) Input Image, (B) Mask Image Before Filtering (C) Mask After Morphological Filtering (D) Image After Rotation Process.

Enhancement: Gabor Filters based technique is used for the enhancement of the image [22]. The enhancement process involves normalization, segmentation of ridge region, removal of small objects morphologically and estimation of the local orientation of ridges in a fingerprint. Thinning is performed for the obtained binary image. Enhancement of fingerprint is illustrated in Figure 3.13



(a) (b) (c) (d)

Figure 3.13: Results after Enhancement (A) Image after Rotation, (B) Enhanced Grayscale Image (C) Enhanced Binary Image (D) Image after Thinning

To refine the ridges three stages of filtering is performed using morphological filtering

- Connect the disjoint pixels, so that all the 0-valued pixels are converted to 1 where it has two nonzero neighbors without connection.
- Remove the isolated pixels i.e. if the Centre isolated and converted to 0.
- Remove H-connected pixels i.e. if the Centre pixel is 1 and it is connected to its neighbors as H, it is converted to 0.

Core Detection: The proposed core detection algorithm is as follows. Figure 3.14 shows the results of core detection.

(a) (b) (c) (d)

Figure 3.14: Results after Core Detection (A) Thinned Image with Candidate Core Pixels Marked In Red, (B) Result After Bridging the Closer Points and Minimizing (C) Result after Applying Conditions 1 and 2 (D) Final Core Detected Image

(i) The thinned image obtained after filtering is transformed to complement the greyscale image by replacing 0's to 255 and 1's with 0's.

(ii) The local orientation of ridges in a fingerprint is estimated and the region mask is applied. Since the orientation is calculated in radians it is converted to degrees.

(iii) For every 3x3 window the difference between the angles is obtained and the following conversion is made. Let D (k) is the different angle for the kth element in the window k= {1, 2, 3…8}.

If D (k) <= -pi/2

D (k) = D (k) + pi; (3.15)

Else if abs (D (k)) < pi/2

D (k) = D (k); (3.16)

Else

D (k) = pi-D (k); (3.17)

End

Obtain the sum of all different values in the window.

(iv) The candidate core pixel is selected by considering all pixel locations where the sum of all the different values in the window is around 360, where we use a tolerance of ±3. Now all the candidate pixels present close to each other are bridged together and only the centroid of the region is considered.

(v) Considering the thinned image around each candidate core pixel, a 3x3 window is taken and the pixels at each side of the window are taken as n1,n2,n3 and n4. The false core pixels are eliminated based on the following two conditions.

1. If (n1 & n3) > 0 & (n2 & n4) == 0 (3.18)
2. If (n2 & n4) > 0 & (n1 & n3) == 0 (3.19)

(vi) As a final step, if still more than one pixel is marked, the candidate pixel which is closest to the Centre of the fingerprint mask is considered to be the identified core point.

Region of Interest

On completion of detection of the core point, the region of interest is cropped from the image. For cropping of the region of interest, ‘n’ pixels around the core point are selected. The number of pixels around the core point ‘n’ is chosen to be 100 -200 such that an adequate area around the core is considered. Shows in Figure 3.15

(b)

(a)

Figure 3.15: Results after Core Detection (A) Input to the Algorithm, (B) Output of Our Method

Feature Extraction: Feature extraction is an attribute reduction process. Unlike feature selection, which ranks the existing attributes according to their predictive significance, feature extraction transforms the attributes. The line-based feature extraction algorithm [23] is used to find the features in the identified region of interest image. The line-based feature extraction is briefed as follows. By using connected component analysis and the ridge tracing approach, all connected line segments to all the pixels are determined. The minutiae extraction process is accomplished by block processing. To validate the minutiae, post-processing is performed on the minutiae extracted image. Two features are identified as shown in Figure 3.16. Bifurcation is shown as red color and termination revealed by yellow color.

(a) (b)

Figure 3.16: Feature Extraction Process. (A) Input Image (B) Feature Extracted Image. Bifurcation Is Represented By Red Color; Termination Is Represented By Yellow Color.

3.4.1 Algorithm Implementation

Once everything is set up, it is time to implement our algorithm. The minutiae-based algorithm is widely used for fingerprint authentication. The classification of fingerprints is one of the important components of this algorithm, allowing the number of fingerprints referenced for each identification procedure to be substantially reduced.

Fingerprint Enrolment: In the enrolment process, the fingerprint of each student is recorded. The fingerprint of the student is scanned using the fingerprint scanner in the system. Each fingerprint is assigned an ID number. The ID number is stored on the NodeMCU board. This number is unique for each student. Enrolment of fingerprints is performed only once. The student IDs can be changed or replaced as and when required.

Fingerprint Comparison and Recognition: The system, being portable, can be passed around during the lecture from student to student to record attendance. During the fingerprint comparison and recognition process, the student's fingerprint will be compared with the stored fingerprints in the NodeMCU board. The student then has to place his/her finger on the fingerprint scanner. The fingerprint input is then verified with the stored fingerprints.

Validation of Recognized Fingerprint: In the previous process, the fingerprint input is compared with the stored fingerprints. If it matches a fingerprint present in the NodeMCU. The student can then try again when the yellow LED glows, starting the Fingerprint Comparison and Recognition process again.

Granting Attendance: Uploading Data to Google Spreadsheet If the fingerprint is recognized, the attendance granting process starts. The unique ID number of the student is recognized. The attendance data is logged into Google Spreadsheet by uploading the student's ID number in it. After the attendance is granted, i.e. the ID is stored. The Fingerprint Comparison and Recognition process start. The system can then be passed on to another student.

3.5 DIAGRAM

A diagram is a valid expression, using visual elements, of details. Diagrams have been used on the cave walls since ancient times, but during the Revolution, they became more widespread. The method uses for three-dimensional representation that is projected onto a two-dimensional layer often. Sometimes the term graph is used to synonymize the diagram.

3.5.1 ER Diagrams

ER diagram which shows that helps to construct databases effectively. Characteristics of ER diagrams are generally modeled as a rectangle with the label of the attribute, connected to the person or interaction that includes the attribute. The end product can typically be classified into two further steps within the hierarchical model to determine the grouping of information within the structure, generally determine the fundamental objects where the data is processed, and then determine the relationships between such information groups or entities. The Entity-Relationship Diagram (ERD) is a graphic illustration of various data that explains how these data are connected using concepts. Specific databases that are used in software development and IT networks are most commonly associated with ER diagrams. During the design phase of a development cycle, ER diagrams are often used to describe various system elements and their interactions with each other. By displaying the relationships among entity sets in such a system, an Entity-Relationship (ER) diagram demonstrates the logical structure of a database. ER diagrams are often used because they help to organize data contained in a database and can be converted into tables directly. A connection is an interaction between two or more sets of individuals. In an ER diagram, a relationship is defined by a diamond. Diagram Entity-Relationship (ER) is a pictorial arrangement of information in databases, showing how data is associated. A student can only be registered in one course, for example, but a course can be enrolled by several students for users (id, name), the main key is serialnumber. The primary key is the id for the users_log. Figure 3.17 shows the ER diagram for this site.

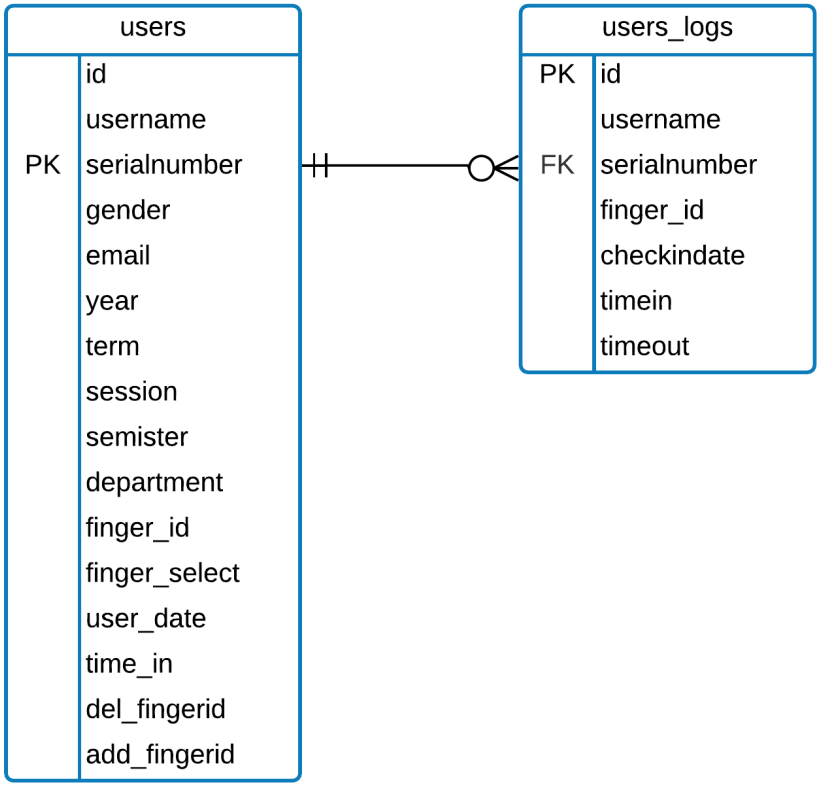


Figure 3.17: ER Diagram

This ER diagram shows the relationship between users and users_log. Category for the Attendance which Teacher posts or uploads in the site.

3.5.2 Context Diagram

In design, a system context diagram (SCD) is a schematic that describes the structure of a system or portion of a process and its setting, showing the elements that communicate with it. This diagrams a view of a device at a high level. It is similar to a diagram of a block. The background diagram illustrates how the method operates with the pupil, the instructor, and the visitor in Figure 3.18 shows how the system works with the student, teacher and course.

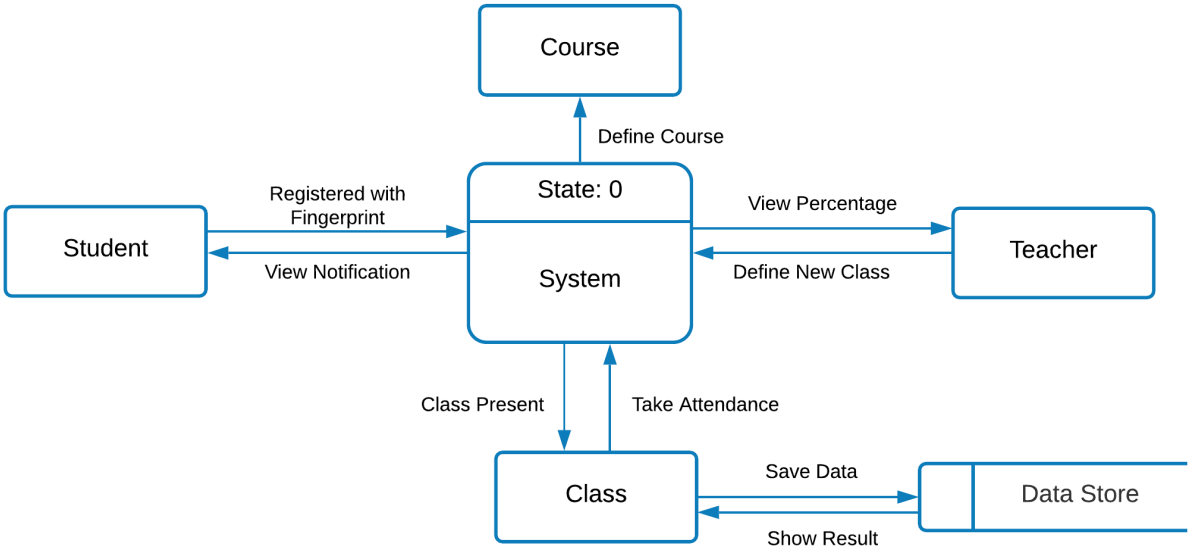


Figure 3.18: Context Diagram

3.5.3 Class Diagram

A Class diagram which Unified Modeling Language in computer science is a class of diagram that defines a system design by showing the classes of the system, its attributes, procedures, and object relationships. The central element of object-oriented dependent programming is defined by the class diagram. It is used for the oriented modeling of the software's systematics and the conversion of the models into computer code for thorough modeling. For representing data, class diagrams may also be used. The classes in the description of a class describe both the key components, the system interactions, and the classes to be coded. Every class diagram for software design is a kind of static diagram that shows a system design by presenting the classes of the system, their attributes, operations, and object relationships. The main work of the class diagram is to provide details. During system growth, it plays a very imperative role. These days, class diagrams are more common as we move more towards Object-Oriented modeling rather than procedural programming. Groups used in every class diagram can specifically be based on Object-Oriented simulation. Figure 3.19 class diagram shows for this project.

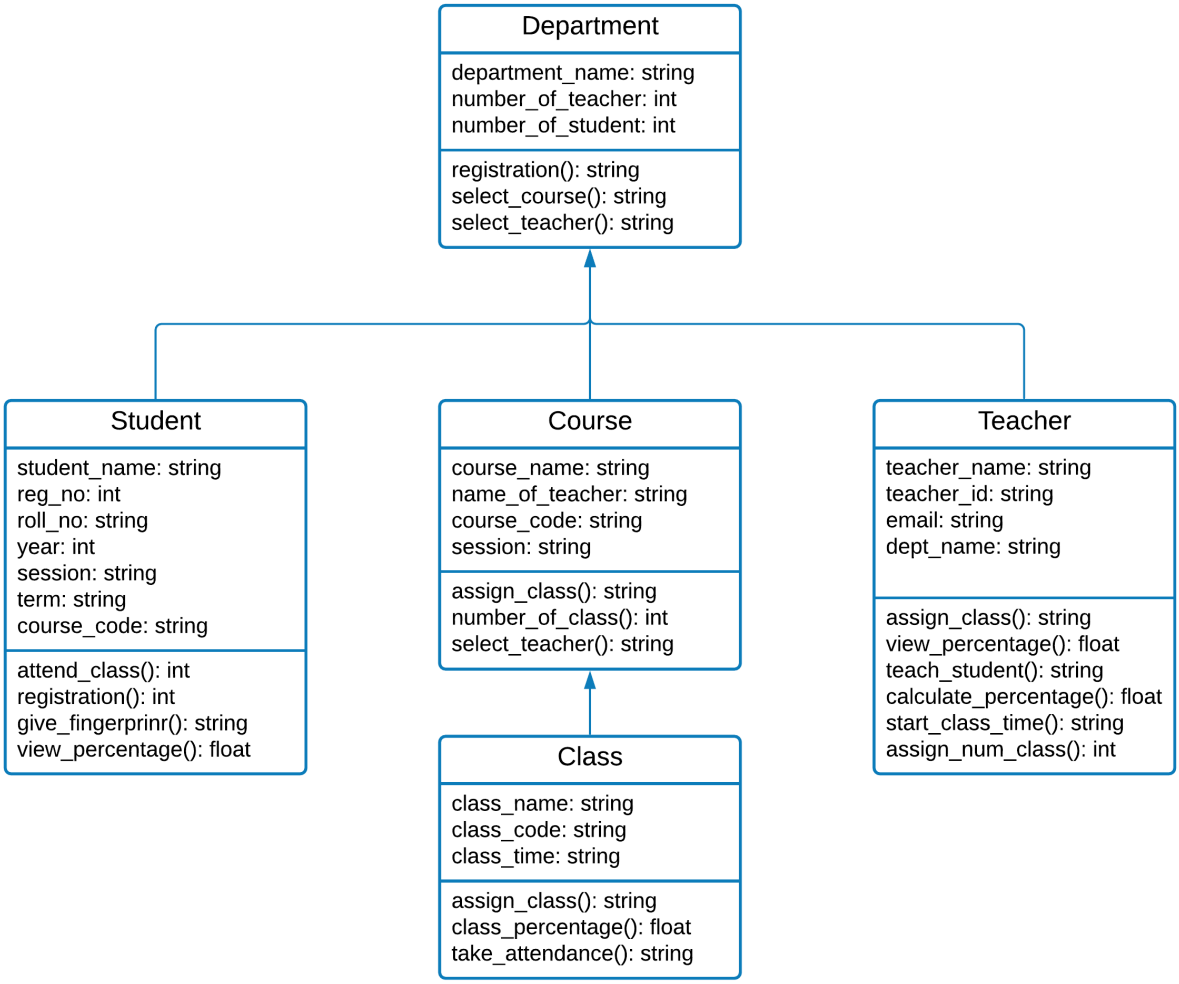


Figure 3.19: Class Diagram

In the diagram, boxes containing three basic parts reflect classes: the top object represents the class name. The very first letter is capitalized and written in bold and centered letters. The middle compartment includes the class's attributes. They are aligned left and there is a lowercase first letter. The bottom compartment includes tasks that can be executed by the class. They are also left-aligned and there is a lowercase first letter.

3.6 REAL OVERVIEW OF THE MODULE

When we assembled all the hardware in a breadboard then we get a nice looking module of the project which is handier to carry and use. Figure 3.20 shows the Real overview of the project module.

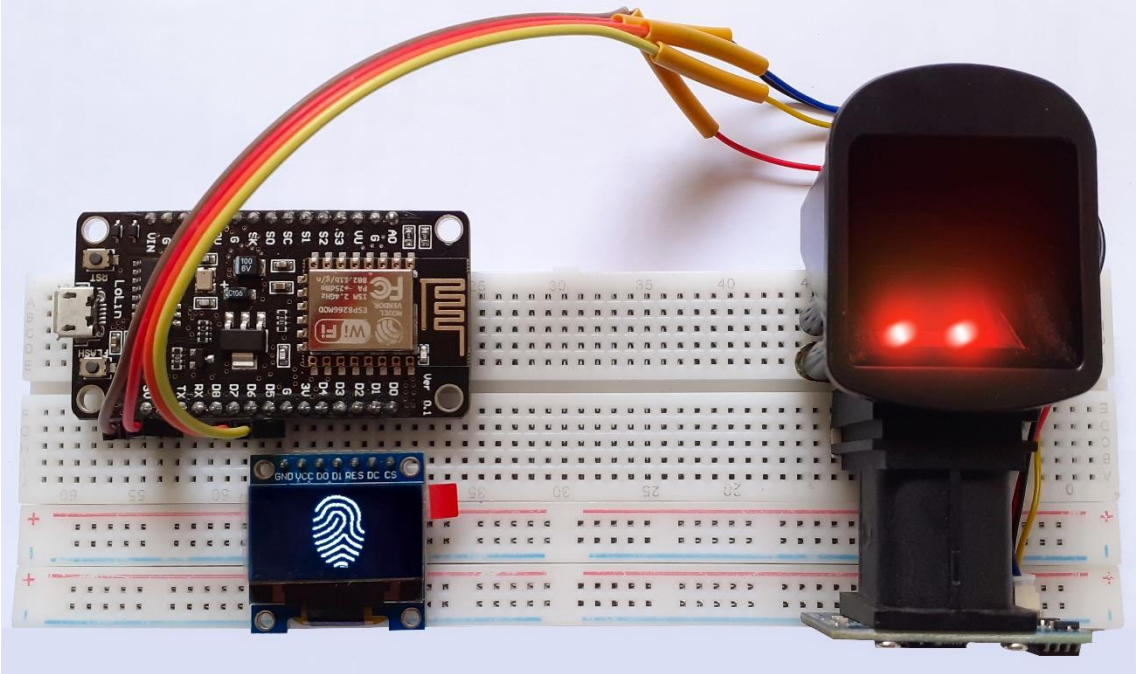


Figure 3.20: Project Overview

3.7 CONCLUSION

From the above study now we know the Design process, Hardware, Software, and the working Algorithm of the system. Users provide information and fingerprint for first time registration. The system used Gabor filter-based method for image processing of the finger. The module process the information and biometric data to produce the attendance percentage.

CHAPTER 4

TESTING & MAINTENANCE

4.1 INTRODUCTION

Software Testing is the review of software with customer requirements and device specifications. Testing is done in the application code at the stage level in the life cycle of developing software or system level. Validation and Evaluation consist of software testing.

Software Validation: Validation is a method of evaluating whether the program meets the specifications of the consumer or not. After the SDLC, it is worked out. It is certified if the program meets the specifications for which it was developed. Validation guarantees that the product under production is according to the specifications of the customer. "Validation answers the question, "Are we creating the item from this program that tries what the user needs? Validation focuses on user requirements.

Software Verification: Verification is a process of verifying whether the software completes the requirements of the organization and is established in compliance with the right standards and techniques. Verification guarantees that the product being produced complies with design requirements. Verification addresses the question, "Are we developing this product by strictly following all design parameters?" Verification focuses on the standards of the design and system.

4.2 TESTING

The identification of errors in the software is included. The research process begins with a test plan that recognizes test-related events, such as the generation of test

cases, test requirements, and the assignment of resources for testing. In the design process, the code is checked and mapped against the design document developed. A test result containing mistakes when testing the application is the result of the testing process. Project research on actual hardware and even on the world of the emulator or software has not been completed. For the project's tasks, research has been performed.

4.2.1 Target of the Test

Three targets of our test. They are-

Errors - These are real errors made by programmers in coding. There is also a variation in program output and an error is known to be the desired output.

Fault - A fault happens whenever an error exists. A fault is the result of an error that can cause a device to malfunction, also known as a bug.

Failure - Failure is perhaps the program's inability to perform the required task. Failure happens in the system when a fault exists.

4.2.2 Manual Vs Automated Testing

Testing can either be done manually or using an automated testing tool:

Manual - Such testing is done without the assistance of computer testing software. For various parts and levels of the code, the software tester prepares test cases, runs the tests, and sends the results to the manager.

Manual research requires both time and energy. The tester needs to check whether the correct test cases are used anyway. Manual testing requires a large portion of the testing.

Automated - This test is a test process that is conducted with the assistance of automated test methods. Using automated evaluation methods, the drawbacks of manual testing can be overcome.

In Internet Explorer, a test is required to verify if a web page can be opened. With manual checking, this can be easily achieved. But it is very impossible to test manually to check if the web-server can take the load of 1 million users. In carrying out load checking, stress testing, and regression testing, there are software and hardware instruments that assist testers. We input some manual data into our project and check how the module works. For a code evaluation, we run the code to see if the code is working right, again and again.

After manually testing the entire code, we organize the complete code and run it at the same time.

4.2.3 Test Plan and Test Activities

Test Plan: The test plan is described as a document that defines the scope, strategy, resources, and timeline of the test plans that are scheduled. It defines test items, the functionality to be tested, the activities to be tested, who will perform each assignment, and any hazards that involve contingency planning. A research plan offers detailed testing details about an entire test attempt in software development, including:

i. Scope of testing
ii. Schedule
iii. Test Deliverables
iv. Release Criteria

Also, it is defined as how the test will occur, who will conduct the test, what is being tested, how long the test will occur, and at what level of performance the test will be conducted.

The identifying process a test project so that it can be calculated and managed appropriately. A high-level test plan document is created by the test planning tool for implementing the software objects to be evaluated, the degree of independence of the tester, the testing process, the nature of the testing phase and test measuring instruments to be used, and the reason for their choice.

Test Activities: Various Testing Activities are as follow:

i. **Black box testing** in this method of testing, the internal device architecture is not considered. Requirements and features are the foundation of assessments.
ii. **White box** test depends on the understanding of an application's code's internal logic. Often known as Examination of Glass Case. For this kind of testing, internal software and code work should be identified. Tests are based on code test cases, divisions, routes, conditions.
iii. **Unit testing** of components of individual software. As it needs thorough knowledge about internal software design and code, it may involve the creation

of test driver modules or testing harnesses, usually performed by the programmer and not by testers.

iv. **Incremental integration testing** Bottom-up methodology for testing, constant software testing as additional features are added; implementing this technology and modules should be sufficiently autonomous to be evaluated by programmers or testers separately.

v. **Integration testing** integrated systems to check, after integration, combined features. Modules are normally code modules on a system, individual programs, client and server applications, etc. Client/server and communications databases are particularly important to this form of research.

vi. **Functional testing** this sort of testing avoids the internal components and focuses on the performance whether necessary or not. Testing of the Black-box form aimed at the functional specifications of an application.

vii. **System testing** the entire scheme is checked according to the specifications. Black-box style inspection, which is focused on specifications of total requirements, includes all of a system's integrated components.

viii. **End-to-end testing** similar to devise testing, in a scenario that mimics actual use, such as communicating with a database, utilizing communication links, or interacting with other hardware, software, or systems, if applicable, a full application environment is evaluated.

ix. **Acceptance testing** this form of testing is typically performed to check whether a device meets the specifications stated by the customer. This checking is performed by the user or client to decide whether to approve the submission.

x. **Usability testing** check for user-friendliness. The project analyses are reviewed, new users can easily investigate the concept, and if the user is stuck at some point, proper assistance is reported. In this research, machine navigation is checked.

Project Scheduling: Project preparation is synonymous with the approaches that can be used to organize the activities which need to be done during a development's design. Scheduling is performed in advance of the beginning of the project and involves:

i. Identifying the operations which need to be done.

ii. Estimating the amount of time they would take.

iii. Allocating money (mainly personnel).

iv. Scheduling when the tasks are going to happen.

4.3 MAINTENANCE

It involves incorporating improvements that could be encountered by software for some time or implementing new specifications after deployment of the software at the customer site. Also after the test process, the maintenance work requires managing the real-world errors that may occur in the program. The maintenance of the system is low cost and effective as the user gets this application free of charge and this application is often spread over a network, so monitoring is a bit challenging.

4.3.1 Maintenance Activities

IEEE provides a framework for sequential maintenance process activities. It can be used iteratively and can be extended so that customized items and processes can be included.

These activities go hand-in-hand with each of the following phases:

Identification & Tracing - It involves activities of identification of requirement of modification or maintenance. It is generated by a user or system that may itself report via logs or error messages. Here, the maintenance type is classified also.

Analysis - The modification is analyzed for its impact on the system including safety and security implications. If the probable impact is severe, an alternative solution is looked for. A set of required modifications is then materialized into requirement specifications. The cost of modification/maintenance is analyzed and estimation is concluded.

Design - New modules, which need to be replaced or modified, are designed against requirement specifications set in the previous stage. Test cases are created for validation and verification.

Implementation - The new modules are coded with the help of structured design created in the design step. Every programmer is expected to do unit testing in parallel.

System Testing - Integration testing is done among newly created modules. Integration testing is also carried out between new modules and the system. Finally, the system is tested as a whole, following regressive testing procedures.

Acceptance Testing - After testing the system internally, it is tested for acceptance with the help of users. If at this state, users complain about some issues they are addressed or noted to address in the next iteration.

Delivery - After the acceptance test, the system is deployed all over the organization either by a small update package or fresh installation of the system. The final testing takes place at the client end after the software is delivered.

The training facility is provided if required, in addition to the hard copy of the user manual.

Maintenance management - Configuration management is an essential part of system maintenance. It is aided with version control tools to control versions, semi-version or patch management.

4.3.2 Software Re-engineering

If we need to upgrade the software to keep it in the modern environment, it is defined as software re-engineering without changing its functionality. It is an in-depth system in which the software design is updated and programs are re-written. Legacy software cannot tune with the new technologies present in the market. Updating applications becomes a headache as the hardware becomes outdated. Even if the software gets outdated over time, its features do not. Other than this, programmers often find that few parts of software need more maintenance than others require re-engineering as well.

4.4 CONCLUSION

Testing is an important part of an errorless system. For that, we completed all the testing phases completely. For a long-lasting workable module, we have to maintain the system carefully. The sensor-based system always needs extra care for the right services.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 INTRODUCTION

Biometric technology is a reliable tool for authentication. Various fingerprint based attendance systems have been reviewed. Some of the systems look promising to be practically implemented in developing countries. The existing systems can further be improved or combined which helps in making the system more user-friendly, secure, and fast. Low cost embedded platform can be combined with the user-friendliness of Microcontroller and added functionality of Arduino technology.

5.2 RESULTS

At the end of the project now we have a website, a database, a fingerprint store and an identity module that is connected with our computer with the help of Wi-Fi. The website can register, manage, update, and export attendance to many students. The database manages the input data and gives us the output which we want. Database saves the data in a structured way. The fingerprint module takes the fingerprint and verifies that with the help of fingerprint sensors. The microprocessors instruct the sensors with the help of Arduino code. The display of the module helps us showing the name of the student. The microprocessor sends the data to the computer database with the help of an IP address through Wi-Fi. The database stores the data process and gives us the attendance sheet. The website also calculates the attendance per sentence of the students after completing the semester. Per sentence is created subject wise for every student and we can export the result as an excel sheet.

5.3 OUTLOOK OF WEBSITE

On our website there are three pages- Manage Users, Users and Users Log. The name of the site is “Biometric Attendance System Department of ICE”. For the primary level used we run the website in the Localhost by creating a local database.

5.3.1 Manage Users

The first page is the Manage Users page. We used this page for the Registration of the students first time. There are several fields to get information about students. First, we declared a Registration ID number it’s a unique ID for every student. Here we also declare Name, Roll No, Year, Term, Session and Department from the drop-down menu. We also have to declare the time and date. A table on the right side shows the list of registered students. There is three-button: Add User, Update User and Remove User for manage the users. Following are the Outlook of the working website which we developed. Figure 5.1 shows the Manage Users page.

5.3.2 Users

On the Users page, all the registered students are shown at the same time. A list of the table that contains the information like Roll No, Registration ID, Name, Department, Session, Year, Term, Date and Time. Here all the student information is gathered at the same time. We can divide the information according to the session, year, or any other criteria about the students. The ultimate target of our site is to enhance the performance of every student. This can be done promptly by reviewing each student's results using professional analytical methods such as a dashboard. The knowledge thus gained can be used to take constructive and corrective steps to assist them in achieving improved results and realizing their potential. This method can become time-consuming and repetitive if not done systematically. The vast amount of information produced by each student can be updated on the student data management program systematically and effectively, thereby enabling the administration to handle and coordinate all kinds of information, ready to be used if and when appropriate. Figure 5.2 shows the Users page.

Figure 5.1: Manage Users Page

5.3.3 Users Log

In this Users Log page first, we select the Session and Course Code for taking the attendance for a class. We can export the attendance sheet by selecting the date from this page. The table shows the Roll, Name, Date, Time In, Time Out and the Attendance Result that is Present or Absent. A student must have to place his/ her finger into the module fingerprint sensor when he/ she come to the class and after that when finishing the class. If time in and time out are being registered only then the student count as a present. If one of them is missing the student count as absent. Figure 5.3 shows the Users Log page.

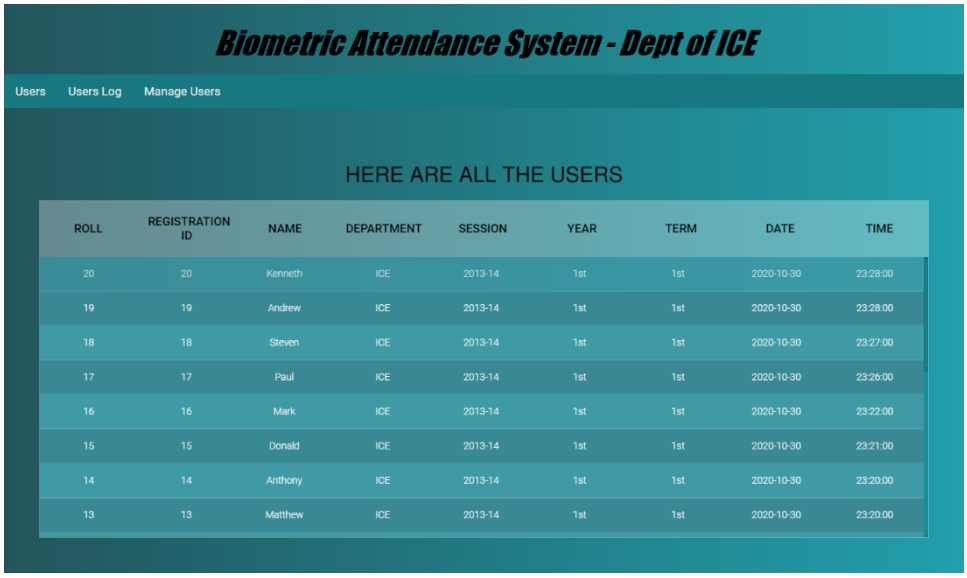


Figure 5.2: Users Page

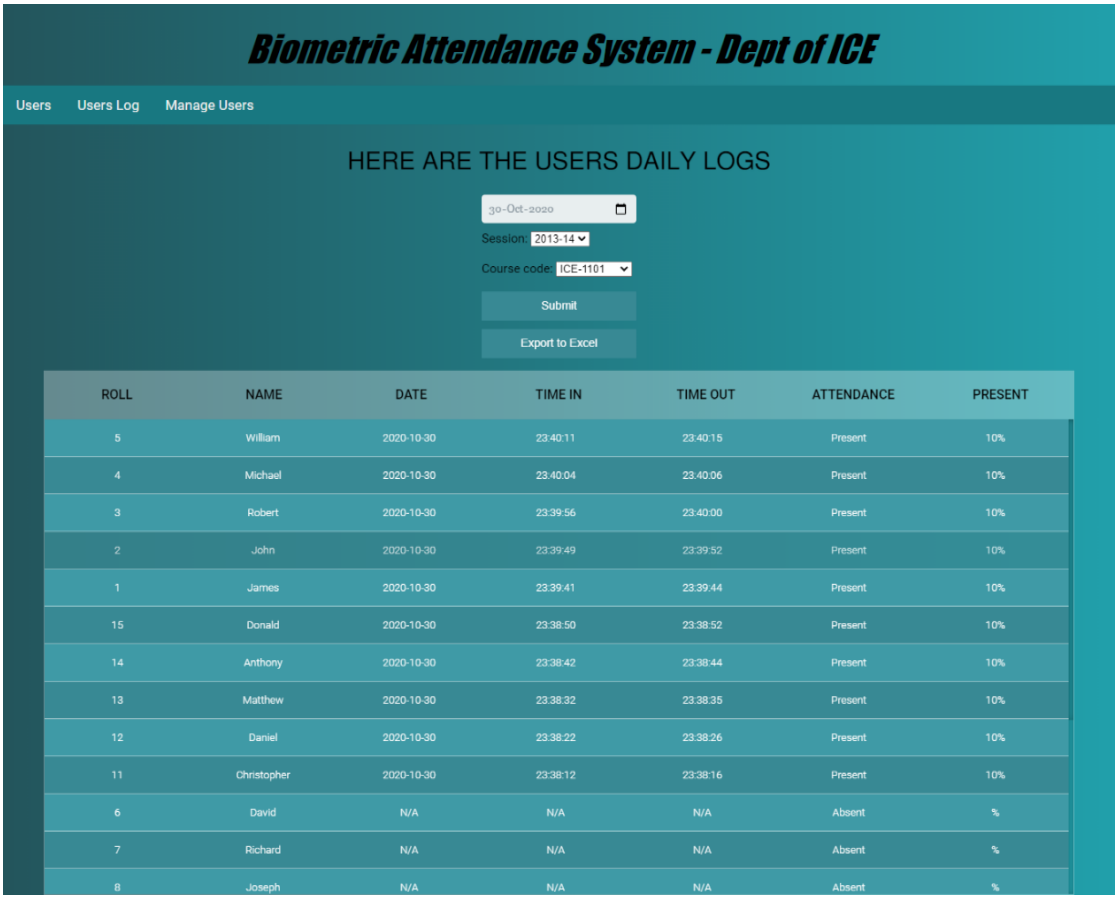


Figure 5.3: Users Log Page

5.4 ATTENDANCE SHEET

The site export an Attendance Sheet as a Microsoft Excel file. The system that has been designed and implemented has been tested on 30 students. The students were properly identified and their attendance has been updated successfully. When a student gives attendance, 'Present' is being written under his ID. If a student is absent, then 'Absent' is being written. This is a more accurate system. This module is accurate and reliable, the matching of fingerprints is about 100% but errors have been detected regarding enrolling fingerprints. Firstly, fingerprints could not be enrolled due to some accident by placing a finger in the wrong places. Secondly, the fingerprint image was failed to capture due to bad skin or rough skin. This is about 2% error during testing of 30 students. The attendance sheet also contains the attendance presentence of a student that is very important to attend in the semester final examination. Because the attendance is below 70% then he/she not eligible for the final exam. The Microsoft Excel file will look like Figure 5.4

ROLL	NAME	DATE	TIME IN	TIME OUT	ATTENDANCE	PRESENT
5	William	30-10-20	23:40:11	23:40:15	Present	10%
4	Michael	30-10-20	23:40:04	23:40:06	Present	10%
3	Robert	30-10-20	23:39:56	23:40:00	Present	10%
2	John	30-10-20	23:39:49	23:39:52	Present	10%
1	James	30-10-20	23:39:41	23:39:44	Present	10%
15	Donald	30-10-20	23:38:50	23:38:52	Present	10%
14	Anthony	30-10-20	23:38:42	23:38:44	Present	10%
13	Matthew	30-10-20	23:38:32	23:38:35	Present	10%
12	Daniel	30-10-20	23:38:22	23:38:26	Present	10%
11	Christopher	30-10-20	23:38:12	23:38:16	Present	10%
6	David	N/A	N/A	N/A	Absent	%
7	Richard	N/A	N/A	N/A	Absent	%
8	Joseph	N/A	N/A	N/A	Absent	%
9	Thomas	N/A	N/A	N/A	Absent	%
10	Charles	N/A	N/A	N/A	Absent	%
16	Mark	N/A	N/A	N/A	Absent	%
17	Paul	N/A	N/A	N/A	Absent	%
18	Steven	N/A	N/A	N/A	Absent	%
19	Andrew	N/A	N/A	N/A	Absent	%
20	Kenneth	N/A	N/A	N/A	Absent	%

Figure 5.4: Attendance Sheet

CHAPTER 6

CONCLUSION

6.1 INTRODUCTION

The device successfully simulated the monitoring of attendance for both classes and exams. New fingerprints to be recorded were successfully collected by the prototype; scanned fingerprints were put on the system sensor and successfully compared against those stored in the database. The performance of the system was acceptable and would be considered for full implementation especially because of its short execution time and report generation. Everyone who tested the system was pleased and interested in the product being developed for use in university. There still have the opportunity to add other features that are not mentioned here. Some minor functional problems may occur during operation, but it will not have any minimum effect on the kernel part of the system. In general, the Digital Attendance Management System Using Biometric Fingerprint Technology will result in an improvement over the existing attendance system used in University.

6.2 CONCLUSION

Our main objective is to make a complete fully functional fingerprint attendance system that will replace the traditional attendance system. We have successfully designed and implemented a secure, fast, reliable and efficient fingerprint attendance system. The Fingerprint attendance system and Fingerprint Data Management Software has been successfully designed. The developed system is very helpful in saving valuable time for students and lecturers, paper and generating report at the required time. The system can record the clock in and clock out the time of students and workers in a very convenient

manner using their fingerprints to prevent impersonation and reduce the level of absence. It also removes most management jobs and minimizes human mistakes, prevents proxy punching, removes time-related conflicts, and allows to update and preserve records of attendance. The designed fingerprint attendance system solves these issues by the following means.

1. No time waste as the attendance is taken during lecture without the intervention of the teacher
2. Managing the attendance is automated
3. No chance for fake attendance marking
4. The system can track the arrival and exit time of the student
5. Automatically calculate the attendance presentence.

6.3 FUTURE SCOPE

The attendance management system can be improved by adding the features that indicate if the student is late. Now we only know the incoming and outgoing time. Some of the future enhancements for this are to extend the current flash memory to store the complete details of the student. Current module work with 8 bits for that we cannot add only 1 to 127 students in a term. The future device will come with access to the university server and from this module, the student can have any information regarding his/her personal information, course grades, CGPA etc.

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APPENDICES

CODING

Index Code

```
<!DOCTYPE html>
<html>
<head>
  <title>Users</title>
<link rel="stylesheet" type="text/css" href="css/Users.css">
<script>
  $(window).on("load resize ", function() {
    var scrollWidth = $('.tbl-content').width() - $('.tbl-content
table').width();
    $('.tbl-header').css({'padding-right':scrollWidth});
}).resize();
</script>
</head>
<body>
<?php include'header.php'; ?>
<main>
  <section>
  <!--User table-->
  <h1 class="slideInDown animated">Here are all the Users</h1>
  <div class="tbl-header slideInRight animated">
    <table cellpadding="0" cellspacing="0" border="0">
      <thead>
        <tr>
          <th>ID | Name</th>
          <th>Serial Number</th>
          <th>Gender</th>
          <th>Finger ID</th>
          <th>Date</th>
          <th>Time In</th>
        </tr>
      </thead>
    </table>
  </div>
  <div class="tbl-content slideInRight animated">
    <table cellpadding="0" cellspacing="0" border="0">
      <tbody>
        <?php
          //Connect to database
          require'connectDB.php';

            $sql = "SELECT * FROM users WHERE NOT username='' ORDER
BY id DESC";
            $result = mysqli_stmt_init($conn);
            if (!mysqli_stmt_prepare($result, $sql)) {
                echo '<p class="error">SQL Error</p>';
            }
            else{
              mysqli_stmt_execute($result);
                $resultl = mysqli_stmt_get_result($result);
```

```
50                if (mysqli_num_rows($resultl) > 0){
51                    while ($row = mysqli_fetch_assoc($resultl)){
52            ?>
53                            <TR>
54                            <TD><?php echo $row['id']; echo" | "; echo
55 $row['username'];?></TD>
56                            <TD><?php echo $row['serialnumber'];?></TD>
57                            <TD><?php echo $row['gender'];?></TD>
58                            <TD><?php echo $row['fingerprint_id'];?></TD>
59                            <TD><?php echo $row['user_date'];?></TD>
60                            <TD><?php echo $row['time_in'];?></TD>
61                            </TR>
62          <?php
63                      }
64                  }
65              }
66          ?>
67        </tbody>
68      </table>
69    </div>
70 </section>
   </main>
   </body>
   </html>
```

Database Connecting Code

```
   <?php
   /* Database connection settings */
1          $servername = "localhost";
2      $username = "root";                //put your phpmyadmin
3  username.(default is "root")
4      $password = "";                    //if your phpmyadmin has a
5  password put it here.(default is "root")
6      $dbname = "biometricattendace";
7
8          $conn = mysqli_connect($servername, $username, $password,
9  $dbname);
10
11         if ($conn->connect_error) {
12         die("Database Connection failed: " . $conn->connect_error);
13     }
   ?>
```

User Log Code

```
1 <?php
2 session_start();
3 ?>
4 <table cellpadding="0" cellspacing="0" border="0">
5   <tbody>
6     <?php
7       //Connect to database
8       require'connectDB.php';
```

```
 9
10      if (isset($_POST['log_date'])) {
11        if ($_POST['date_sel'] != 0) {
12            $_SESSION['seldate'] = $_POST['date_sel'];
13        }
14        else{
15            $_SESSION['seldate'] = date("Y-m-d");
16        }
17      }
18
19      if ($_POST['select_date'] == 1) {
20          $_SESSION['seldate'] = date("Y-m-d");
21      }
22      else if ($_POST['select_date'] == 0) {
23          $seldate = $_SESSION['seldate'];
24      }
25
26      $sql = "SELECT * FROM users_logs WHERE checkindate='$seldate'
27 ORDER BY id DESC";
28      $result = mysqli_stmt_init($conn);
29      if (!mysqli_stmt_prepare($result, $sql)) {
30          echo '<p class="error">SQL Error</p>';
31      }
32      else{
33        mysqli_stmt_execute($result);
34          $resultl = mysqli_stmt_get_result($result);
35        if (mysqli_num_rows($resultl) > 0){
36            while ($row = mysqli_fetch_assoc($resultl)){
37      ?>
38                  <TR>
39                  <TD><?php echo $row['id'];?></TD>
40                  <TD><?php echo $row['username'];?></TD>
41                  <TD><?php echo $row['serialnumber'];?></TD>
42                  <TD><?php echo $row['fingerprint_id'];?></TD>
43                  <TD><?php echo $row['checkindate'];?></TD>
44                  <TD><?php echo $row['timein'];?></TD>
45                  <TD><?php echo $row['timeout'];?></TD>
46                  </TR>
47    <?php
48              }
49        }
50      }
51    ?>
52  </tbody>
  </table>
```

Export Excel Code

```
1 <?php
2 //Connect to database
3 require'connectDB.php';
4
5 $output = '';
6
7 if(isset($_POST["To_Excel"])){
```

```
 8
 9      if ( empty($_POST['date_sel'])) {
10
11          $Log_date = date("Y-m-d");
12      }
13      else if ( !empty($_POST['date_sel'])) {
14
15          $Log_date = $_POST['date_sel'];
16      }
17          $sql = "SELECT * FROM users_logs WHERE
18  checkindate='$Log_date' ORDER BY id DESC";
19          $result = mysqli_query($conn, $sql);
20          if($result->num_rows > 0){
21              $output .= '
22                          <table class="table" bordered="1">
23                            <TR>
24                              <TH>ID</TH>
25                              <TH>Name</TH>
26                              <TH>Serial Number</TH>
27                              <TH>Fingerprint ID</TH>
28                              <TH>Date log</TH>
29                              <TH>Time In</TH>
30                              <TH>Time Out</TH>
31                            </TR>';
32                  while($row=$result->fetch_assoc()) {
33                      $output .= '
34                                  <TR>
35                                      <TD> '.$row['id'].'</TD>
36                                      <TD> '.$row['username'].'</TD>
37                                      <TD>
38  '.$row['serialnumber'].'</TD>
39                                      <TD>
40  '.$row['fingerprint_id'].'</TD>
41                                      <TD> '.$row['checkindate'].'</TD>
42                                      <TD> '.$row['timein'].'</TD>
43                                      <TD> '.$row['timeout'].'</TD>
44                                  </TR>';
45                  }
46                  $output .= '</table>';
47                  header('Content-Type: application/xls');
48                  header('Content-Disposition: attachment;
49  filename=User_Log'.$Log_date.'.xls');
50
51                  echo $output;
52                  exit();
53          }
54          else{
55              header( "location: UsersLog.php" );
                exit();
            }
    }
    ?>
```