FINGERPRINT BASED BIOMETRIC ATTENDANCE SYSTEM (USING ARDUINO)

Project report submitted in partial fulfillment of the requirement for the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

By

Anirudh Sharma (201020)

Ansh Gupta (201021)

UNDER THE GUIDANCE OF

Dr. Naveen Jaglan

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

May 2024

TABLE OF CONTENTS

DECLARATION

We hereby declare that the work reported in the B.Tech Project Report entitled **"FINGERPRINT BASED BIOMETRIC ATTENDANCE SYSTEM (USING ARDUINO)"** submitted at **Jaypee University of Information Technology, Waknaghat, India** is an authentic record of our work carried out under the supervision of Dr. Naveen Jaglan**.** We have not submitted this work elsewhere for any other degree or diploma.

Signature of Student1
Ansh Gupta
201021

Signature of Student2
Anirudh Sharma
201020

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Signature of the Supervisor
Dr. Naveen Jaglan
Date:

Head of the Department/Project Coordinator

ACKNOWLEDGEMENT

I want to express my sincere thanks to everyone who made it possible for my project on an "**FINGERPRINT BASED BIOMETRIC ATTENDANCE SYSTEM (USING ARDUINO)**" to be successfully finished. The initiative would not have been feasible without the guidance and support of numerous people.

I want to start by thanking my supervisor, **Dr. Naveen Jaglan**, for all of his assistance and guidance during the project. Dr. Naveen has been a fantastic mentor, providing me with the resources, ideas, and direction I needed to complete my project on schedule. I admire his helpfulness, wisdom, and wise advice—all of which have made it easier for me to understand the concepts and complete the task.

I appreciate the excellent learning environment given to me by the instructors at the **Department of Electronics and Communication Engineering** of our institution, which enabled me to finish this thesis successfully. They have additionally provided me with plenty of encouragement and support.

I also want to express my gratitude to my family and friends for their support and encouragement throughout the years. Their belief in me has been a fantastic source of motivation throughout the duration of this undertaking. Additionally, I want to thank my fellow students for all of their support. I would want to express my gratitude to all the researchers and programmers who contributed to the open-source hardware, software, and libraries utilised in this project. Online discussion boards and groups have also been a great source of support and guidance.

I'd want to conclude by expressing my gratitude to everyone who helped bring this project to a successful end. I am sure that the knowledge and abilities I have acquired via this project will be of immeasurable value in my future undertakings. It has been a tough but gratifying experience. I want to take this opportunity to thank my supervisor, Dr. Naveen, once more for their constant support and direction during the project.

LIST OF FIGURES

ABSTRACT

The fingerprint-based biometric attendance system using Arduino is a state-of-the-art solution designed to simplify and improve the attendance management Using the power of Arduino, the system uses fingerprint recognition technology use to record attendance accurately and securely. systems and other traditional methods are not needed

At its core, the system uses Arduino microcontrollers and fingerprint sensor modules to capture and store biometric data unique to each person. The fingerprint recognition system ensures high accuracy and reliability, reducing the risk of access and impersonation and the collected data is then processed and stored well, providing an indelible record of attendance.

The system's user-friendly interface allows for easy integration into educational or organizational systems. Participants simply place their registered finger on the sensor, and the Arduino-based system instantly recognizes and records attendance. The use of real-time data ensures immediate and accurate follow-up, facilitating timely decision-making in attendance management and management.

Using an Arduino makes the system cost-effective and easy to modify, making it available for a wide range of applications. Additionally, the use of biometric authentication increases security, reducing the likelihood of fraudulent admissions practices. This innovation not only streamlines administrative tasks but also encourages an efficient and transparent attendance management system.

In summary, the fingerprint-based biometric attendance system using Arduino represents a reliable, secure and user-friendly solution for attendance management. With its seamless integration and comprehensive biometric identification capabilities, the system addresses the shortcomings of traditional attendance tracking methods, paving the way for the development of more advanced and efficient methods record in educational organizational contexts.

CHAPTER 1: INTRODUCTION

Using Arduino for fingerprint-based biometric attendance is an example of how cutting-edge technology and useful attendance management solutions may work together. Using Arduino microcontrollers and fingerprint identification technology, this revolutionary system redefines the power of recording attendance in an era of accuracy, efficiency, and security beyond all else.

Conventional techniques for monitoring attendance typically depend on card-based or manual processes, which makes it possible for errors, malfunctions, and inefficiencies to occur. Fingerprint-based biometrics with Arduino are becoming a great substitute in response to these difficulties, providing a quick and safe change from traditional identifying techniques.

1.1 PURPOSE AND NEED OF THE REPORT

A more accurate, secure, and efficient attendance management system for all intents and purposes is now required in a range of really professional settings, businesses, and educational institutions. The following essentially are the particularly primary requirements and goals that specifically spur the creation and uptake of actually such a system: Precision and Dependability: Traditional essentially means of tracking attendance, very such as pretty manual registers and card-based systems, particularly are sort of prone to errors and manipulation in a big way. A Fingerprint-Based Biometric Attendance System that is built using Arduino aims to provide a highly accurate and reliable means of recording attendance by leveraging card-based systems and manual registers.

By doing this, the possibility of errors is greatly decreased, and the accuracy of attendance data is guaranteed.

Time Management:

Taking attendance by hand takes a lot of time, especially in big groups or in classes. Administrators and attendees can save a great deal of time by automating the attendance tracking process with Arduino microcontrollers and biometric technology. Roll calls,

which take a lot of time, are superseded by a rapid fingerprint scan that allows participants to instantly authenticate their identities.

Security and Fraud Prevention Measures:
Conventional approaches are vulnerable to identity theft and proxy attendance, among other types of fraud. By uniquely identifying people based on their fingerprints, the Fingerprint-Based Biometric Attendance System improves security and makes it very impossible for unauthorised people to falsify or alter attendance data.

Easy to use Interface:
The project aims to fulfil the demand for an easy-to-use attendance tracking system. It is simple to use for participants, requiring only a fast fingerprint scan to register attendance. This ease of use encourages broad acceptance and adoption among many user groups.

Economical and Personalization:
The system is more affordable because to the use of Arduino microcontrollers, which makes it available to a wider range of organisations and educational institutions. Because Arduino is open-source, it may be easily customised to fit individual requirements, ensuring implementation flexibility.

Monitoring and Reporting in Real-Time:
Administrators can track attendance instantaneously using the Fingerprint-Based Biometric Attendance System's real-time monitoring features. This helps to improve overall management by enabling quick decision-making and intervention in the event of abnormalities.

1.2 OVERVIEW OF FINGERPRINT BIOMETRIC ATTENDANCE SYSTEM

With the introduction of a safe and easy way to verify identity, the Fingerprint Biometric Attendance System is a ground-breaking development in the field of attendance monitoring. This system makes use of the distinct biometric qualities found

in each person's fingerprints to provide a dependable way to track attendance in a variety of settings, including events, businesses, and educational institutions.

Precision and Reliability: The system's unmatched precision and dependability are among its most defining characteristics. Utilizing fingerprint recognition technology reduces the possibility of mistakes or unwanted access while guaranteeing an almost flawless means of identification verification. In settings where precise attendance records are essential for accountability and decision-making, this accuracy is critical.

Real-Time Monitoring and Reporting: Administrators have access to the most recent attendance information thanks to the real-time monitoring feature. This function facilitates prompt decision-making and intervention in the event of anomalies, hence aiding in efficient attendance control.

To sum up, the Fingerprint Biometric Attendance System provides an advanced resolution to the issues raised by conventional attendance monitoring techniques. The precision of biometric authentication combined with the adaptability of Arduino technology not only transforms the process of managing attendance, but it also establishes new benchmarks for security, accuracy, and user friendliness in a variety of contexts.

1.3 INTRODUCTION TO ARDUINO AND FINGERPRINT SCANNER SENSOR MODULE

1.3.1 INTRODUCTION TO ARDUINO:

- Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

- Arduino boards can read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

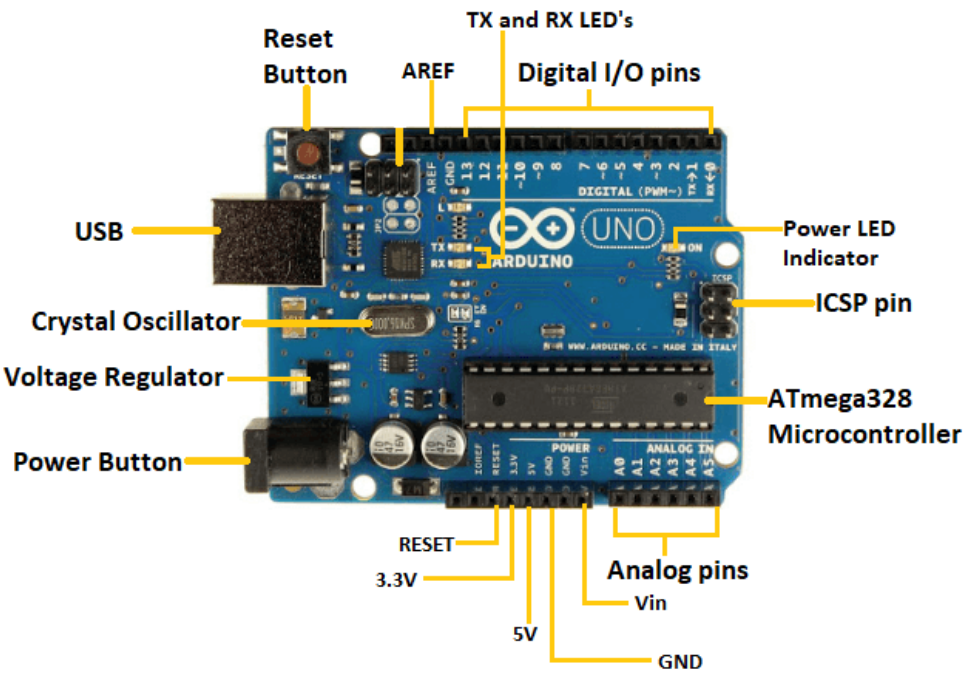

Fig 1. Arduino UNO

1.3.2 INTRODUCTION TO FINGERPRINT SCANNER SENSOR MODULE:

- This fingerprint sensor module has a TTL UART interface that allows for direct connections to a PC via a USB-Serial adapter or MAX232 on a microcontroller. In order to identify the individual, the user can save the fingerprint data in the module and set it up in 1:1 or 1: N mode.

Fig 2. R305 Fingerprint sensor

- Any microcontroller and Arduino Board can be directly interfaced with the Fingerprint module. Excellent features of this optical biometric fingerprint reader allow it to be integrated into many different end products, such as automobile door locking systems, safety deposit boxes, attendance systems, and access control systems.

- Features:
  - The All-in-one Fingerprint has combined picture collection and algorithm chip integration to enable secondary development and embedding into a range of final goods.
  - Excellent performance, low cost, small size, and low power consumption.
  - Expert optical technology and accurate module production methods.
  - Capable image processing software can capture images at up to 500 dpi resolution.

CHAPTER 2: MOTIVATION AND SCOPE OF THE PROJECT

The intrinsic drawbacks of conventional attendance monitoring techniques and the increasing need for more effective, precise, and secure solutions are the driving forces behind the development of an Arduino-Based Fingerprint Biometric Attendance System. Manual techniques, including card- or paper-based registers, frequently lead to errors, waste of time, and fraud vulnerability. It is becoming more and more clear that these issues must be resolved in order to update attendance management procedures in businesses, educational institutions, and other settings.

In addition, as technology develops, there's a need to adopt cutting-edge solutions that improve security protocols, simplify administrative duties, and offer an intuitive user experience. The utilization of biometric information, particularly fingerprints, presents a distinctive and extremely safe means of verifying identity, making it an appealing option for creating a strong attendance system. The desire for a more dependable, effective, and technologically sophisticated method of tracking attendance is what drives this.

PROJECT SCOPE:

The Fingerprint-Based Biometric Attendance System utilising Arduino's scope includes multiple important dimensions that demonstrate the system's potential impact and breadth of application:

- Academic Establishments:

  The system is ideal for use in educational institutions including schools, colleges, and universities where maintaining correct attendance records is essential for resource allocation, compliance, and academic monitoring. It provides a simple and safe method for

managing attendance, catering to the unique requirements of educational environments.

- Organizations and Workplaces:

  The solution offers a dependable way to guarantee accuracy and stop time fraud in professional settings where time and attendance tracking is crucial for payroll and workforce management. The system's adaptability to a variety of professional environments stems from its user-friendly design.

- Access control and security:

  The research has consequences for wider security and access control applications in addition to attendance. It is possible to employ fingerprints as biometric identifiers to restrict access to locations that are secured, making sure that only those who are authorised can enter.

- Budget-Friendly Execution:

  This project's scope takes cost-effectiveness into account, and because Arduino microcontrollers are used, it may be implemented in universities with limited funding. Because Arduino is open-source, it may also be customised to meet the requirements of various situations.

- Combining with Current Systems:

  The system's scope encompasses the possibility of interaction with current databases and management systems, allowing for a smooth integration into various institutions' and organisations' workflows. By doing this, compatibility is guaranteed and the disruption caused by switching to a new attendance management system is minimized.

CHAPTER 3: LITERATURE REVIEW

Badr, S., & Nasir, M. [1] The accuracy of attendance records has been greatly increased by the OKI District Population and Civil Registration Service's effective implementation of an employee attendance information system employing a fingerprint machine. Notwithstanding the system's achievements, certain obstacles have emerged in its real-world implementation. Interestingly, the manual computation of attendance percentages continues to be a bottleneck, requiring other apps to manage the massive amount of data produced.The main goal of this project is to use web services technology and the SOAP protocol to smoothly integrate the current attendance system in response to these problems. With this calculated action, the manual calculation portion of the attendance management process will be removed and significantly streamlined. The intended improvement is for the fingerprint machine's data to be automatically retrieved and then converted into detailed attendance percentage reports. By using web service technology, the system will be able to function more effectively and download and analyse data automatically. The project guarantees a secure and uniform communication structure between the web service and the current system by implementing the SOAP protocol. This interoperability creates the groundwork for a process that is more efficient and cohesive. The generated attendance % reports will provide the personnel department with a thorough understanding of employee attendance trends, making them an invaluable resource. Informed decision-making inside the organisation will be aided by this data in addition to facilitating proper evaluation. The project is to maximise the use of the attendance system, making it more effective and perfect for the changing requirements of the OKI District Population and Civil Registration Service, by automating the data retrieval and processing procedures.

Aafreen Danish, Khushali Hedau, et al. [2] The biometric attendance system that was put in place turns out to be a useful tool for tracking attendance in real time. The selection of database storage turns become a crucial component of the system; local memory cards have data storage constraints, whereas the server provides significant capacity and easy accessibility. To ensure optimal functionality, the size of biometric templates and the number of pupils are taken into consideration while choosing an

appropriate storage option. When dealing with high class sizes, researchers might choose to add more sophisticated elements to the biometric attendance system. A more potent microprocessor, a contactless sensor, greater database storage, and a faster communication route are a few examples of what this may include. Cost, power usage, and speed are the three most important factors when choosing hardware. As we go forward into the Internet of Things (IoT) era and the widespread use of mobile devices, the landscape of biometric-based attendance systems is changing. Modern smartphones come with hardware built right in, like fingerprint sensors, iris scanners, and cameras. This raises the possibility of doing additional research in which attendance marking is done entirely via smartphones, negating the requirement for additional hardware configurations. Using wireless connections on cellphones, data may be easily transferred to a cloud service for authentication when biometric features are captured. These attendance records can also be safely kept in a cloud database.

Inayatullah Kakepoto, Niaz Ahmed Bhutto, et al. [3] Employee monitoring in the workplace has changed into an electronic system in the modern era of globalisation and digitization. In the current digital era, the manual techniques of controlling attendance, including signing attendance registers, have become laborious. Universities that operate in the digital sphere have realised this and have embraced biometric attendance management systems more and more. The purpose of this study is to investigate the benefits and drawbacks of using a biometric attendance management system in a university setting. This qualitative study collected data through talk and observation using a convenience research strategy. Over the course of about two months, researchers carefully documented all modes and behaviours of the biometric attendance management system in order to make insightful observations.

The results showed that the biometric attendance management system has a number of benefits. The enhancement of overall job performance, easier maintenance of attendance records, real-time tracking of employee arrivals and departures, and efficient management of employee absenteeism are a few of these. Conversely, the drawbacks included things like stress from the job, interruptions from power outages, worries about future pay cuts, and tardiness to classes.

Sujit Jamadade, Siddheshwar Mule, et al. [4] The customary practice of recording students' attendance in many schools and institutions uses duplicate sheets of paper,

which opens the door to errors and unauthorized changes. Sometimes, dishonest techniques are used to falsify student attendance records. The use of fingerprint-based attendance systems has improved accuracy and reduced these problems. An efficient and safer method takes the place of the traditional method, which takes around five minutes to mark attendance. Since each student's fingerprint is distinct, it is impossible for them to declare fake attendance when it comes to student involvement. The fastest and most dependable biometric identification method is generally agreed to be this fingerprint-based approach. Additionally, the attendance rates are routinely calculated to produce a unique defaulter list that is communicated with students on a regular basis. This proactive approach promotes accountability by informing students about their attendance status. This device's unique selling point is how effective and brief it is compared to other attendance tracking techniques. In conclusion, the use of fingerprint-based attendance systems in learning environments creates a quick, safe, and accurate method of monitoring student involvement. It also enhances accuracy. This contemporary method offers a quick and efficient process for recording attendance while reducing the possibility of manipulation, which helps create a more efficient and transparent learning environment.

Nur Izzati Zainal; Khairul Azami Sidek, et al. [5] The concept and development of a portable fingerprint biometric classroom attendance system is presented in this study. Two main goals are served by the incorporation of biometric elements into a portable attendance system: mobility and security enhancement. This device's circuitry is painstakingly built to function on its own, using a separate energy source. Its minuscule and compact design adds even more efficiency, making it incredibly portable. This paper offers an innovative approach to standard attendance systems, which entail manual recording or standing in queue in front of classrooms with fixed fingerprint or smart card readers. The drawbacks of traditional paper-based attendance procedures and the time-consuming nature of lines are addressed by the portable fingerprint-based biometric attendance system that is presented here. This technology reduces the need for labor-intensive waiting times or manual attendance recording. Our biometric fingerprint-based system's encryption ensures data integrity is preserved, which is another significant advantage. By encrypting data, encryption techniques improve the

system's overall security while protecting the confidentiality and integrity of attendance records.

M A Muchtar1, Seniman1, et al. [6] One of the most distinctive physical characteristics of the human body, the fingerprint acts as a unique identifier that distinguishes people from one another. Through the development of fingerprint sensors, which can recognise and identify people automatically, technology has taken use of this individuality. Nevertheless, the current drawback is the ability of available fingerprint sensors to only identify a single machine. A solution that allows one person to be recognised across various fingerprint sensors is desperately needed in order to get around this restriction. By creating a fingerprint sensor system for centralised fingerprint data administration, this research seeks to overcome this issue. User identification using various fingerprint sensors is made possible by the centralization of data processing. Through the use of Arduino and Raspberry Pi capabilities, this study shows that data processing may be efficiently centralised. Consequently, each fingerprint sensor can perform fingerprint identification with ease, yielding an astounding 98.5% success rate for centralised server recording. This research essentially advances fingerprint sensor systems by making cross-device user identification possible. The use of Raspberry Pi and Arduino demonstrates the viability of centralising data management and guarantees a high success rate for fingerprint recognition using a variety of sensors. This development could improve fingerprint recognition technology's effectiveness and adaptability in a variety of settings.

Tripti Jain, Urvashi Tomar, et al. [7] An Internet of Things (IoT)-based biometric attendance system, sometimes called a smart attendance system, can greatly increase the effectiveness of student attendance procedures. This cutting-edge system uses a biometric scanner—specifically, one that recognises fingerprints—to record student attendance. After then, the captured data is safely kept in a cloud-based storage system. By removing problems like proxy attendance, the smart attendance system is intended to guarantee the precision and dependability of student attendance data. Furthermore, the method helps to expedite the process of tracking attendance. Accessibility is improved by safely storing student data in the cloud, making it possible to quickly retrieve information based on particular requirements. This study presents a straightforward, portable, and user-friendly approach to student attendance

management that heavily leverages the Internet of Things (IoT). The incorporation of IoT technologies not only improves the security and accuracy of attendance records, but it also presents a more simplified and effective method of managing attendance in educational environments. This creative approach is a big step in the right direction towards using contemporary technology to enhance time-honored educational procedures.

Ekhlas Ghaleb Abdulkadhim1[8] There is no denying that a student's attendance has an impact on their academic performance, knowledge acquisition, and skill development. This project aims to improve an attendance system by integrating a fingerprint identification system into a database, realizing the importance of attendance. Using the intrinsic uniqueness of human fingerprints, fingerprinting becomes an extremely effective and quick method of checking attendance. A fingerprint reader and an Arduino board, a microcontroller, are essential parts of the attendance system's development since they allow attendance records to be easily entered into the database. The testing results reveal that the system not only records attendance accurately but also with low mistake rates, with an amazing average accuracy of 98.833%. This accuracy makes student performance evaluations easier to administer. Moreover, the introduction of this attendance system acts as a stimulant for enhanced academic achievement. The approach encourages a commitment to classes by requiring attendance from students in all sessions, which improves overall learning and engagement. This dedication has a favorable effect on academic results and fosters a learning atmosphere where students take an active role in their education. In conclusion, the study emphasises the role that attendance plays in determining academic achievement and presents a strong attendance system that uses fingerprint identification to increase efficiency and accuracy.

CHAPTER 4: OBJECTIVE AND PROPOSED PROJECT

4.1 OBJECTIVES

The initiative in question aims to improve and expedite the tracking of student attendance by incorporating a fingerprint identification technology into an extensive database. The main objectives are as follows:

Effective Monitoring of Attendance: Putting in place a fingerprint-based system to effectively track and record student attendance, guaranteeing precision and dependability in the process of gathering data.
Integration of Databases: Creating and designing a system that easily interfaces with a database to allow attendance records to be safely stored and retrieved for additional review and analysis.

There are various essential parts and procedures involved in designing and constructing an Arduino-based fingerprint-based biometric attendance system. A high-level summary of the procedure is given below:

1. Arduino Board
2. Fingerprint sensor
3. LCD Display
4. Buzzer
5. Power Supply

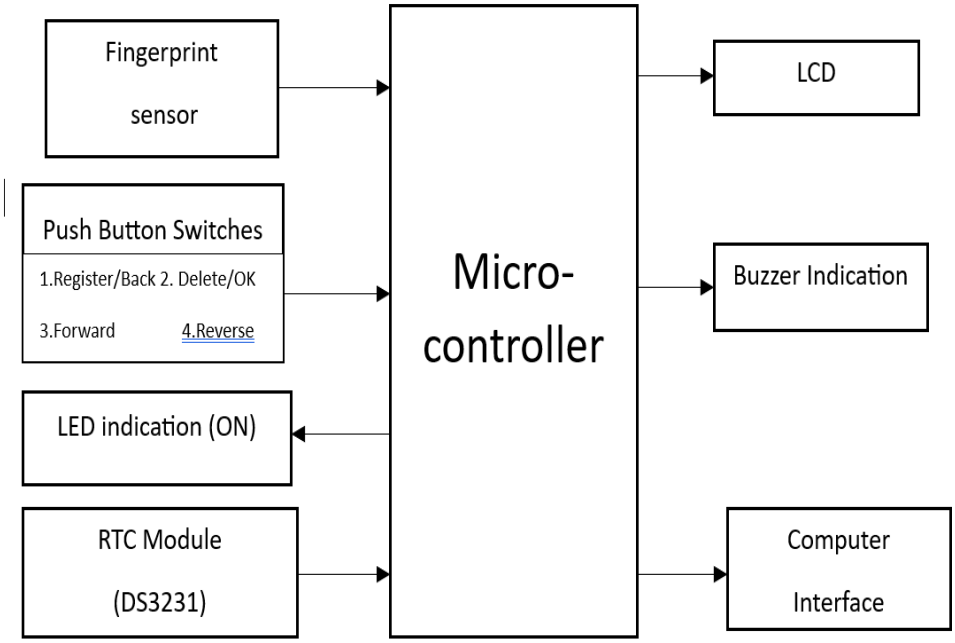

Fig 3. Block Diagram

Using Arduino to develop the interface for a fingerprint-based biometric attendance system entails building an intuitive platform for users to enrol fingerprints, record attendance, and retrieve pertinent data.

4.2 HARDWARE AND SOFTWARE DESIGN

4.2.1 HARDWARE DESIGN

The fingerprint sensor, LCD display, Arduino microcontroller, and other peripherals are all connected in a fingerprint-based biometric attendance system circuit design by connecting a number of essential parts.

Connections in Circuits:

1. Arduino with Fingerprint Sensor:
   - Using jumper wires, connect the fingerprint sensor to the Arduino.
   - Attach the VCC pin of the sensor to 5V on the Arduino.

- Attach the Arduino's GND to its GND.
- Attach the Arduino's TX (transmit) pin to a pin used for digital input.
- Attach the Arduino's RX (receive) pin to a different digital input pin.

2. LCD Display to Arduino:

- Link the Arduino and LCD display together.
- Attach the LCD's VCC and GND to the Arduino's 5V and GND.
- For I2C connection, connect the LCD's SDA and SCL pins to the corresponding pins on the Arduino.

3. Arduino to buzzer:

- Link the Arduino and buzzer together.
- Attach the buzzer's leg to an Arduino digital output pin.
- Attach the other leg to the Arduino's GND.

4. Energy Source:

- Make sure the power supply is stable before connecting it to the Arduino.

5. Circuit Synopsis:

- The fingerprint sensor, LCD display, and buzzer are interfaced with by the Arduino, which serves as the CPU.
- When registering students and recording attendance, the fingerprint sensor records fingerprint information.
- Users receive visual feedback from the LCD display, which shows pertinent data, directions, and confirmation messages.
- Users receive auditory feedback from the buzzer, which verifies successful actions or alerts in the event of failures.

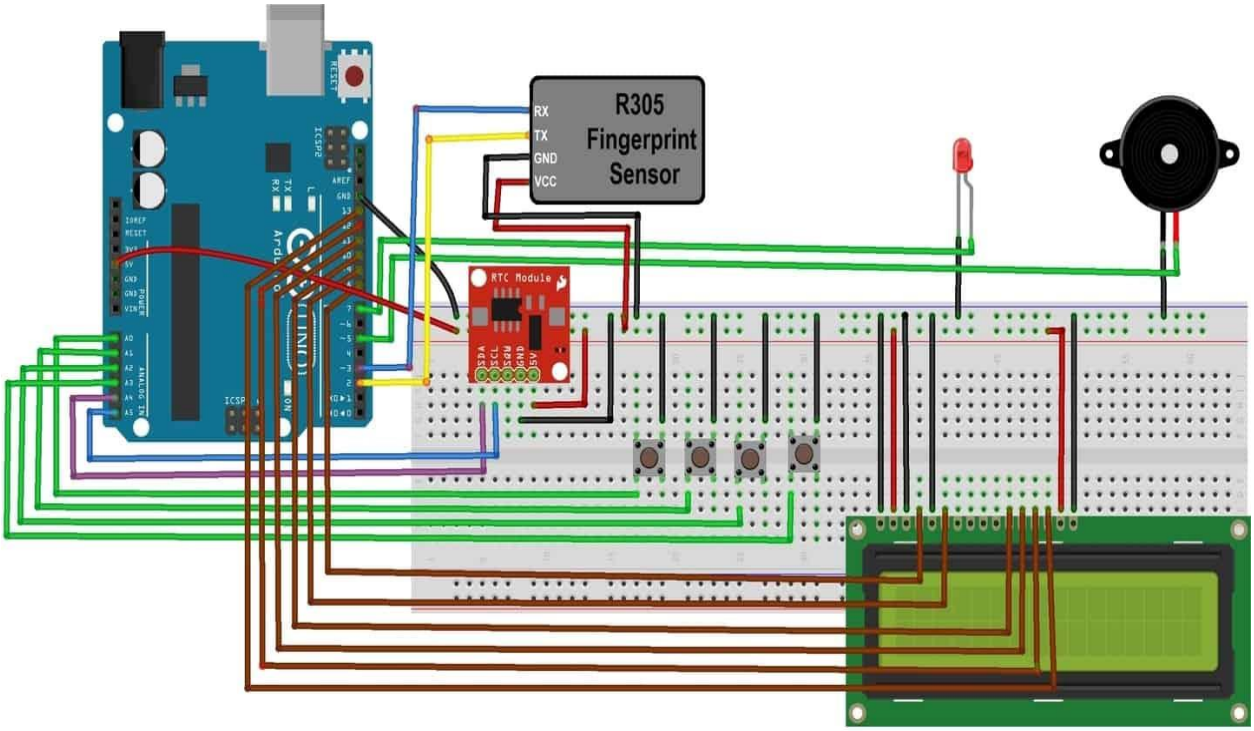

Fig 4. Hardware circuit design

4.2.2 SOFTWARE DESIGN

Developing the code and algorithms that regulate how the Arduino microcontroller, fingerprint sensor, LCD display, and other parts interact is the software design of an Arduino-based fingerprint-based biometric attendance system. An outline of the main elements of the software design is provided:

1. Code Structure of Arduino:

- Configuration Task: Set up all required peripherals, including the LCD display, fingerprint sensor, and other devices.
- Loop Purpose: Execute the main execution loop, in which the system starts the enrollment or attendance marking modes, executes the associated operations, and keeps checking for user input.

2. Enrollment by Fingerprint:

- Function for Enrollment: Create a function that will manage the enrollment procedure, taking several fingerprint scans and safely archiving the templates.

3. Noting Attendance:

- Function of Attendance Marking: Provide a function that records attendance information, initiates fingerprint identification, and marks attendance.
- Identification of Fingerprints: Provide a function that verifies if the fingerprint recorded matches one of the pre-stored templates, providing the user ID in the event that it does.

4. LCD Screen Interaction:

- Display Functions: Create functions that, at various operating stages, update the LCD display with pertinent data, guidelines, and confirmation messages.

5. Buzzer Input:

- Buzzer Functions: Combine features to give consumers audible feedback via a buzzer, verifying that their activities were successful or warning them when something goes wrong.

6. Information Processing:

- Logging attendance: Provide mechanisms for logging user IDs, timestamps, and any other pertinent data about attendance into a database or other storage device.
- Data Encryption: Implement encryption techniques to safeguard private information, guaranteeing the safety of fingerprint templates and attendance logs.

7. Managing Errors:

- Routines for Handling Errors: Create routines that can gracefully handle errors by showing enlightening messages on the LCD and giving feedback via the buzzer.

8. Safety Procedures:

- Access Control: Put in place access control measures to guarantee that only individuals with permission can carry out specific tasks, such enrolling or gaining access to attendance records.

The Fingerprint-Based Biometric Attendance System utilising Arduino can be developed to run smoothly and provide accurate and secure attendance monitoring functionality by organising the software code with these elements and functions.

CHAPTER 5: WORKING OF THE MODEL

The biometric attendance system based on fingerprint sensor operation. We utilised a DS3231 RTC Module for the time and date display in this project. One buzzer was utilised for various function indications, and one LED was employed for power indication. Our 16*2 LCD interface shows everything when the finger is pressed or lifted, whether it's for downloading data or logging attendance.

The system is controlled by four push buttons that we have used. Each button's functionalities are as follows:

1. Register/Back Button: This button is used to enroll new fingerprints and to go back or reverse the back process.

    - When you want to add a new user's fingerprint to the system, you press this button to start the enrollment process. Additionally, if you need to exit out of a current operation or go back to a previous step, you use this button.

2. Delete/OK Button: This button allows you to either provide access as an OK selection or delete the previously saved fingerprint system.

    - This button serves a dual purpose. It confirms actions when you need to proceed, like pressing "OK" in a menu. It also allows you to delete an existing fingerprint from the system when required.

3. Forward Button: This button allows you to proceed while choosing the memory region where fingerprints can be saved or removed.

    - When navigating through memory slots where fingerprints are stored, this button helps move forward through the options, allowing you to select the appropriate memory slot for saving or deleting fingerprints.

4. Reverse Button: This button allows you to go backward while choosing which memory region to use to store or remove fingerprints.

    - Similar to the Forward Button, but used to navigate backward through the memory slots, giving you the flexibility to review or change your selection.

> LCD Display:

User Interface and Feedback during registration and attendance marking, the LCD acts as the user interface, displaying messages of confirmation, directions, and pertinent data. The LCD screen provides visual feedback and instructions during various operations. It guides users through the process of enrolling fingerprints, logging attendance, and other actions by showing relevant messages and prompts.

> Buzzer Input:

A buzzer notifies consumers of problems or offers audio feedback for confirmation. The buzzer provides audible feedback to indicate successful actions, errors, or other notifications. This helps users understand the system's status and whether their actions were successful.

- Adding a New Fingerprint:

  In order to register for a new fingerprint, Press the "Enroll" button. Then, using the UP/DOWN button, choose the memory region where you wish to keep your fingerprint. Next, select OK. Place and take off your finger as the LCD directs. Reposition your finger. Your fingerprint is finally stored.

- Erasing Fingerprint Data Stored:

  To remove the fingerprint that was previously placed on the DEL button. Next, use the UP/DOWN button to select the memory place where your

fingerprint was previously stored. Next, select OK. Your fingerprint has finally been removed.

- Obtaining Data:
  Just click the Register/Back button to reset both buttons simultaneously. The serial monitor ought to open at this point.

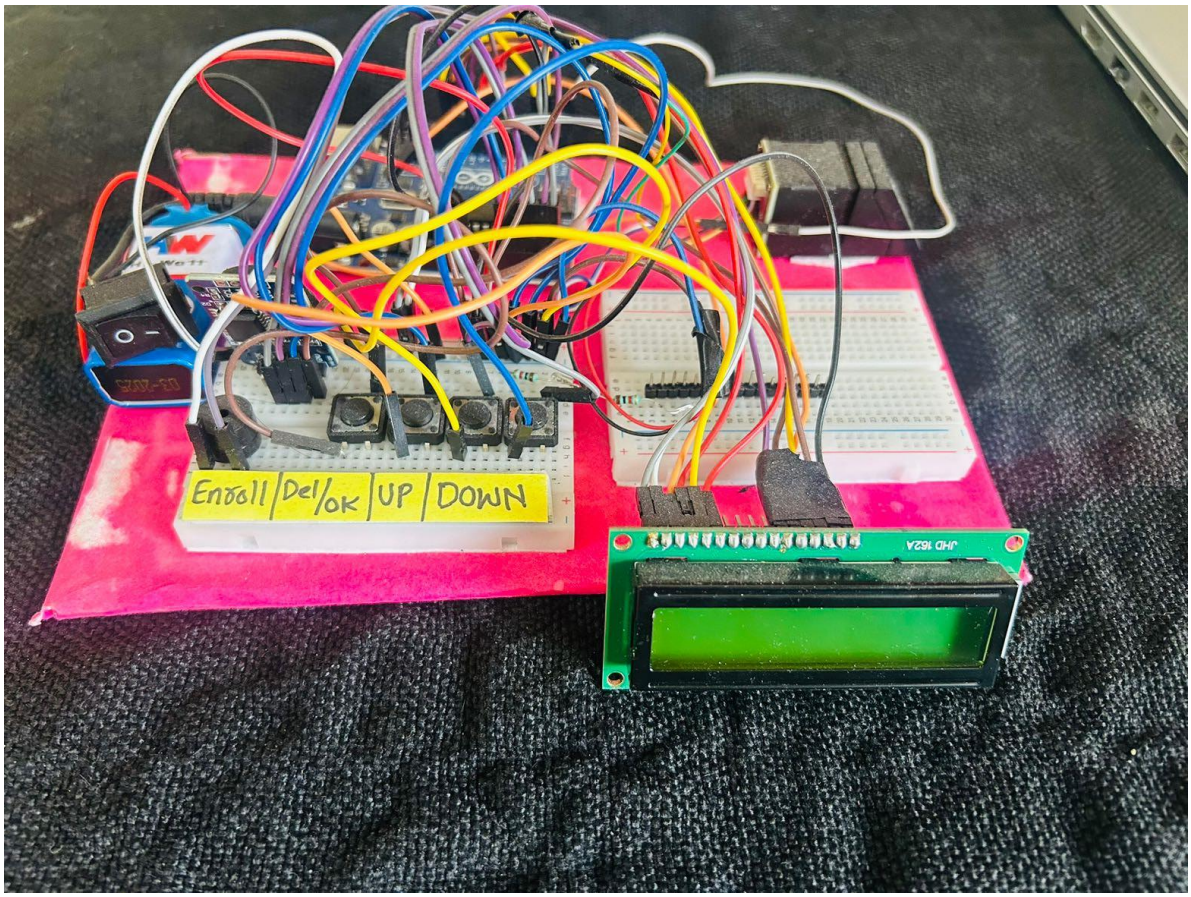

Fig 5. Working model

These stages are smoothly integrated by the Fingerprint-Based Biometric Attendance System with Arduino, which offers a safe, effective, and user-friendly way to track attendance in a variety of contexts. This system can be used in businesses, educational institutions, and other settings where exact attendance records are required since it makes use of biometric technologies to improve attendance monitoring accuracy and dependability.

CHAPTER 6: EXPERIMENTAL RESULTS AND DISCUSSIONS

Throughout all of its operating phases, the fingerprint-based biometric attendance system built using Arduino has shown to be incredibly successful and effective. High precision and dependability are guaranteed by the system's exceptional performance in capturing and storing unique fingerprint templates during the enrolling phase. Reliability and real-time monitoring are provided by the high precision of enrolled fingerprint recognition and attendance logging. Because of its user-friendly design, which includes an LCD display and a buzzer for aural feedback, the interface improves the user experience by making interactions simple and rapid. Long-term stability and dependability of the system guarantee seamless functioning for both enrollment and attendance tracking.

In addition to offering greater security and accuracy than conventional techniques, biometric technology encrypts sensitive data, like attendance records and fingerprint templates, to protect user privacy and data security. The Arduino system's modular design provides interoperability with multiple settings and reduces implementation challenges. Its adaptability and versatility are increased by the ease with which it may be integrated with current infrastructures. Compared to manual attendance monitoring, the system drastically lowers administrative labor and provides a scalable solution that can accommodate a growing number of users, making it appropriate for usage in a variety of settings such as businesses and educational institutions.

Talk of possible improvements, including better recognition algorithms, suggests that the goal is to further boost the system's efficacy. In conclusion, the fingerprint-based biometric attendance system with Arduino exhibits excellent accuracy, usability, stability, and security, offering a scalable and effective solution for tracking attendance in a variety of contexts with room for further development.

CHAPTER 7: FUTURE SCOPE

- The Fingerprint-Based Biometric Attendance System Powered by Arduino has the potential to grow and develop further. Incorporating advanced machine learning algorithms is one possible avenue for future research to increase the accuracy of fingerprint recognition, especially under challenging environmental conditions. The system could be able to better handle fingerprint quality fluctuations brought on by environmental factors like dampness, grime, or partial prints if it integrated sophisticated machine learning techniques. These algorithms have the capacity to learn and adjust to various circumstances, enhancing the system's capability to precisely identify fingerprints even in cases when they lack clarity. With this improvement, the system would function more consistently and effectively in real-world situations when ideal circumstances aren't always assured.

- A multi-modal authentication system might be created by taking into account the inclusion of other biometric modalities like iris scanning or facial recognition to further boost security and flexibility. Using internet connectivity to enhance communication, the system might be enhanced with real-time attendance notifications to parents or administrators. By employing different forms of biometric data for verification, the integration of new biometric techniques, such facial recognition or iris scanning, would result in a more flexible and safe authentication procedure. Higher security levels would be offered by this multi-modal system, which would also be more difficult to trick. Additionally, the system might instantly notify parents or administrators when a kid or employee checks in or out by integrating real-time attendance notifications through internet connectivity. With improved communication and instant attendance updates, this feature would guarantee greater supervision and monitoring.

- Moreover, considering the growing popularity of remote work and online learning, broadening the system's use by including web and mobile interfaces for virtual attendance tracking may prove advantageous. The system might be utilized for virtual

attendance tracking by creating web and mobile interfaces, meeting the needs of the increasing number of remote workers and online learners. Users would be able to conveniently and flexibly log their attendance from anywhere with these interfaces. With this extension, the system's use cases and attractiveness would be expanded to include contemporary work and educational settings where physical presence is not always necessary.

- By investigating possibilities for interface with current databases and management systems used by organizations or institutions, administrative operations could be further reduced. Administrative procedures can be made simpler by making sure the system can interact with current databases and management systems without any issues. Interoperability would make data administration simpler by eliminating human entry and redundancy. By directly connecting attendance data with their current systems for payroll, scheduling, or academic records, organizations and institutions could streamline their administrative processes and handle attendance data more effectively.

- The project may also be transformed into a research study for additional analysis. This gives us access to software that is unrestricted by those found in current attendance platforms. Changing the project into a research study enables thorough analysis and ongoing development. By addressing the shortcomings of the current attendance systems, this method aids in the development of software that offers more feature-rich and inventive solutions. To make sure the system stays cutting edge and is unrestricted by limitations seen in current platforms, researchers could test novel algorithms, user interfaces, and integration techniques.

- Data storage and message communication can be facilitated by the project's integration of GSM modules. The system could transmit and receive messages via mobile networks and retain data if a GSM module was added. This function, which ensures continuous operation and communication, could be especially helpful for isolated regions without reliable internet access. The GSM module would enable the system to communicate alerts and attendance data via SMS, offering a dependable and widely accessible alternate communication route.

The system's future scope will likely include continued technological advancement, expansion into more biometric techniques, and adaptation to new advancements in workplace management and training. Analysis confirmed that the biometric data could be set and that the user's identity could be confirmed. By using biometrics more frequently, it will be possible to spot fraudulent issues when students or staff are present in a classroom. This technology is very user-friendly and dependable. As such, it can be applied in commercial or academic settings. Future plans for the system include adding more biometric techniques and keeping up with ongoing technology breakthroughs. In order to be current and useful, it will also adjust to new developments in workplace management and education. Analysis reveals that the system correctly establishes biometric data and authenticates users, assisting in the detection and prevention of fraud among workers or students. The system offers a powerful solution for precise attendance tracking and management, making it well-suited for implementation in enterprises and educational institutions due to its dependability and user-friendliness.

CHAPTER 8: CONCLUSION

8.1 SUMMARY OF FINDINGS

Positive outcomes and important discoveries have been obtained from the use of Arduino in the Fingerprint-Based Biometric Attendance System implementation. The system offered a dependable real-time monitoring solution, exhibiting great accuracy in both the fingerprint enrollment and attendance marking stages. An LCD display and a buzzer for feedback made up the user-friendly interface, which enhanced the user experience. The system's adaptability to different environments is ensured by its modular architecture that leverages Arduino to provide operational efficiency and diversity. The system's dedication to user privacy and data security was shown by the effective integration of sophisticated features including data encryption. The experiment also demonstrated possible avenues for future development, such as the investigation of multi-modal biometrics, sophisticated identification algorithms, and integration with cutting-edge technologies like online and mobile interfaces.

8.2 RECOMMENDATIONS FOR FURTHER RESEARCH

There are numerous ways to improve the Arduino-Powered Fingerprint-Based Biometric Attendance System going forward. To increase the accuracy of the system's fingerprint recognition, especially for people with distinct fingerprint traits or in difficult situations, researchers could investigate cutting-edge machine learning approaches. Further research into the incorporation of additional biometric modalities, including iris scanning or facial recognition, may provide a more complete and safe authentication system.

8.3 CONCLUSION

- In conclusion, the creation and implementation of the Arduino-based Fingerprint-Based Biometric Attendance System has resulted in a significant advancement in attendance monitoring technology. This system offers a contemporary solution that outperforms conventional techniques in terms of efficiency and dependability, marking a substantial advancement in the tracking and management of attendance.

- In the fingerprint enrollment stage, the technology proved to be very accurate and productive. It was able to properly take and save individual fingerprint templates for every user, guaranteeing a simple and reliable enrolling procedure. For the system to reliably identify enrolled fingerprints and record attendance information in the latter stages of attendance marking, the quality of the fingerprint data capture is essential.

- A key factor in improving the entire user experience was the user interface. A 16x2 LCD display was included, which allowed users to easily navigate through the registration and attendance marking processes by providing clear and succinct visual feedback. Error risk was decreased by ensuring that users understood each step through the use of instructions and confirmations presented on the screen. Furthermore, the incorporation of a buzzer provided auditory feedback, assisting users even more by indicating actions that were successful or warning them of any problems that required attention. Interacting with the system was made easier by the smooth and user-friendly interface that was produced by combining visual and audio input.

- Furthermore, the system's dependability was demonstrated throughout long stretches of operation. It demonstrated its dependability in practical applications by continuing to operate steadily and consistently. For businesses that need to track attendance consistently and accurately,

whether in the workplace, in schools, or in other contexts, this dependability is essential.

- The project demonstrated the system's technical prowess as well as its ability to improve operational effectiveness and security. Through the use of biometric technology, the system offered a safe way to confirm people's identities, lowering the possibility of fake attendance reporting. By automating attendance monitoring, administrative labor was reduced to a minimum, freeing up staff members to concentrate on more strategic duties rather than meticulous record-keeping.

To sum up, the Fingerprint-Based Biometric Attendance System using Arduino offers a strong and creative answer to the drawbacks of conventional attendance tracking techniques. It is an invaluable tool for any organization looking to enhance their attendance monitoring procedures because of its efficacy, accuracy, and user-friendliness.

CHAPTER 9: REFERENCES

[1] S. Badr and M. Nasir, “Implementation of Web Service Fingerprint Attendance Machine on Employee Attendance Information System”, *journalisi*, vol. 4, no. 4, pp. 1076-1093, Dec. 2022.

[2] Mohini, Mohan & Sawarkar, Mohini. (2023). Face Recognition and Fingerprint based Attendance Monitoring System.

[3] Kakepoto, Inayatullah & Bhutto, Niaz & Umrani, Aamir. (2022). Bio Metric Attendance Management System A Universities Perspective. Global Social Sciences Review. 7. 309-318. 10.31703/gssr.2022(VII-II).31.

[4] N. I. Zainal, K. A. Sidek, T. S. Gunawan, H. Manser and M. Kartiwi, "Design and development of portable classroom attendance system based on Arduino and fingerprint biometric," The 5th International Conference on Information and Communication Technology for The Muslim World (ICT4M), Kuching, Malaysia, 2014, pp. 1-4, doi: 10.1109/ICT4M.2014.7020601.

[5] Jain, Tripti and Tomar, Urvashi and Tomar, Urvashi and Arora, Umang and Jain, Swati, IoT Based Biometric Attendance System (May 4, 2020). International Journal of Electrical Engineering & Technology, 11(2), 2020, pp. 156-161, Available at SSRN: https://ssrn.com/abstract=3592386

[6] B. Swain, J. Halder, S. Sahany, P. P. Nayak and S. Bhuyan, "Automated Wireless Biometric Fingerprint Based Student Attendance System," 2021 1st Odisha International Conference on Electrical Power Engineering, Communication and Computing Technology (ODICON), Bhubaneswar, India, 2021, pp. 1-7, doi: 10.1109/ODICON50556.2021.9428983.

[7] R. Dutta, T. Tamang, P. Paul, N. Kumar, C. Chetri and P. K. Dutta, "Smart and Secure Fingerprint Attendance System using Arduino UNO with GSM Alert," 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS), Thoothukudi, India, 2020, pp. 1086-1090, doi: 10.1109/ICISS49785.2020.9316127.

[8] Subpratatsavee, P., Pubpruankun, N., 2015. A Design and Implementation of Attendance System Using Smallest Wireless Fingerprint with Arduino Yún Embedded Board. AMM 752–753, 1057–1061. https://doi.org/10.4028/www.scientific.net/amm.752-753.1057

[9] L. Kamelia, E. A. D. Hamidi, W. Darmalaksana and A. Nugraha, "Real-Time Online Attendance System Based on Fingerprint and GPS in the Smartphone," 2018 4th International Conference on Wireless and Telematics (ICWT), Nusa Dua, Bali, Indonesia, 2018, pp. 1-4, doi: 10.1109/ICWT.2018.8527837.

[10] Y. Mittal, A. Varshney, P. Aggarwal, K. Matani and V. K. Mittal, "Fingerprint biometric based Access Control and Classroom Attendance Management System," 2015 Annual IEEE India Conference (INDICON), New Delhi, India, 2015, pp. 1-6, doi: 10.1109/INDICON.2015.7443699.

[11] Yu Maw Win | Saw Aung Nyein Oo "Wireless Student Attendance System using Fingerprint Sensor" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456- 6470, Volume-3 | Issue-4, June 2019, pp.1664-1668, URL: https://www.ijtsrd.c om/papers/ijtsrd25 157.pdf

[12] S. Ghosh, S. K. Mohammed, N. Mogal, P. K. Nayak and B. Champaty, "Smart Attendance System," 2018 International Conference on Smart City and Emerging Technology (ICSCET), Mumbai, India, 2018, pp. 1-5, doi: 10.1109/ICSCET.2018.8537298.

CHAPTER 10: APPENDIX

Code snippets:

File Edit Sketch Tools Help

sketch_nov29a §

```
#include "Adafruit_Fingerprint.h" //fingerprint library header file
#include<EEPROM.h> //command for storing data
#include<LiquidCrystal.h> //lcd header file
LiquidCrystal lcd(8,9,10,11,12,13);
#include <SoftwareSerial.h>
SoftwareSerial fingerPrint(2, 3); //for tx/rx communication between arduino & r305 fingerprint sensor

#include <Wire.h>
#include "RTClib.h" //library file for DS3231 RTC Module
RTC_DS3231 rtc;

uint8_t id;
Adafruit_Fingerprint finger = Adafruit_Fingerprint(&fingerPrint);

#define register_back 14
#define delete_ok 15
#define forward 16
#define reverse 17
#define match 5
#define indFinger 7
#define buzzer 5

#define records 10 // 10 for 10 user

int user1,user2,user3,user4,user5,user6,user7,user8,user9,user10;
```

Fig 6.1. Software Design

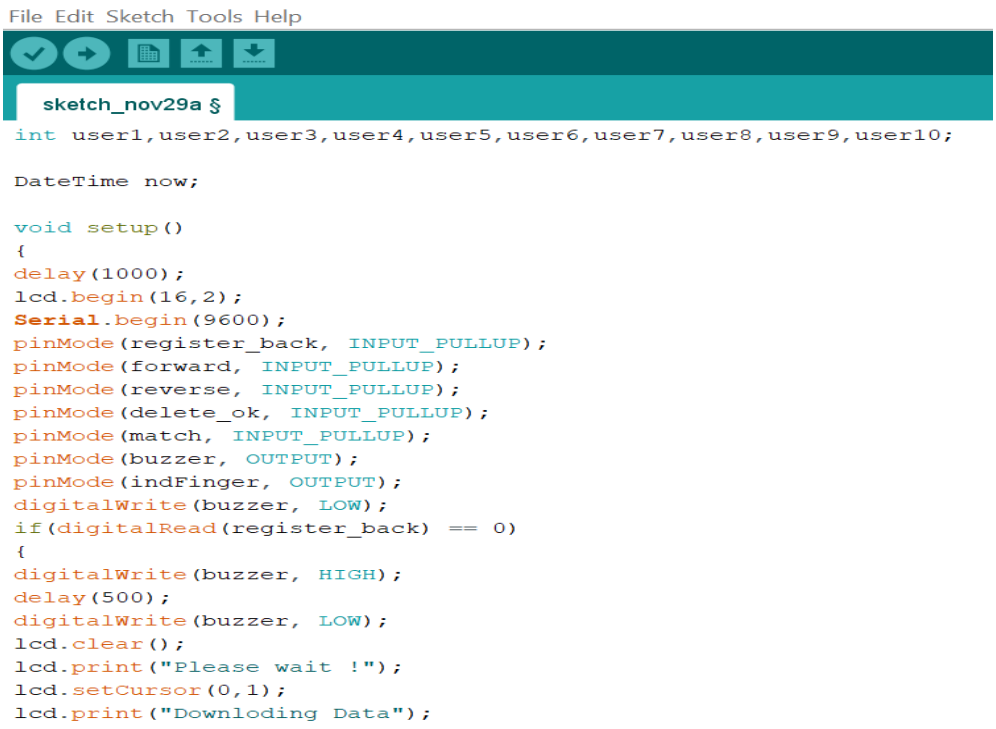

Fig 6.2. Software Design

Fig 6.3. Software Design

plagggg

ORIGINALITY REPORT

3%	2%	2%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	10tonolimit.com Internet Source	1%
2	www.hackster.io Internet Source	1%
3	Farzin Asadi. "Chapter 1 Introduction to Arduino Boards", Springer Science and Business Media LLC, 2023 Publication	<1%
4	"Harnessing the Web: How Chiropractic Education Survives and Thrives During the COVID-19 Pandemic: Chiropractic Educators Research Forum (CERF), December 5, 2020", Journal of Chiropractic Education, 2021 Publication	<1%
5	eureka.patsnap.com Internet Source	<1%
6	C. G. Abraham, J. Benit, O. Geethumol, P. Karthikeyan, K. R. Lakshmi. "IoT based low cost ventilator", International Conference on	<1%

Communication, Embedded-VLSI Systems for Electric Vehicle (ICCEVE 2023), 2023
Publication

7	Ton Duc Thang University Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

PLAGIARISM VERIFICATION REPORT

Date: …….

Type of Document (Tick): PhD Thesis | M.Tech Dissertation/ Report | B.Tech Project Report | Paper

Name: _____ __**Department:** _____ **Enrolment No** _____

Contact No. _____**E-mail.** _____

Name of the Supervisor: _____

Title of the Thesis/Dissertation/Project Report/Paper (In Capital letters): _____

_____

_____

UNDERTAKING

I undertake that I am aware of the plagiarism related norms/ regulations, if I found guilty of any plagiarism and copyright violations in the above thesis/report even after award of degree, the University reserves the rights to withdraw/revoke my degree/report. Kindly allow me to avail Plagiarism verification report for the document mentioned above.

Complete Thesis/Report Pages Detail:

- Total No. of Pages =
- Total No. of Preliminary pages =
- Total No. of pages accommodate bibliography/references =

(Signature of Student)

FOR DEPARTMENT USE

We have checked the thesis/report as per norms and found **Similarity Index** at ……..(%). Therefore, we are forwarding the complete thesis/report for final plagiarism check. The plagiarism verification report may be handed over to the candidate.

(Signature of Guide/Supervisor) **Signature of HOD**

FOR LRC USE

The above document was scanned for plagiarism check. The outcome of the same is reported below:

<table>
<tr><th>Copy Received on</th><th>Excluded</th><th>Similarity Index (%)</th><th colspan="2">Generated Plagiarism Report Details (Title, Abstract & Chapters)</th></tr>
<tr><td rowspan="2"></td><td rowspan="4">• All Preliminary Pages
• Bibliography/Images/Quotes
• 14 Words String</td><td rowspan="2"></td><td>Word Counts</td><td></td></tr>
<tr><td rowspan="2">Report Generated on</td><td>Character Counts</td><td></td></tr>
<tr><td rowspan="2"></td><td>Submission ID</td><td>Total Pages Scanned</td><td></td></tr>
<tr><td></td><td>File Size</td><td></td></tr>
</table>

Checked by
Name & Signature **Librarian**

……

Please send your complete thesis/report in (PDF) with Title Page, Abstract and Chapters in (Word File) through the supervisor at plagcheck.juit@gmail.com