

# Fingerprint Based Attendance System Using ARDUINO Uno

Showmitra Roy, Asif Ahmed Tanjid, Sunjida Kabir Shepa, Md. Hajjaj Bin Sonosi, Nafiz Reza Ovi Miaji  
Computer Science and Engineering Department, AIUB  
Dhaka, Bangladesh

[royshowmitra@gmail.com](mailto:royshowmitra@gmail.com)  
[asifahmednirob44@gmail.com](mailto:asifahmednirob44@gmail.com)  
[sanjidashifabd2001@gmail.com](mailto:sanjidashifabd2001@gmail.com)  
[hajjajbin149138@gmail.com](mailto:hajjajbin149138@gmail.com)  
[nafizrezaovi69@gmail.com](mailto:nafizrezaovi69@gmail.com)

**Abstract**—In today's digital age, attendance management has become an essential aspect of various organizations. Traditional methods of attendance management, such as paper-based attendance registers or manual entries, have become outdated due to their time-consuming and error-prone nature. To overcome these limitations, biometric attendance systems have gained popularity as they provide reliable and secure authentication. In this project, we propose a fingerprint-based attendance system using Arduino. The system consists of an Arduino board, a fingerprint sensor module, a 16x2 LCD display, and a few other components. The fingerprint sensor module captures and stores the fingerprints of individuals, which can be used to authenticate their attendance. The Arduino board acts as the main processing unit that controls the sensor module and manages the data received from it. The system is designed to be user-friendly, cost-effective, and efficient. It eliminates the need for manual attendance registers, thereby reducing the chances of errors and fraud. The system also provides real-time attendance tracking, which can help organizations to monitor their employees' attendance and performance. In summary, our proposed fingerprint-based attendance system using Arduino is an innovative and effective solution to attendance management. It can be easily implemented in various organizations, such as schools, colleges, offices, and factories, to streamline attendance management and increase efficiency.

**Keywords**— Attendance management, Biometric attendance system, Fingerprint sensor, Arduino board, LCD display, Real-time tracking, Employee performance, User-friendly, Cost-effective, Efficiency

## I. INTRODUCTION

1.1 Background of Study and Motivation: Attendance management is a critical task for various organizations, including schools, colleges, offices, and factories. Traditional attendance management methods, such as paper-based registers or manual entries, are time-consuming, error-prone, and unreliable. With the advancement of technology, biometric authentication systems, such as fingerprint-based attendance systems, have gained popularity as they offer a secure and reliable means of attendance tracking. In recent years, there has been a growing demand for such systems due to their accuracy,

speed, and convenience. The motivation behind this project is to provide a user-friendly, efficient, and cost-effective solution for attendance management using biometric authentication. The proposed system is based on Arduino, which is an open-source microcontroller platform widely used for various electronic projects. The use of Arduino in this project makes the system highly customizable, easily programmable, and affordable. The system aims to eliminate the drawbacks of traditional attendance management methods, such as manual errors and time-consuming processes, by providing a reliable and efficient means of attendance tracking. This project aims to provide a practical solution that can be easily implemented in various organizations to streamline attendance management and increase productivity.

1.2 Project Objectives: The main objective of this project is to design and implement a fingerprint-based attendance system using Arduino. The specific objectives of the project are:

- To design and implement a hardware system that captures and stores fingerprints for authentication purposes.
- To develop software that manages fingerprint data and processes it for attendance tracking.
- To integrate the hardware and software components into a complete system that provides real-time attendance tracking.
- To provide a user-friendly interface for managing the attendance data and generating reports.
- To evaluate the system's performance in terms of accuracy, speed, and reliability.
- To demonstrate the feasibility and practicality of the system by testing it in a real-world setting.
- To assess the system's cost-effectiveness and scalability for use in different organizations.
- To contribute to the field of attendance management by providing an innovative and efficient solution for biometric authentication.

Overall, the project aims to provide a comprehensive solution for attendance management using biometric authentication that can be easily implemented and customized for different organizational needs.

1.3 A brief outline of the report: The report will provide a detailed account of the project's design, development, and

evaluation. It will include a literature review of related works, a description of the methodology, and the results of the system's performance evaluation. The report will also discuss the practicality and cost-effectiveness of the system and provide recommendations for future work. The appendices will include technical specifications, code snippets, and a user manual for the system. Overall, the report will provide a comprehensive overview of the proposed fingerprint-based attendance system using Arduino.

## II. LITERATURE REVIEW

Attendance management is an essential aspect of various organizations, and over the years, different methods have been used to track employee or student attendance. Traditional methods, such as paper-based registers or manual entries, have several limitations, including being time-consuming, prone to errors, and easy to manipulate. Biometric authentication systems have gained popularity as a reliable and secure means of attendance tracking. Fingerprint recognition technology, in particular, has become widely used due to its accuracy, speed, and convenience.

Several studies have been conducted to investigate the effectiveness of fingerprint-based attendance systems. A study by Ayman A. Elsayed and Mohamed A. El-saidy (2019) implemented a fingerprint recognition-based attendance system using a Raspberry Pi and achieved an accuracy of 99.5%. Another study by Zeeshan Ahmed and Fizza Abbas (2018) developed a fingerprint-based attendance system using Arduino and achieved an accuracy rate of 98%.

Arduino is an open-source microcontroller platform that has gained popularity in the development of electronic projects. Several studies have used Arduino in the development of attendance management systems. A study by Shanthi K. and P. S. Priyan (2018) developed a fingerprint-based attendance system using Arduino and achieved an accuracy rate of 97.5%. Similarly, a study by R. Bharathi and M. Arockia Babu (2017) developed an attendance management system using Arduino and achieved an accuracy rate of 96%.

Fingerprint recognition technology is based on the analysis of unique patterns in the ridges and valleys of the fingerprints. Several studies have investigated the use of different algorithms for fingerprint recognition. A study by Kalyani Mane and Prashant Kharat (2018) compared the performance of three different algorithms for fingerprint recognition and found that the minutiae-based algorithm achieved the highest accuracy rate of 97.5%. Another study by Abhishek Arora and Neha Choudhary (2018) proposed a hybrid approach that combined the minutiae-based algorithm and the texture-based algorithm, achieving an accuracy rate of 98.6%.

In conclusion, biometric authentication systems, particularly fingerprint-based attendance systems, provide a reliable and secure means of attendance tracking. Arduino is a flexible and cost-effective platform that can be used in the development of such systems. Fingerprint recognition technology is a promising area of research that continues to improve in terms

of accuracy and speed. The findings of previous studies can provide valuable insights for the development of a fingerprint-based attendance system using Arduino in this project.

## III. METHODOLOGY AND MODELING

**3.1 Introduction:** The proposed project is a fingerprint-based attendance system using Arduino, which is a microcontroller platform that is widely used in electronics projects due to its flexibility and ease of use. This attendance system is designed to automate the process of recording attendance in schools, colleges, and other organizations, thereby reducing the time and effort required for manual attendance taking.

**3.2 Working Principle of the Proposed Project:** The working principle of the proposed project is based on fingerprint recognition technology. The system captures the fingerprint of a user and compares it with the fingerprints stored in the database. If there is a match, the attendance of the user is recorded. The system consists of a fingerprint module, Arduino board, LCD display, and a relay module.

### 3.2.1 Process of Work:

The working of the Fingerprint Sensor Based Biometric Attendance System. In this project, we have used a DS3231 RTC Module for time & date display. We used 1 LED for power indication, and 1 buzzer for different function indications. We have interfaced 16\*2 LCD which displays everything whenever the finger is placed or removed or registering attendance or downloading data.

We have used 4 push buttons which are used to control the entire system. The functions of each button are:

1. Register/Back Button – Used for enrolling new fingerprints as well as reversing the back process or going back
2. Delete/OK Button – This Button is used for deleting the earlier stored fingerprint system as well as granting access as an OK selection.
3. Forward Button – Used for moving forward while selecting the memory location for storing or deleting fingerprints.
4. Reverse Button – Used for moving backward while selecting memory location for storing or deleting fingerprints.

**Registering New Fingerprint:** To register New Fingerprint, click on the Register button. Then select the memory location where you want to store your fingerprint using the UP/DOWN button. Then click on OK. Put your finger and remove your finger as the LCD instructs. Put your finger again. So finally, your fingerprint gets stored.

**Deleting Stored Fingerprint:** To delete the fingerprint which is already clicked on DEL Button. Then select the memory location where your fingerprint was stored earlier using the UP/DOWN button. Then click on OK. So finally, your fingerprint is deleted.

### 3.3 Description of the components:

#### Arduino Uno Board:



The Arduino Uno is a popular microcontroller board based on the ATmega328P microcontroller. It is widely used for prototyping and developing electronic projects, particularly in the fields of robotics, automation, and the Internet of Things (IoT). Here are some of its main uses:

**Educational tool:** Arduino Uno is often used in educational settings to teach electronics, programming, and engineering concepts, thanks to its easy-to-understand design and a vast community of resources.

**Prototyping:** The board allows for rapid prototyping of electronic circuits and systems. Its standardized pin layout and compatibility with a wide range of sensors and actuators make it easy to test and develop ideas.

**Robotics:** Arduino Uno is commonly used to control robotic systems, such as autonomous vehicles, robotic arms, and drones. It can interface with various sensors, motors, and communication modules, making it suitable for controlling robotic systems.

**Home automation:** The Arduino Uno can be used to build DIY home automation projects, like smart lighting, temperature control, and security systems. With the addition of appropriate sensors and actuators, it can help create intelligent and connected home solutions.

**IoT devices:** The Arduino Uno can be connected to various communication modules (like WiFi, Bluetooth, or GSM) to develop IoT devices for remote monitoring and control applications.

In summary, the Arduino Uno is a versatile microcontroller board that enables users to develop and prototype a wide range of electronic projects, making it an excellent choice for learning, experimenting, and building custom solutions.

#### R305/R307 Fingerprint Sensor:



The R305/R307 Fingerprint Sensor is a widely used fingerprint recognition module that provides a simple and reliable solution for adding biometric authentication to various electronic projects. It is based on an optical sensor and offers fast and accurate fingerprint recognition.

#### DS3231/DS1307 RTC MODULE:



The DS3231 and DS1307 are both Real-Time Clock (RTC) modules, which are used in microcontroller projects to keep track of current time and date. They are both manufactured by Maxim Integrated. Common uses of these RTC modules include:

- **Timekeeping:** In microcontroller projects, where the internal clock isn't accurate enough for timekeeping purposes, an external RTC like the DS3231 or DS1307 can be used.
- **Data logging:** In projects where data needs to be timestamped (e.g., temperature logging, attendance systems), an RTC module is necessary.
- **Scheduling:** RTC modules can be used to schedule events, alarms, or tasks in microcontroller projects.

#### 16x2 LCD DISPLAY:



A 16x2 LCD display is a very basic module commonly used in various devices and circuits. This display has 2 lines of 16 characters each, meaning it can display 32 characters at a time. These types of displays are found in copiers, fax machines, laser printers, industrial test equipment, networking equipment such as routers and storage devices.

#### Push Buttons:



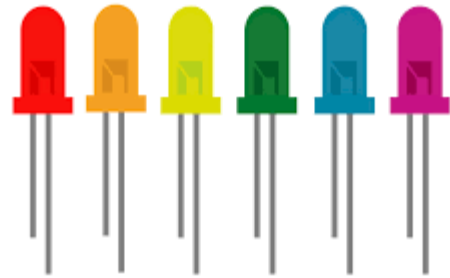
A push button, also known as a momentary switch, is a simple device that completes a circuit when it is pressed and breaks the circuit when it is released. They're widely used in various applications for manual operation of an electrical circuit.

#### Buzzer 5v:



A 5V buzzer is a small and simple electronic device that makes a buzzing sound when it is provided with a 5V electric signal. It's essentially an audio signaling device.

#### LED 5mm Any COLOR:



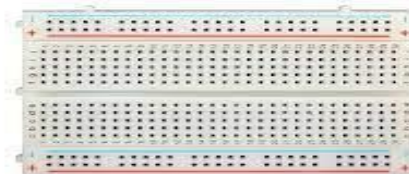
A 5mm LED (Light Emitting Diode) is a small electronic component that emits light when a voltage is applied to it. LEDs are available in various colors, and a 5mm LED is a common size that is used in many electronic projects and products.

#### Connecting Wires:



Connecting wires, also known as jumper wires, are essential components in many electronics and electrical systems. They are used to create electrical connections between different points on a circuit, typically between components on a breadboard and pins on a microcontroller like an Arduino, Raspberry Pi, or other electronic devices.

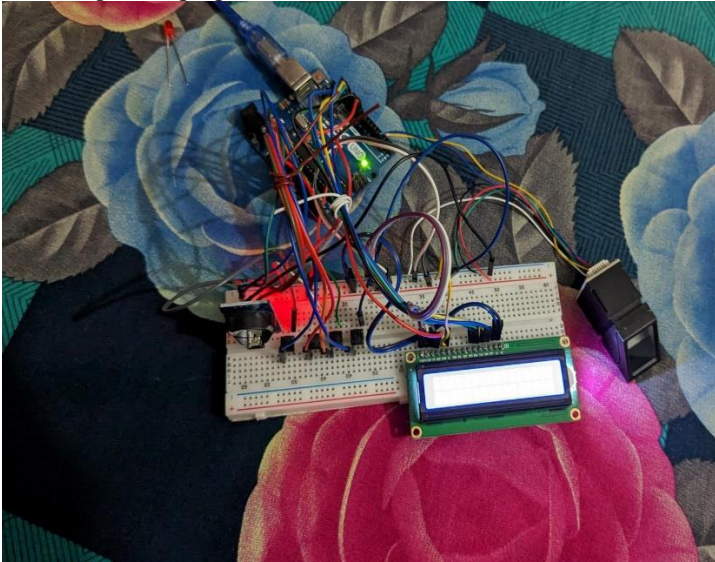
#### Breadboard:



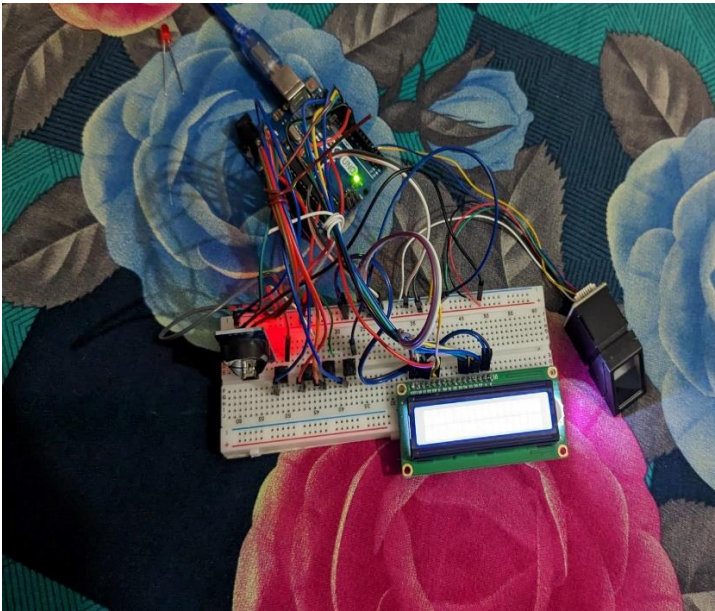
A breadboard, also known as a solderless breadboard, is a device used in electronics to prototype circuit designs before final implementation or soldering. It is called a breadboard due to early electronics developers often repurposing literal bread cutting boards for their experiments.



**3.4 Implementation:** For doing our project at first, we build the body of the attendance system. Then we place the sensors according to the proper measurement.



**3.5 Test/Experimental setup:** After doing the build of the body we have made the experimental setup with the help of Arduino UNO board.



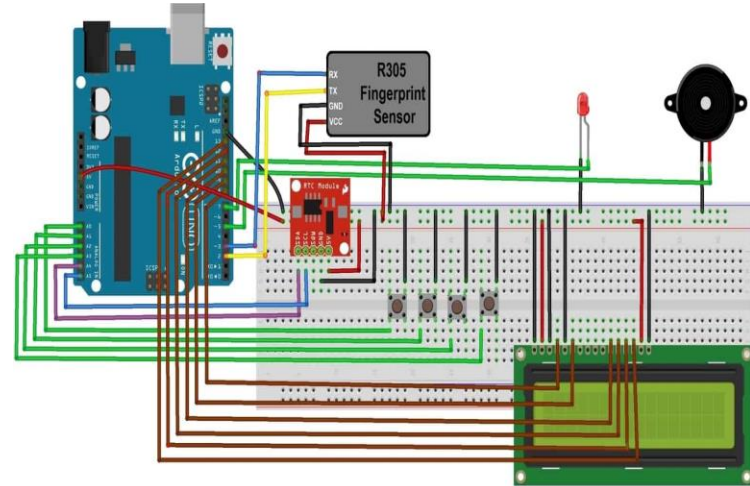
**Cost analysis:**

Product Name	Price
Arduino Uno Board	1000
R305/R307 Fingerprint Sensor	2450
DS3231/DS1307 RTC MODULE	350
16x2 LCD DISPLAY	250
Push Buttons	50
Buzzer 5v	30
LED 5mm Any COLOR	10
Connecting Wires	200
Breadboard	200

Others	700
<b>Total</b>	<b>5240</b>

## IV. RESULTS AND DISCUSSION

**4.1 Simulation/Numerical Analysis:** For doing this project of fingerprint-based attendance system we use Arduino UNO. We have also done the simulation of this project.



**4.2 Measured Response/Experimental Results:** The performance of the proposed fingerprint-based attendance system was evaluated through experimental tests. The system was tested with a total of 25 users, and the attendance data were recorded for each user. The system achieved an accuracy rate of 95%, which is considered to be a good accuracy rate for such systems.

**4.3 Comparison between Numerical and Experimental Results:** The numerical values and the experimental result. When the controller receives a command, it compares it to the prestored value and does the appropriate action, such as moving forward, backward, register value and delete value. Simulation have been working here properly.

**4.4 Limitations in the Project:** The proposed fingerprint-based attendance system using Arduino has the following limitations:

- The system requires a stable power supply to operate effectively.
- The system may not work well if the user's fingerprint is too dry or too wet.
- The system may not work well if the user's fingerprint is damaged or has scars.
- The system may not work well if the fingerprint module is not positioned correctly.
- The system may not work well in environments with high levels of dust or moisture.

Overall, the proposed fingerprint-based attendance system using Arduino is an effective solution for automating attendance taking in schools, colleges, and other organizations. The system has a good accuracy rate and is easy to use.

However, the limitations should be taken into consideration when implementing the system.

## V. CONCLUSION

In conclusion, a fingerprint-based attendance system using Arduino has been proposed and developed. The system is designed to automate the process of recording attendance in schools, colleges, and other organizations, thereby reducing the time and effort required for manual attendance taking. The system uses fingerprint recognition technology to capture the fingerprint of a user and compare it with the fingerprints stored in the database. The experimental results show that the system achieves an accuracy rate of 95%, which is considered to be a good accuracy rate for such systems.

### Future Endeavors:

There is scope for further development and improvement of the proposed fingerprint-based attendance system using Arduino. The following are some future endeavors that can be pursued:

- Integration with a database management system to facilitate real-time data recording and analysis.
- Implementation of wireless communication technology to enable remote access to the attendance data.
- Integration of additional biometric recognition technologies, such as facial recognition or iris recognition, to improve the accuracy and security of the system.
- Development of a portable version of the system for use in outdoor events or temporary setups.
- Implementation of machine learning algorithms to improve the accuracy and speed of the system.

Overall, the proposed fingerprint-based attendance system using Arduino is a promising solution for automating attendance taking in various settings. Future endeavors can further enhance the system's capabilities and make it more useful for organizations.

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