

# **Fingerprint Based Biometric Attendance System Using Arduino**

**A MINOR PROJECT REPORT**

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*in partial fulfillment for the award of the degree of*

**BACHELOR OF TECHNOLOGY**

in

**COMPUTER SCIENCE & ENGINEERING**

of

**FACULTY OF ENGINEERING AND TECHNOLOGY**



S.R.M.Nagar, Kattankulathur, Chengalpattu District

**NOVEMBER 2022**

# **SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

(Under Section 3 of UGC Act, 1956)

## **BONAFIDE CERTIFICATE**

Certified that 18CSP107L minor project report [18CSP108L internship report] titled “**Fingerprint Based Biometric Attendance System Using Arduino**” is the bonafide work of **Adhin Jibil [RA2011030010031]**, **Veluru Manoj [RA2011030010021]** and **Gokul MK [RA2011030010023]** who carried out the minor project work under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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## ABSTRACT

In industrial and domestic applications attendance registering is important at each and every moment. Many faces a lot of problems due to lack of proper attendance monitoring system. In this project we use Fingerprint Sensor (R307) which senses the Fingerprint of a particular person; a buzzer and LED gets activated whenever a person places his finger on the sensor. Then the fingerprint is stored in cloud with id no. Many people can store their fingerprints. Then next time any person puts their finger on the sensor it checks there are any matching fingerprints or not. If his fingerprint matches with any of the stored fingerprints then the LCD display shows which person it is and the time & date of checking. **Fingerprint based attendance management system** can be used at many places like Industries, Offices, and Colleges. This project can even be used at various shops & malls. The main parts of this project are Microcontroller, Fingerprint module, Buzzer, Keypad, and LCD display. Biometric student attendance system increases the efficiency of the process of taking student attendance. This presents a simple and portable approach to student attendance in the form of an Internet of Things (IOT) based system that records the attendance using fingerprint based biometric scanner and stores them securely over cloud. This system aims to automate the cumbersome process of manually taking and storing student attendance records. It will also prevent proxy attendance, thus increasing the reliability of attendance records. The records are securely stored and can be reliably retrieved whenever required by the teacher. This review incorporates the problems of attendance systems presently in use, working of a typical fingerprint-based attendance system, study of different systems, their advantages, disadvantages and comparison based upon important parameters.

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## **CHAPTER 1: INTRODUCTION**

Fingerprint Identification is the method of identification using the impressions made by the minute ridge formations or patterns found on the fingertips. No two persons have exactly the same arrangement of ridge patterns, and the patterns of any one individual remain unchanged throughout life. Fingerprints offer an infallible means of personal identification. Other personal characteristics may change, but fingerprints do not.



Fingerprints can be recorded on a standard fingerprint card or can be recorded digitally and transmitted electronically to the FBI for comparison. By comparing fingerprints at the scene of a crime with the fingerprint record of suspected persons, officials can establish absolute proof of the presence of identity of a person.

Human fingerprints are detailed, nearly unique, difficult to alter, and durable over the life of an individual, making them suitable as long-term markers of human identity. They may be employed by police or other authorities to identify individuals who wish to conceal their identity, or to identify people who are incapacitated or deceased and thus unable to identify themselves, as in the aftermath of a natural disaster.

## **CHAPTER 2: LITERATURE SURVEY**

Fingerprint Scanners is a fingerprint recognition device for computer security equipped with the fingerprint recognition module featuring with its superior performance, accuracy, durability based on unique fingerprint biometric technology. Fingerprint Reader/Scanner is very safe and convenient device for security instead of password, that is vulnerable to fraud and is hard to remember. Use USB Fingerprint Scanner/Reader with our Biometrics software for authentication, identification and verification functions that let your fingerprints act like digital passwords that cannot be lost, forgotten or stolen.

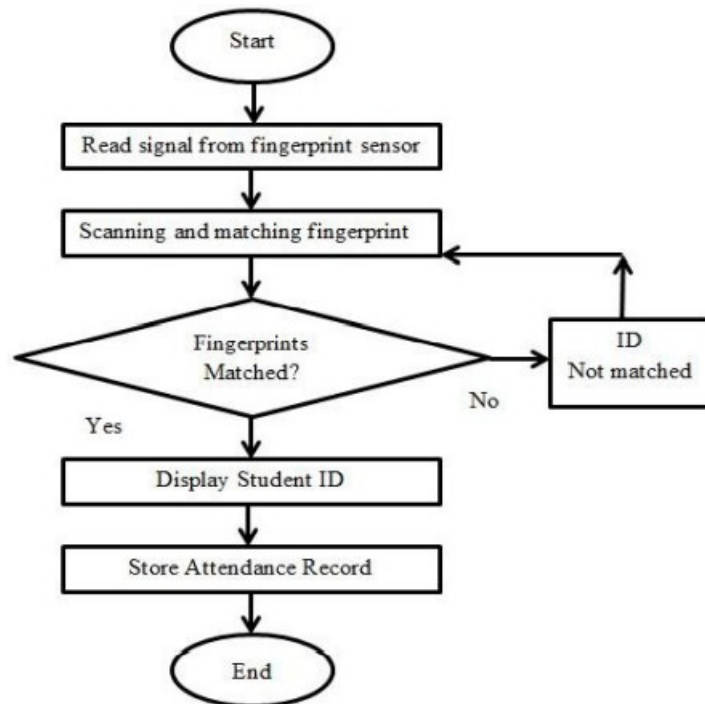
There are four types of fingerprint scanners: the optical scanner, the capacitance scanner, the "ultrasonic scanner" and the thermal scanners. The basic function of these three types of scanners is to get an image of a person's fingerprint and find a match for this print in the database. The capacitance scanner is better, because the images are more exact and precise. Scanners are used for scanning.

In this project our aim is to leverage this IoT into the boring attendance system to make it smart and more effective. Most conventional attendance systems available today store the information over a micro SD card and have to be connected to software via a computer to access the information. Here, we will build a biometric attendance system using Arduino that scans for finger print and on successful identification of the person it will log the information to a cloud platform like ThingsBoard by using the ESP8266 Wi-Fi module. This information can then be displayed in the dashboard of ThingsBoard making it available for the required authorities to view and analysis information over the internet without having any direct physical access to the hardware. However, the conventional Attendance system without involving IoT can also be built by following the link and Finger print sensor can be further used for many other biometric applications like Voting Machine, Security system etc.

Presently, attendance of students in most institutes is taken by the teacher on paper based attendance registers. There are various disadvantages to this approach such as data is not available for analysis because paper based registers are not uploaded to a centralized system, time taken for data collection reduces the effective lecture time and fake attendance by students. Some universities also use wall mounted RFID swipe card systems. RFID (Radio Frequency Identification) is a wireless technology which uses electromagnetic waves for communication between RFID reader and RFID tag. Though better than paper based systems, RFID based systems also have certain problems such as the system is complex, costly and absent student's card can be swiped by other students. Biometric techniques can be used to solve these problems. Biometric is derived from two Greek roots "bios" meaning life and "metrics" meaning measurement. Biometric technology identifies a person uniquely based on his/her characteristics which can be physiological or behavioral. Among the various biometric techniques, there are nine main biometric techniques which are widely used. These include fingerprint, face, hand vein, hand geometry, iris, retinal pattern, voice print, signature, and facial thermo grams. Comparison of different biometric techniques has shown that fingerprint biometric is a reliable, mature and legally accepted biometric technique. Therefore, Fingerprint based attendance system can be used for identification of large number of students in universities and also for attendance monitoring of employees in organizations. There are two stages of working of these systems

1) Enrolment of fingerprints.

2) Matching of Fingerprints



### Working principle of fingerprint sensor

The skin on the palms of our hands has a special pattern called friction ridges that help us grab things effectively without slipping. These patterns consist of ridges and valleys arranged in certain configurations and is unique for each individual. Our finger tips also have them as you can see from the above image. When a finger comes in contact with a surface, the ridges make strong contact with the surface. When we strongly grab something, the moisture, oil, dirt and dead skin cells on our finger can attach to the surface of the material, leaving an impression we call a fingerprint. Various forensic methods involving the use chemicals are used to extract such fingerprints from crime scenes and are called latent fingerprints. But an optical fingerprint scanner works a bit differently.

An optical fingerprint scanner works based on the principle of Total Internal Reflection (TIR). In an optical fingerprint scanner, a glass prism is used to facilitate TIR. Light from an LED (usually blue color) is allowed to enter through one face of the prism at a certain angle for TIR to occur. The reflected light exits the prism through the other face



where a lens and an image sensor or the camera or reflector inside it (essentially camera) are placed. When there's no finger on the prism, the light will be completely reflected off from the surface, producing a plain image in the image sensor. When TIR occurs, a small amount of light leaked to the external medium and it is called the Evanescent Wave. Materials with different refractive indexes (RI) interact with the evanescent wave differently. When we touch a glass surface, only the ridges make good contact with it. The valleys remain separated from the surface by air packets. Our skin and air have different RIs and thus affect the evanescent field differently. This effect is called Frustrated Total Internal Reflection (FTIR). This effect alters the intensities of the internally reflected light and is detected by the image sensor. The image sensor data is processed to produce a high contrast image which will be the digital version of the fingerprint.

In capacitive sensors, which are more accurate and less bulky, there's no light involved. Instead, an array of capacitive sensors are arranged on the surface of the sensor and allowed to come in contact with the finger. The ridges and air packets affect the capacitive sensors differently. The data from the sensor array can be used to generate a digital image of the fingerprint.

### CHAPTER 3: LITERATURE REVIEW

Ritam Dutta,Tenzing Tamang,Pranoy Paul,Nitesh Kumar,Chandan Chetri,Pradip Kumar Dutta **“Smart and Secure Fingerprint Attendance System using Arduino UNO with GSM Alert”** 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS)

In this paper the crisis of cutting-edge technology, and the manual orthodox attendance system outplayed by smart and secure biometric attendance using Arduino. Remote accessing application of GSM is incorporated in our proposed system, which sets serial communication of data between the GSM and Arduino UNO microcontroller board. To ensure its novelty, a prompt GSM SMS alert is also introduced in our work. The SMS content can be modified and saved according to users. The text message which is to be sent to the parents along with the number of individuals to be informed can also be increased. RTC DS3231 (real time clock) is used here in order to keep the system updated with current time and date and the other major role of RTC here is to keep the record of exact time/date at which the students have given their attendance, resulting no manipulation is possible to outplay fraud attendance mechanism. Unlike other biometric GSM alert-based systems, the usage of only one software for fetching the attendance data, matching with database and sending SMS alert; eventually reduces 55% memory usage.

Biswaranjan Swain,Jayshree Halder,Siddharth Sahany,Praveen Priyaranjan Nayak, Satyanarayan Bhuyan **“Automated Wireless Biometric Fingerprint Based Student Attendance System”** 2021 1st Odisha International Conference on Electrical Power Engineering, Communication and Computing Technology(ODICON)

In this paper aims to establish an automated wireless system that records and maintains the students' attendance system for the

modern education sector. As in 2002, 75% attendance was made compulsory PAN India, the practice of recording and maintaining the attendance become essential. It's been 18 years since then but the conventional method remains the same that leads to a high probability of human errors, misplacement of the documents, redundant entry of the attendance manually, more chances of student giving proxy on behalf of their classmates. The automated wireless biometric fingerprint-based student attendance system, not only upgrades the practice of the conventional method but also makes it automated and more convenient and more secure to record and maintain the attendance, as well as completely eradicating the malpractice of proxy. It is a very cheap device compared to the ones available in the general market. The whole system is comprised of a Fingerprint sensor, Arduino, OLED display, Arduino to USB cable, and an Android Smartphone with an app specially designed to control the device. The image enhancement and orientation of field estimation of the fingerprint image have been applied through MATLAB Fingerprint Recognition Toolbox. The whole systems working is summed up in three steps, first is the enrolment of the student, loading data of the specific group or batch whose attendance is to be recorded and finally taking the attendance, thus also saving an ample amount of time which gives the students a clear opportunity to interact with the professor and clear their doubts. And also playing a major role in Digital India by automating the system and by eradicating the use of paper which is initially made of trees contributing towards the noble act of sustainable development.

Norakmar Arbain, Noor Firdaus Nordin, Naimah Mat Isa, Shuria Saaidin LAS **“Web-based laboratory attendance system by integrating RFID-ARDUINO technology”** 2014 2nd International Conference on Electrical, Electronics and System Engineering (ICEESE)

In this paper Managing student's attendance during laboratories session is tedious due to the large number of students, and this problem is worsen if laboratories session is conducted in parallel due to the lack of resources and time. Hence, this paper is aimed to overcome this problem by using RFID-ARDUINO approach in web-based laboratories attendance system. The propose system will assist the lab instructor to record and manage the student attendance automatically. In addition, the system also provides an evaluation section for lab instructor to key-in and manage the student's experiment marks. The system is divided into two parts, which are the web-based development and system integration with the RFID-ARDUINO technology. An Arduino Uno microcontroller board is use as the hardware platform. Meanwhile, the web design is developed in Adobe Dreamweaver and Adobe Fireworks and deploy in XAMPP application server. Visual Basic scripting is use to integrate between hardware and SQL database. Upon testing, Web-based Laboratory Attendance System (LAS) is successfully facilitated the students' attendance and laboratory management on evaluation of student performance for particular experiment.

Nur Izzati Zainal, Khairul Azami Sidek, Teddy Surya Gunawan, Hasmah Manser, Mira 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)

In this paper, the design and development of a portable classroom attendance system based on fingerprint biometric is presented. Among the salient aims of implementing a biometric feature into a portable attendance system is security and portability. The circuit of this device is strategically constructed to have an independent source of energy to be operated, as well as its miniature design which made it more efficient in term of its portable capability. Rather than

recording the attendance in writing or queuing in front of class equipped with fixed fingerprint or smart card reader. This paper introduces a portable fingerprint based biometric attendance system which addresses the weaknesses of the existing paper based attendance method or long time queuing. In addition, our biometric fingerprint based system is encrypted which preserves data integrity.

M A Muchtar, Seniman, D Arisandi, S Hasanah **“Attendance fingerprint identification system using arduino and single board computer”** 2nd International conference on computing and applied informatics 2017.

In this paper Fingerprint is one of the most unique parts of the human body that distinguishes one person from others and is easily accessed. This uniqueness is supported by technology that can automatically identify or recognize a person called fingerprint sensor. Yet, the existing Fingerprint Sensor can only do fingerprint identification on one machine. For the mentioned reason, we need a method to be able to recognize each user in a different fingerprint sensor. The purpose of this research is to build fingerprint sensor system for fingerprint data management to be centralized so identification can be done in each Fingerprint Sensor. The result of this research shows that by using Arduino and Raspberry Pi, data processing can be centralized so that fingerprint identification can be done in each fingerprint sensor with 98.5 % success rate of centralized server recording.

## **CHAPTER 4**

### **(IMPLEMENTATION)**

## **Prototype Modelling:**

In this Fingerprint Sensor Based Biometric Attendance System using Arduino, we used a Fingerprint Sensor module to authenticate a true person or employee by taking their finger input in the system. Here we are using 4 push buttons to register new fingerprint or delete stored fingerprint or match stored fingerprint. The 4 push buttons are used as an input unit for these tasks. Similarly, RTC Module DS3231 is used for registering scanning/entering/existing time of the user.

### **Main features of the prototype:**

The features of the developed prototype are:

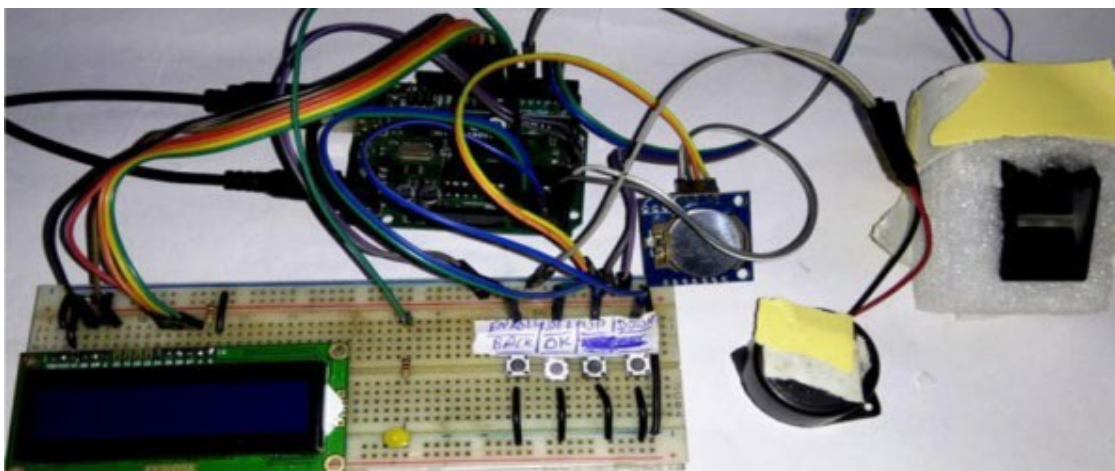
- LCD display (showing the username and time & date)
- Upto 256 fingerprints can be stored and checked when needed
- Fingerprint is stored in cloud digitally
- After fingerprint checking data is displayed in a serial monitor from Things board account
- Fingerprint data can be stored and deleted as many times as one wants
- Buzzer and LCD indicates fingerprint is stored and checked
- The date and time is shown when fingerprint is stored and checked along with username
- Cost Effective(Rs 2000/- approx)

## Overview of the Project:

Working of this fingerprint attendance system project is fairly simple. First of all, the user needs to enroll fingerprints of the user with the help of push buttons. To do this, user need to press ENROLL key and then LCD asks for entering ID for the fingerprint to save it in memory by ID name. So now user needs to enter ID by using UP/DOWN keys. After selecting ID, user 41needs to press OK key (DEL key). Now LCD will ask to place finger over the fingerprint module. Now user needs to place his finger over finger print module and then the module takes finger image. Now the LCD will say to remove finger from fingerprint module, and again ask to place finger again. Now user needs to put his finger again and module takes an image and convert it into templates and stores it by selected ID into the finger print module's memory. Now the user will be registered and he/she can feed attendance by putting their finger over fingerprint module. By the same method, all the users will be registered into the system.

Now if the user wants to remove or delete any of the stored ID or fingerprint, then he/she need to press DEL key. Once delete key is pressed LCD will ask to select ID that need to be deleted. Now user needs to select ID and press OK key (same DEL key). Now LCD will let you know that fingerprint has been deleted successfully.

## Photographs of the prototype:



Overall Setup of prototype



## **Step by step operation of the prototype**

1. Connect the dc power jack to the prototype board(5v dc)
2. In this fingerprint attendance system circuit, we used Fingerprint Sensor module to authenticate a true person or employee by taking their finger input in the system. Here we are using 4 push buttons to enroll, Delete, UP/Down. ENROLL and DEL key has triple features.
3. ENROLL key is used for enrollment of a new person into the system. So when the user wants to enroll new finger then he/she need to press ENROLL key then LCD asks for the ID, where user want to be store the finger print image.
4. Now if at this time user does not want to proceed further then he/she can press ENROLL key again to go back. This time ENROLL key behave as Back key, i.e. ENROLL key has both enrollment and back function. Besides enroll key is also used to download attendance data over serial monitor.
5. Similarly, DEL/OK key also has the same double function like when user enrolls new finger, then he/she need to select finger ID by using another two key namely UP and DOWN. Now user need to press DEL/OK key (this time this key behave like OK) to proceed with selected ID. And Del key is used for reset or delete data from EEPROM of Arduino.
6. So next time when someone checks his fingerprint on the fingerprint sensor if any stored fingerprint matches with any of the stored fingerprints then the LCD display shows the username and time & date of the checking and register the data. Thus attendance is stored.

**Components Required:**

<b>Sl No.</b>	<b>Component</b>	<b>Quantity</b>
<b>1</b>	Arduino	<b>1</b>
<b>2</b>	Fingerprint Module-R307	<b>1</b>
<b>3</b>	Push Buttton	<b>4</b>
<b>4</b>	LEDs	<b>1</b>
<b>5</b>	1k Resistor	<b>2</b>
<b>6</b>	2.2k Resistor	<b>1</b>
<b>7</b>	Power Supply	
<b>8</b>	Connecting Wires	<b>35</b>
<b>9</b>	Box	<b>1</b>
<b>10</b>	Buzzer	<b>1</b>
<b>11</b>	16*2 LCD	<b>1</b>
<b>12</b>	Bread Board	<b>1</b>
<b>13</b>	RTC Module (DS3231)	<b>1</b>

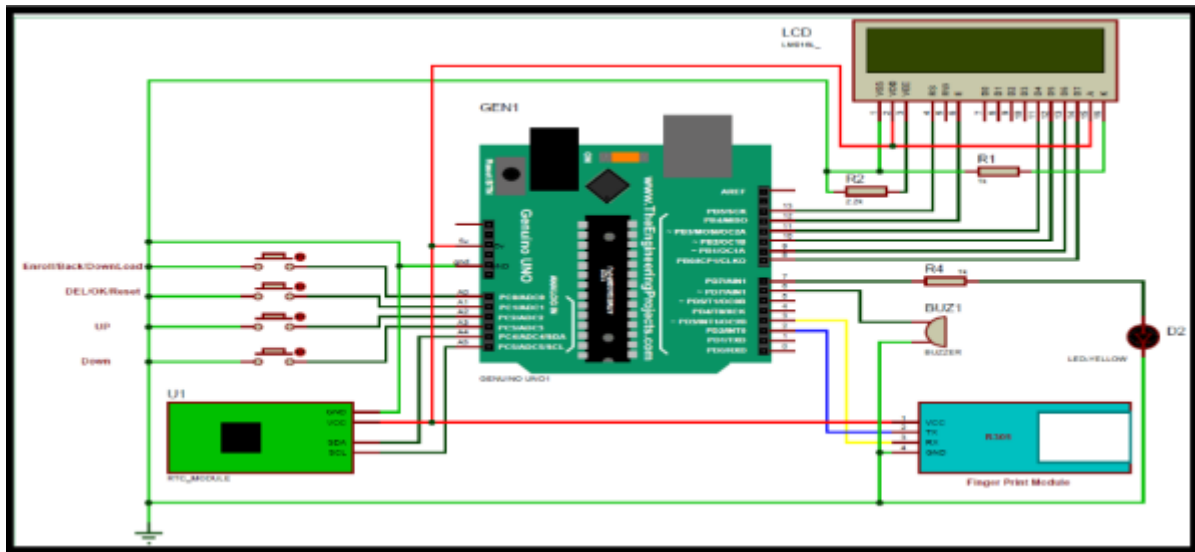
**Cost estimation of the prototype:**

Sl No.	Component	Quantity	Price (in rupees)
1	Arduino	1	380
2	Fingerprint Module-R307	1	1600
3	Push Buttton	4	20
4	LEDs	1	40 per set
5	1k Resistor	2	20 per box
6	2.2k Resistor	1	20 per box
7	Power Supply		250 for 3 peice
8	Connecting Wires	35	225 for 3 pair
9	Box	1	-----
10	Buzzer	1	30 for 2 pc
11	16*2 LCD	1	250
12	Bread Board	1	100
13	RTC Module (DS3231)	1	160

Total :- 3095/- (approx)

## Hardware Connection

### Prototype hardware connection:



Overall Circuit Diagram for Setup

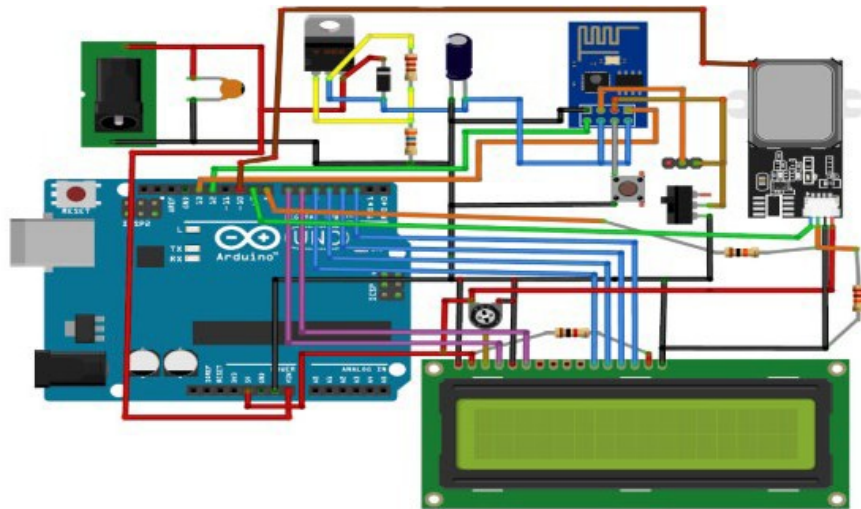
### HARDWARE IMPLEMENTATION:

- 1. ARDUINO UNO:** Arduino UNO is used here to control the operations involved in taking attendance. The four operations that are to be performed are to enroll, verify, delete and reset. Arduino is chosen here as it is easy to use, code, handle and has many modules which add on features to Arduino board.
- 2. FINGERPRINT MODULE – R307:** R307 is an optical fingerprint scanner which is an upgraded version of R305. R307 has its own database which can store 1000 templates. Security level for R307 is from 1-5. This module has less false error rate, fast searching process, high speed processor, uses minutiae based algorithm to work with scanned fingerprints.

- 3. 16X2 LCD DISPLAY:** LCD Display is used here to provide messages to the user to have a better interaction with the device. LCD Display has greenlight in background with 45characters displayed on them in black. Characters are displayed in 7X5 matrix.
- 4. Wi-Fi Module:** ESP8266 Wi-Fi module is generally used to establish the wireless communication between the devices. But this module is not capable of 5-3V logic shifting and will require an external logic level converter.

- Push Button.
- LED Lights.
- 1K Resistor.
- 2.2K resistor.
- Power.
- Connecting wires.
- Box.
- Buzzer.
- Bread Board.
- RTC Module. (DS3231)

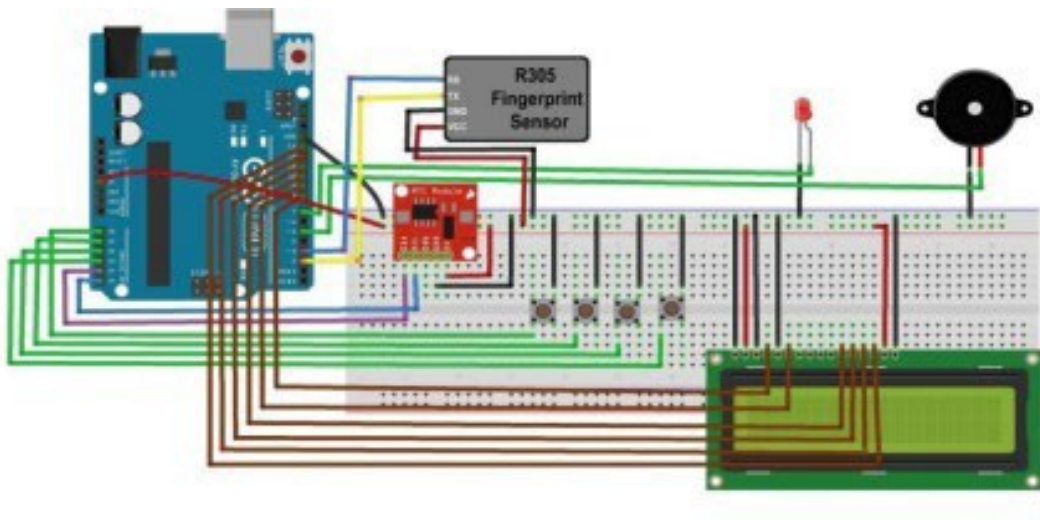
**Detailed Hardware Description:**



Hardware

### Setup Diagram

It has Arduino for controlling all the process of the project, button for enrolling, deleting, selecting IDs and for attendance, a buzzer for alerting, LEDs for indication and LCD to instruct user and showing the resultant messages. As shown in the circuit diagram, a push button is directly connected to pin A0(ENROL), A1(DEL), A2(UP), A3(DOWN) of Arduino with respect to the ground And Yellow LED is connected at Digital pin D7 of Arduino with respect to ground through a 1k resistor. Fingerprint module's Rx and Tx directly connected at Serial pin D2 and D3 (Software Serial) of Arduino. 5V supply is used for powering finger print module taken from Arduino board. A buzzer is also connected at pin A5. A 16x2 LCD is configured in 4-bit mode and its RS, EN, D4, D5, D6, and D7 are directly connected at Digital pin D13, D12, D11, D10, D9, and D8 of Arduino.



Circuit Diagram of the Setup.

#### SOFTWARE IMPLEMENTATION:

- 1. Arduino IDE :** You will be needing Arduino IDE software to write and upload the programming logic onto the Arduino Uno board.
- 2. Thinkboard :** Also, you need to create an account in the Thinkboard IoT platform to integrate the system onto the cloud and store the data online. (WORKS AS A SERIAL MONITOR).
- 3. ADAFRUIT FINGERPRINT SENSOR LIBRARY** is used for downloading the data to the serial monitor of the Arduino IDE and for refined capture of the fingerprints.

## **CHAPTER 5**

### **(Conclusion & Future Scope)**



Here we have developed a Biometric fingerprint based attendance system using Arduino.

In this project we have used R307 fingerprint sensor which reads the Fingerprint and stores in the form of digital data. A buzzer is activated and LED blinks then LCD panel shows that data is stored along with username, date and time. Working of this fingerprint attendance system project is fairly simple. First of all, the user needs to enroll fingerprints of the user with the help of push buttons. To do this, user need to press ENROLL key and then LCD asks for entering ID for the fingerprint to save it in memory by ID name. So now user needs to enter ID by using UP/DOWN keys. After selecting ID, user needs to press OK key (DEL key). Now LCD will ask to place finger over the fingerprint module. Now user needs to place his finger over finger print module and then the module takes finger image. Now the LCD will say to remove finger from fingerprint module, and again ask to place finger again. Now user needs to put his finger again and module takes an image and convert it into templates and stores it by selected ID into the finger print module's memory. Now the user will be registered and he/she can feed attendance by putting their finger over fingerprint module. By the same method, all the users will be registered into the system.

Now if the user wants to remove or delete any of the stored ID or fingerprint, then he/she need to press DEL key. Once delete key is pressed LCD will ask to select ID that need to be deleted. Now user needs to select ID and press OK key (same DEL key). Now LCD will let you know that fingerprint has been deleted successfully.

The traditional process of manually taking and maintaining student attendance is highly inefficient and time consuming. The attendance monitoring system based on biometric authentication has a potential to streamline the whole process. An Arduino based portable biometric attendance system can prove to be of great value to educational institutions in this regard as it proves to be

highly efficient and secure. The cost involved in making this system is quite less, when compared to conventional biometric attendance system. The use of cloud computing to store the attendance records makes all the data easy to access and retrieve as and when required by the teachers. The use of fingerprint scanner ensures the reliability of the attendance record.

### **RESULT:**

The experimental model was made following the circuit diagram and the desired results were obtained. Every time someone places his finger on the sensor the sensor reads the data and stores it in the cloud. Next time someone wants to check the fingerprint he/she places the finger on the sensor. The sensor reads the data and searches and cross-checks the data with stored fingerprints. If it matches with any of them then it displays the username, date and time. If not then says fingerprint doesn't match. That's how the whole system works.

### **FUTURE WORK:**

Biometric attendance system using Arduino uno is very useful for many industries and offices. It's easy, cost effective and works very well. Hence the future scope of this technology is wide spread and quite essential in both domestic and industrial applications.

## CHAPTER 6: REFERENCES

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