# EE381A - 2023-24
# EC LAB PROJECT

**Section:** D
**Table Number:** 8

**Team Members:**
Rishi Agarwal (210849)
Ridin Datta(210840)
Shivam Sharma (210983)

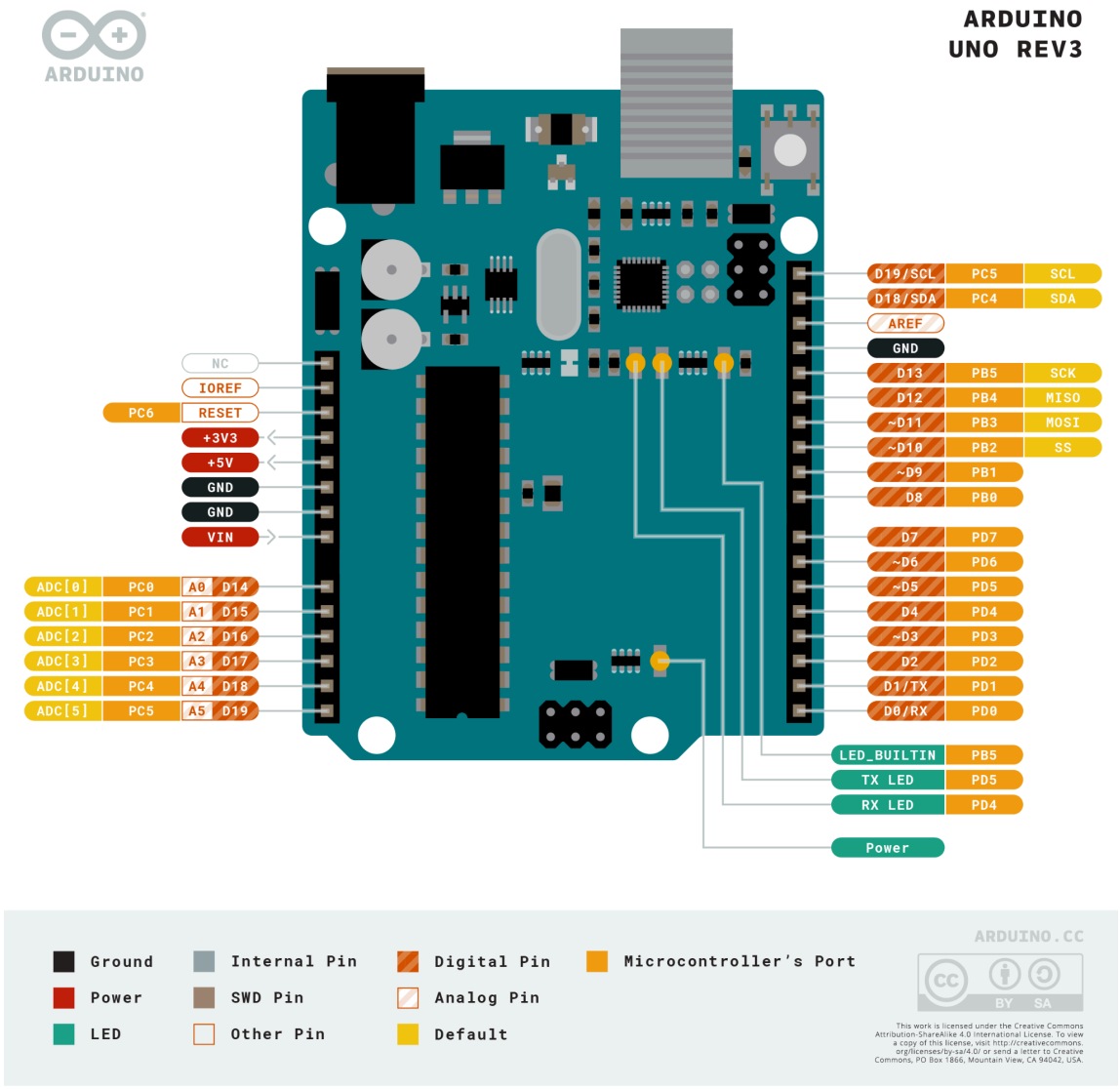
## Project Objective:

The objective of the project is to make an end-to-end biometric attendance system with data persistence. All the user registration data and the attendance logs are stored on a remote server and a frontend is also provided for admin interface.

## Description of each component:

1. Arduino UNO:

Arduino UNO is a popular microcontroller board designed for hobbyists, students, and professionals who want to build their own electronic projects. It is based on the ATmega328P microcontroller and uses an open-source platform that allows users to create, share, and modify electronic designs.
Some of the key specifications of the Arduino UNO board are:
i) Microcontroller: ATmega328P
ii) Operating Voltage: 5V
iii) Input Voltage: 7-12V
iv) Digital I/O Pins: 14 (of which 6 provide PWM output)
v) Analog Input Pins: 6
vi) Flash Memory: 32 KB (of which 0.5 KB is used by bootloader) vii)SRAM: 2 KB
viii)Clock Speed: 16 MHz
ix) USB Interface: Type B




2. Biometric Fingerprint Sensor:

The Invento R307 fingerprint sensor is a cutting-edge biometric authentication solution renowned for its accuracy and security features. Designed for a wide range of applications, it offers seamless integration into access control systems, time attendance devices, and other security solutions. The R307 sensor utilizes advanced fingerprint recognition technology to provide fast and reliable authentication, enhancing security while streamlining user experience. With its compact and durable design, it can withstand various environmental conditions, making it

suitable for both indoor and outdoor deployments. The technical specifications of the Invento R307 fingerprint sensor include:

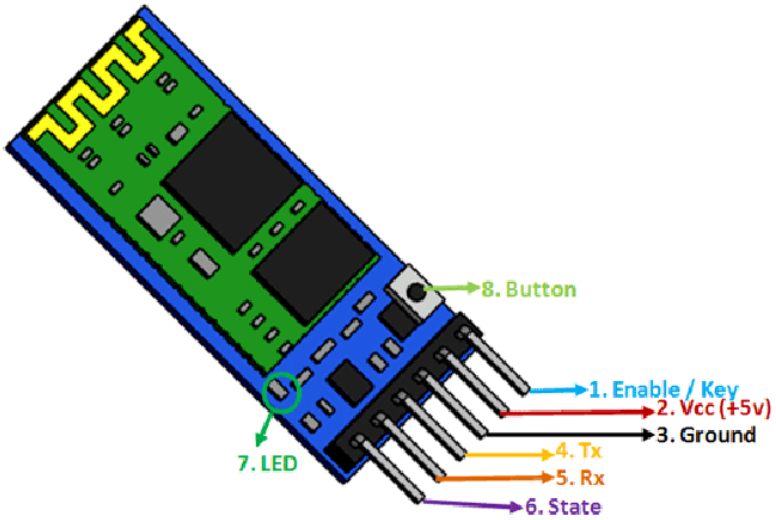
- High-resolution optical sensor with 500 DPI
- Fast fingerprint matching algorithm
- 1:N verification and 1:1 matching modes
- Supports up to 1,000 fingerprint templates
- False acceptance rate (FAR) of less than 0.001%
- False rejection rate (FRR) of less than 0.1%
- USB interface for easy connectivity to host devices
- Compatible with Windows, Linux, and Android operating systems
- Power consumption: less than 150mA during operation
- Operating temperature range: -20°C to +50°C
- Dimensions: 55mm x 32mm x 15.5mm

3. HC-05 Bluetooth Module:

The HC-05 Bluetooth module is a popular module that allows wireless communication between devices over Bluetooth. It uses the Bluetooth 2.0+EDR (Enhanced Data Rate) protocol and can be configured as either a master or a slave device.
Here are some specifications of the HC-05 module:

- Bluetooth Version: Bluetooth 2.0+EDR
- Frequency Band: 2.4 GHz ISM band
- Modulation: GFSK (Gaussian Frequency Shift Keying)

- Transmit Power: Class 2, up to 4dBm
- Sensitivity: -84dBm at 0.1% BER
- Range: Up to 10 meters (Class 2)
- Operating Voltage: 3.3V DC to 6V DC
- Current Consumption: <30mA (at 3.3V DC)
- Interface: UART (Universal Asynchronous Receiver/Transmitter)
- Baud Rate: Default 9600 baud, configurable up to 1382400 baud
- Dimensions: 28mm x 15mm x 2.35mm

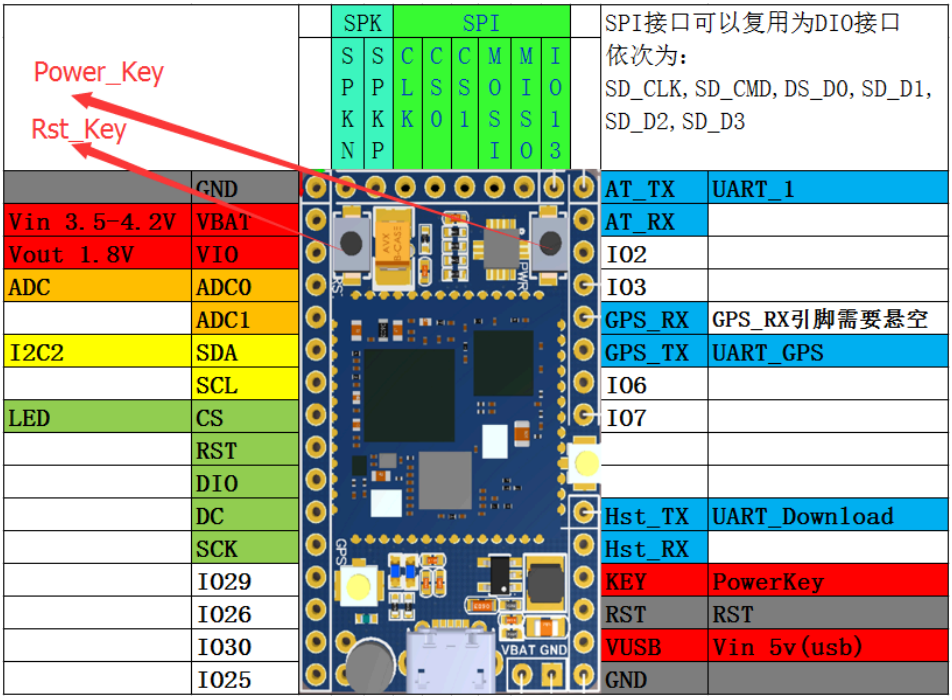



4. AIThinker A9 GSM Module:

The AIThinker A9 GSM module is a compact and versatile communication solution renowned for its reliability and efficiency. Designed for IoT applications, it integrates seamlessly into various projects, offering robust connectivity through GSM networks. With its compact form factor, the A9 module is suitable for space-constrained environments, ensuring flexibility in deployment. Equipped with advanced features, it enables bidirectional communication, data transmission, and remote monitoring, making it ideal for applications such as smart home automation, asset tracking, and industrial control systems. The module boasts impressive technical specifications, including:

- GSM/GPRS 850/900/1800/1900MHz frequency bands
- Support for standard GSM07.07, 07.05 AT commands
- Embedded TCP/IP, FTP, HTTP, and other internet protocols
- SIM application toolkit, USSD, STK support
- Class 4 (2W @ 850/900MHz) and Class 1 (1W @ 1800/1900MHz) power output
- Quad-band antenna for excellent signal reception

- Low power consumption for extended operational life
- Compact size: 22.8mm × 16.8mm × 2.5mm
- Operating temperature range: -30°C to +80°C
- UART interface for seamless integration with microcontrollers

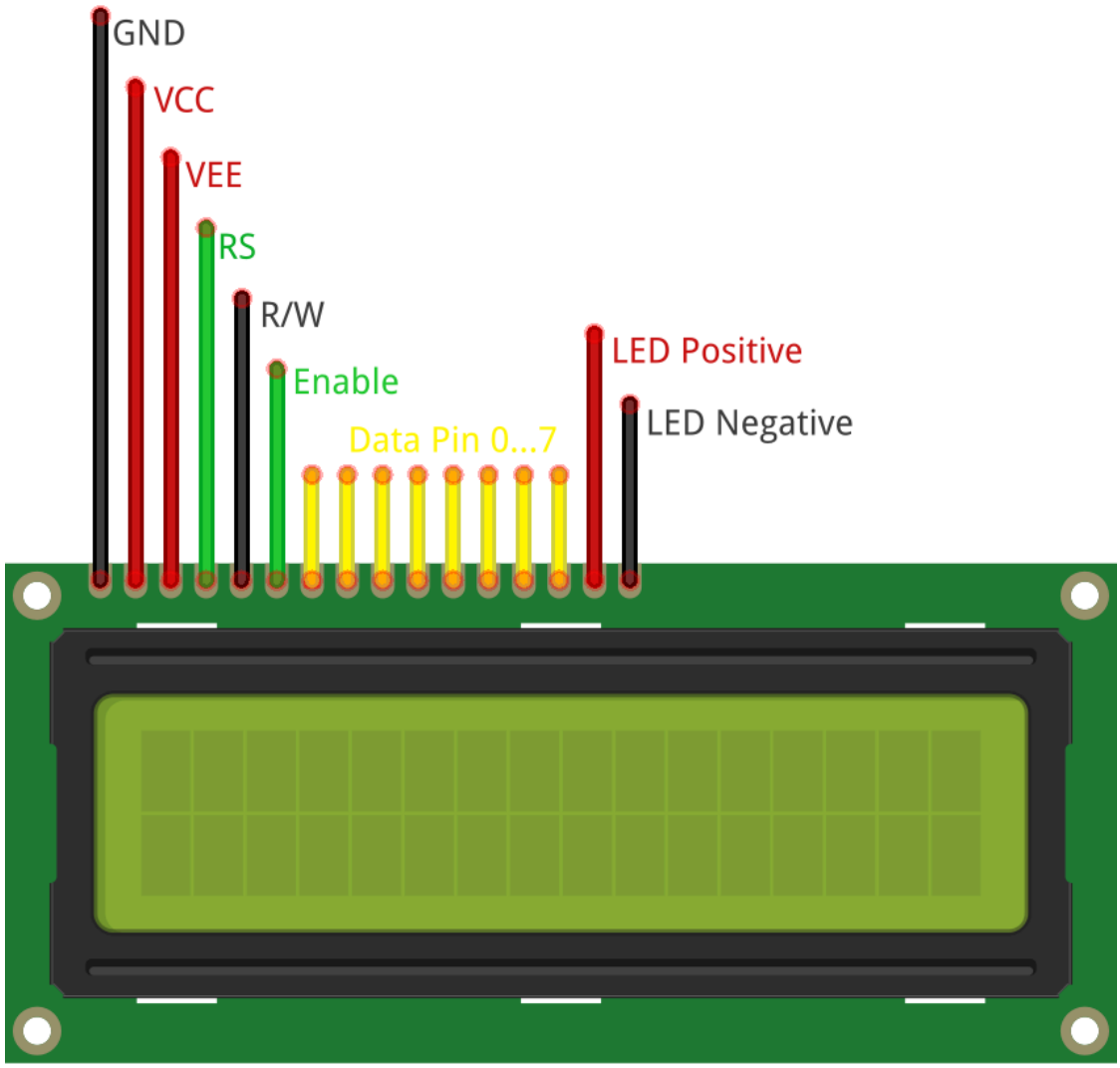



5. LCD Display:

The term LCD stands for liquid crystal display. It is a kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. . The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

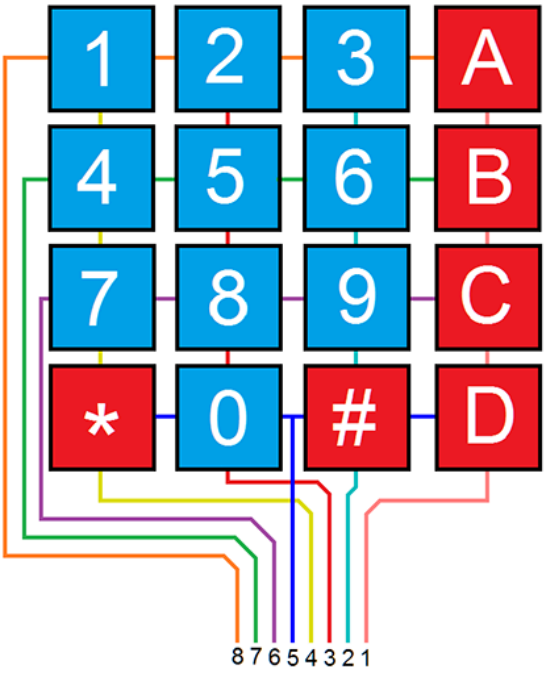
Here are some of its specifications:

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Consists of two rows and each row can print 16 characters.
- Each character is built by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom-generated characters



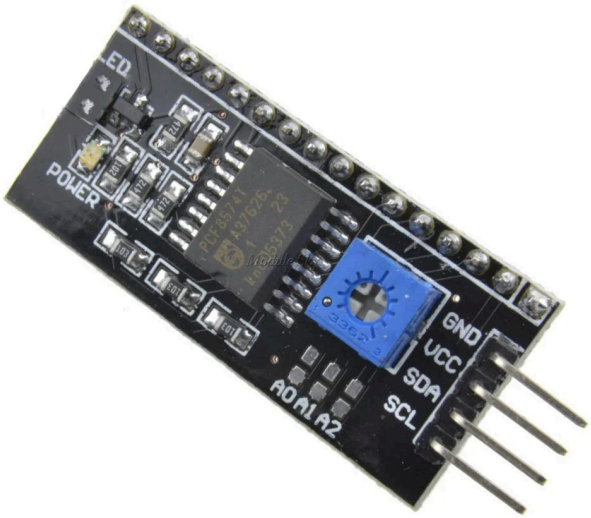

6. Keypad:

A matrix keypad consists of push button switches that are located at the column and row intersections of a grid or matrix. Switches in the same row are connected together as are switches in the same column.




7. I2C Converter:

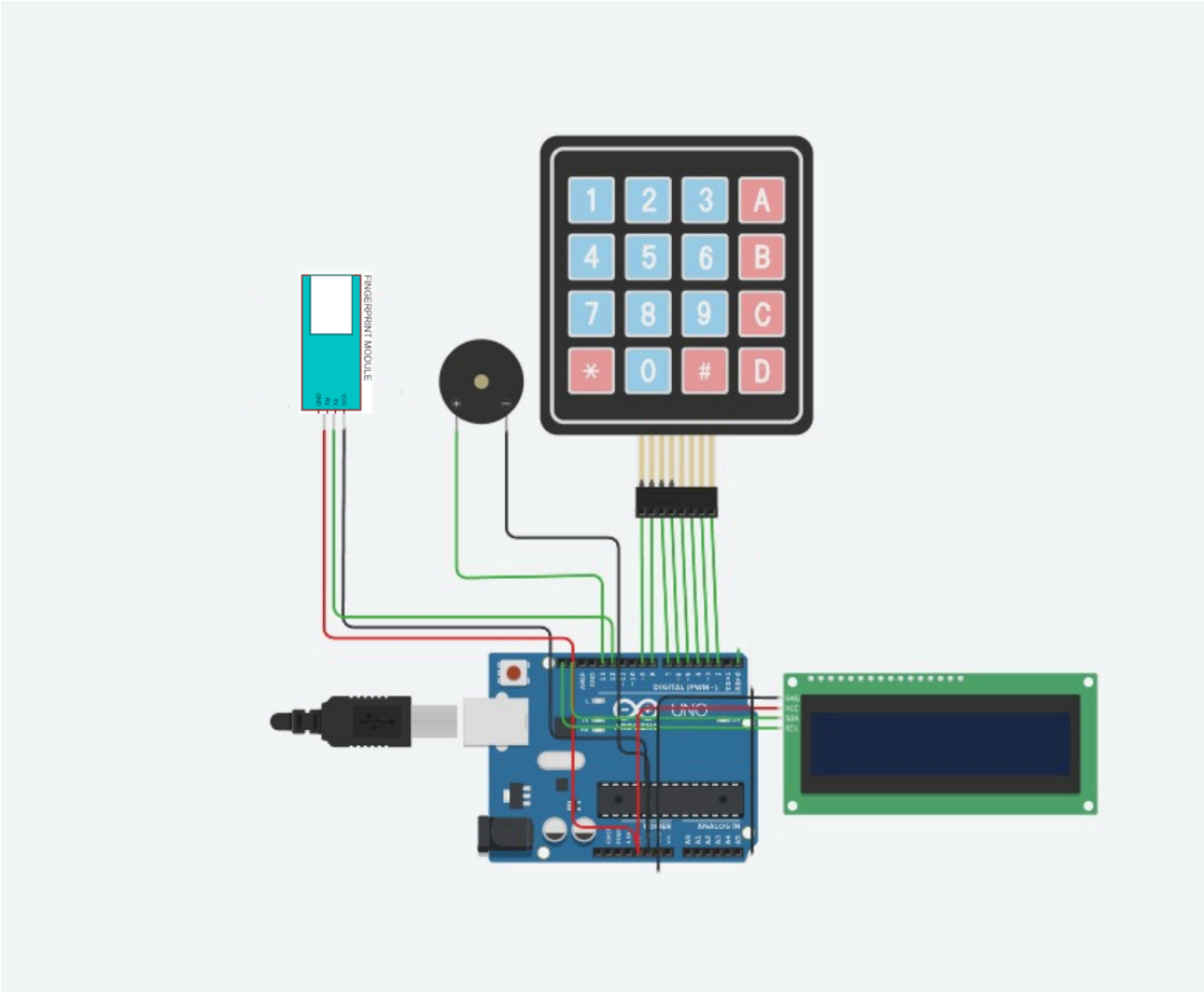
I2C (Inter-Integrated Circuit) is a short-distance serial interface that requires only 2 bus lines for data transfer. It was invented by Philips in 1980's, originally to provide easy on-board communications between a CPU and various peripheral chips in a TV set.

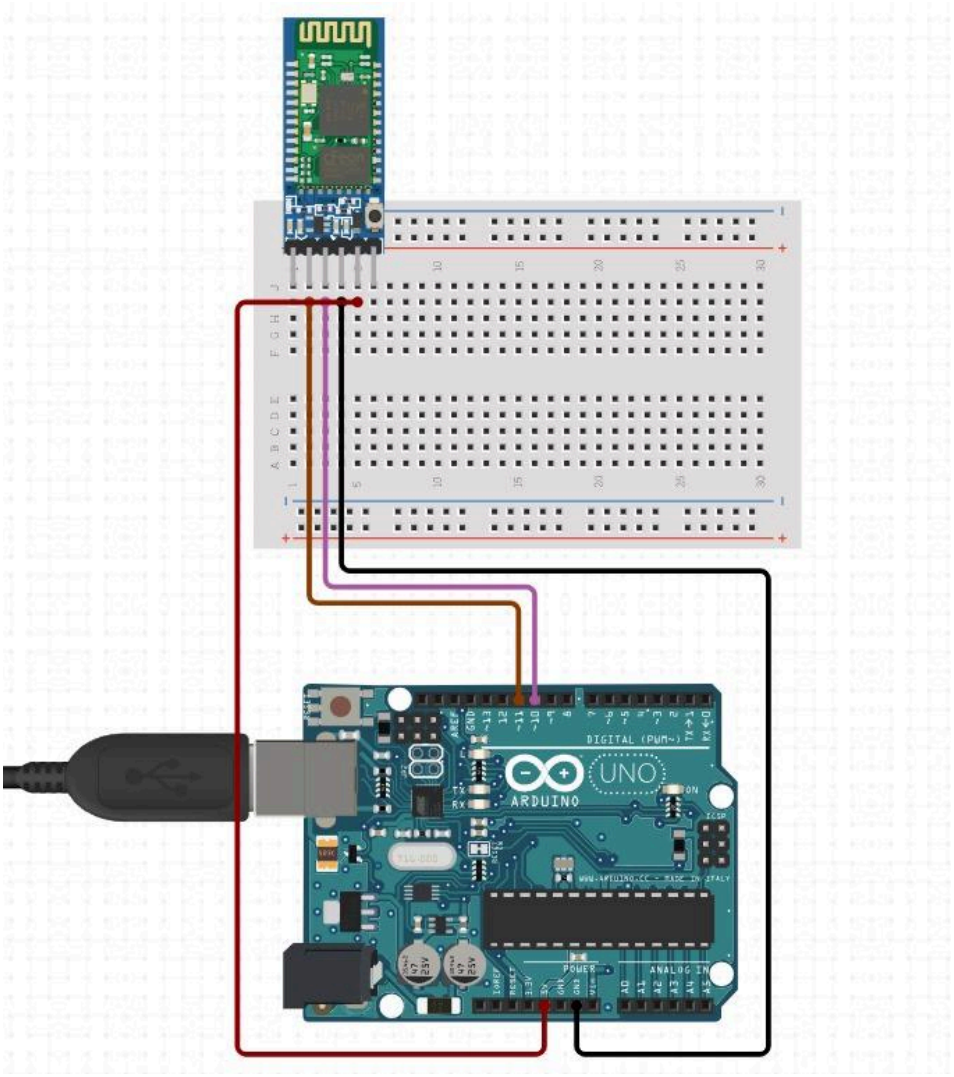


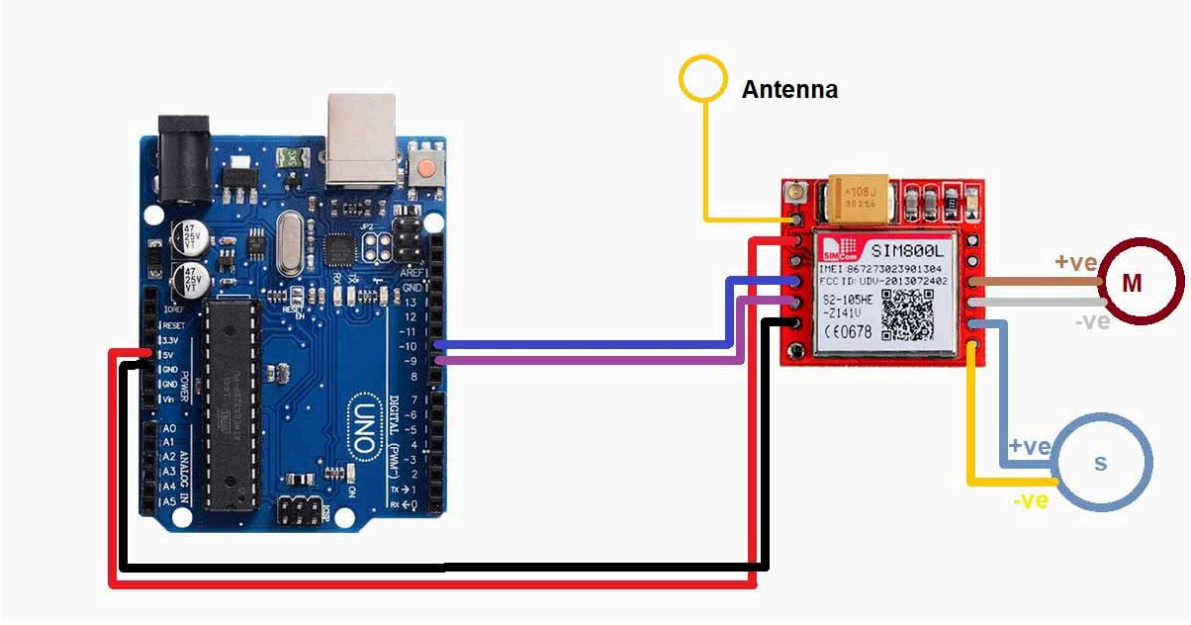
## Cost Analysis:

| Component | Cost |
|---|---|
| Arduino UNO | 400 |
| Keypad | 50 |
| Fingerprint Sensor | 800 |
| Buzzer | 30 |
| HC-05 Bluetooth Module | 300 |
| Breadboard | 100 |
| Jumper Wires | 50 |
| Labour Cost | 1000 |
| LCD Display | 200 |
| I2C Converter | 70 |
| GSM Module | 350 |
| **Total** | **3350** |

## Circuit Diagram:




ARDUINO
UNO
DIGITAL (PWM~)
POWER
ANALOG IN


Antenna
SIM800L
+ve
-ve
M
+ve
-ve
S

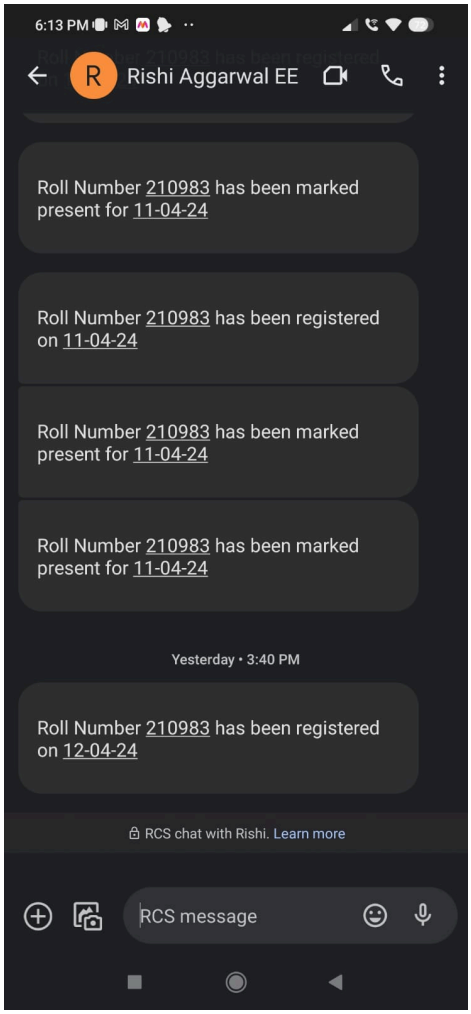
## Technical Design:

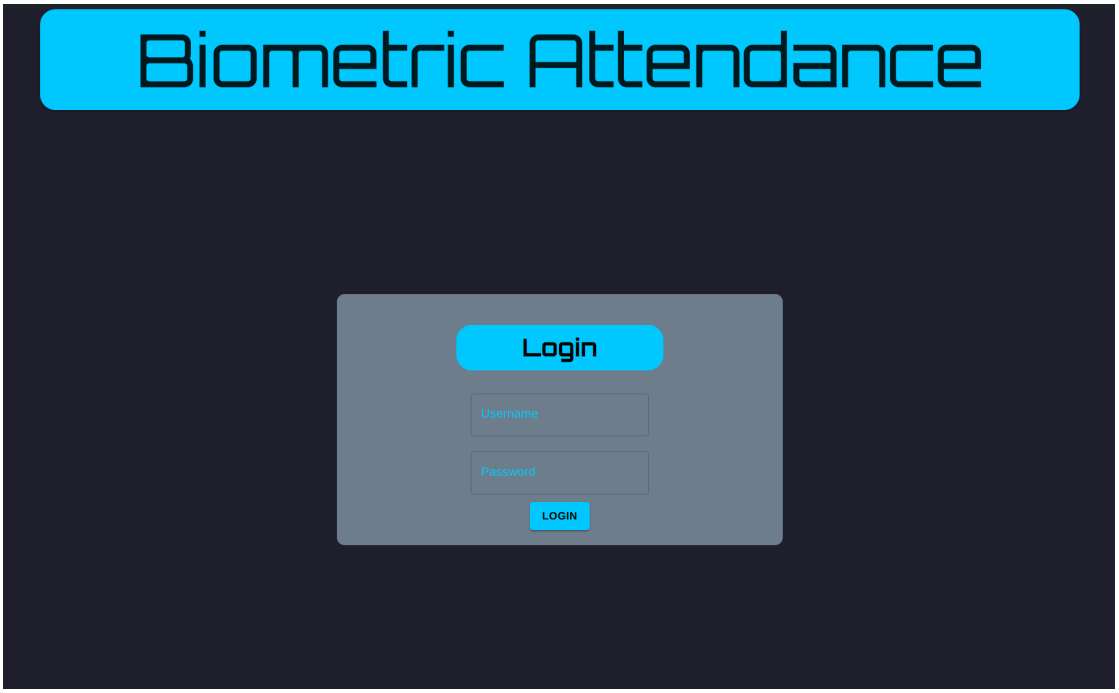
The server is written in golang and uses sqlite3 as the database. The server communicates with the arduino via serial communication on the HC05 module. Apart from this, the server also has a http API for communication with the frontend. The frontend is written in NextJS. The fingerprint sensor, HC05, LCD, Keypad and GSM are all interfaced with a single Arduino UNO. The serial communication protocol is described below -

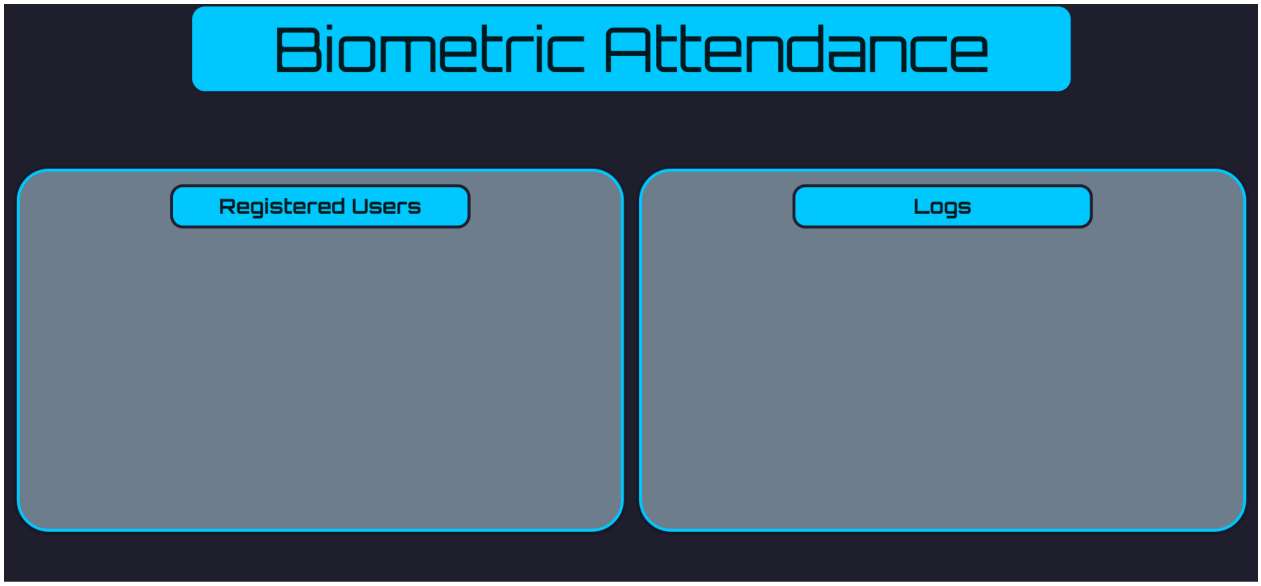
- Register Request Packet(28 bytes) - <Header=0x42>< Rollnum=6bytes><PhNo.=10bytes> <AdmPass=10bytes><ID=1byte>
- Register Response Packet - <Header=0x69><Was admin? = 1byte><date=8bytes>
- Attendance Request Packet(2 bytes) - <Header=0x96><ID matched=4bytes>
- Attendance Response Packet(25 bytes) - <Header=0x69><Date=8bytes>< Rollnum=6bytes> <PhNo.=10bytes>

The detailed workflows are described below-

- Register User - The LCD display and the keypad are used to prompt the user to enter the admin password, the new user's phone number and roll number. Then, the user is prompted to put his finger on the fingerprint sensor. All this information is sent to the server via bluetooth serial communication. The server performs a password check and if it is correct, stores the information in its database and sends back a response. If not correct, only the response packet is sent. The arduino checks the received packet and if the password has been verified by the server, sends a store request to the fingerprint sensor which saves the previously entered fingerprint on the sensor's flash memory
- Mark Attendance - The LCD prompts the user to place his finger on the sensor. The sensor does a 1:N matching and responds with a match id. The arduino sends the attendance request packet to the server and receives the user's roll number, phone number and current date. The GSM sends a message on the received phone number.


6:13 PM
Rishi Aggarwal EE
Roll Number 210983 has been marked present for 11-04-24
Roll Number 210983 has been registered on 11-04-24
Roll Number 210983 has been marked present for 11-04-24
Roll Number 210983 has been marked present for 11-04-24
Yesterday • 3:40 PM
Roll Number 210983 has been registered on 12-04-24
RCS chat with Rishi. Learn more
RCS message


Biometric Attendance
Login
Username
Password
LOGIN




All the code is available at [github](#).

## Future Improvements:

The current design used bluetooth serial communication, which has range issues. This could be improved by using a WiFi module instead to have better connectivity. The current GSM module could be replaced by an LTE module since 3G networks are getting more uncommon. At present, the raw fingerprint data is being stored on the sensor itself. This could be problematic in case of sensor failure and in general only allows a limited number of registered users. This can be resolved by storing the raw fingerprint data on the database as well..