Fingerprint Attendance System

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The purpose of this project is to design and implement a fingerprint-based attendance system for schools and institutions using biometric technology. The scope of this project includes:

- Developing a software application that can enroll and verify fingerprints, and store and retrieve attendance data from a database.
- Using a fingerprint sensor, a Raspberry Pi 4, and some Python libraries and modules to create the hardware and software components of the system.
- Testing the functionality and performance of the system in terms of accuracy, speed, and usability.

Introduction

The fingerprint attendance system is a project that aims to develop a reliable and efficient way of recording and managing the attendance of students or employees using fingerprint sensors and Raspberry Pi. The system uses the Adafruit Fingerprint Sensor, which is a capacitive fingerprint scanner that can store up to 127 fingerprints and communicate with the Raspberry Pi via serial port. The system also uses an LCD display to show the name and status of the person who scanned their fingerprint, and a CSV file to store and retrieve the attendance data.

Objectives

The main objectives of the project are:

- To enroll, delete, and search fingerprints using the Adafruit Fingerprint Sensor and the Raspberry Pi.
- To display the name and status of the person who scanned their fingerprint on an LCD screen.
- To store and retrieve the attendance data in a CSV file.
- To generate a report of the attendance data.

The research questions of this project are:

- How can a fingerprint sensor be connected to a Raspberry Pi 4 and used to enroll and verify fingerprints?
- How can a database be created and used to store and retrieve fingerprint data and attendance records?
- How can a Python script be written to perform various operations with the fingerprint sensor and the database?
- How can an LCD screen be used to display messages on the fingerprint-based attendance system?
- How does the fingerprint-based attendance system perform in terms of accuracy, speed, and usability?

Methodology

The methodology of the project consists of the following steps:

- Importing the required libraries, such as time, datetime, serial, adafruit_fingerprint, tempfile, rpi_lcd, csv, and os.
- Creating a Serial object to communicate with the fingerprint sensor via serial port.
- Creating a Fingerprint object to enroll, delete, and search fingerprints using the sensor's protocol.
- Creating an LCD object to display text or graphics on an LCD screen.
- Creating a writer object to write rows to a CSV file.
- Creating a reader object to read rows from a CSV file.
- Defining various functions to perform different tasks, such as enrolling fingerprints, deleting fingerprints, searching fingerprints, displaying messages, storing data, retrieving data, generating reports, etc.
- Calling the appropriate functions based on the user's input or the sensor's output.

This section describes the hardware and software components of the fingerprint-based attendance system, and explains how they were used to create the system.

Hardware Components:

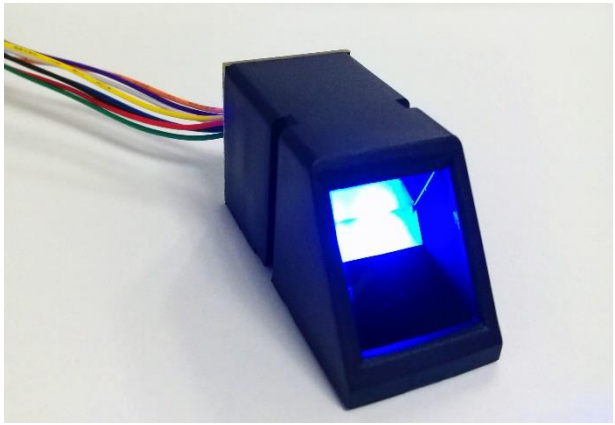
The hardware components of the system are:

1)- A Raspberry Pi 4:

This is a single-board computer that can run Linux operating system and Python programming language. The model used in this project is Raspberry Pi 4 Model B, which has a quad-core processor, 4 GB of RAM, and 40 GPIO pins .

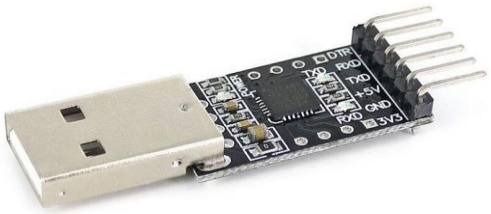
2)- AS608 Fingerprint Sensor:-

The AS608 module is used to scan fingerprints and send the data to a microcontroller via serial communication. The module can store up to 127 individual fingerprints.



3) CP 2102 USB to TTL converter :

It is used to establish connectivity between USB and Serial UART interfaces. UART stands for Universal Asynchronous Receiver/Transmitter and its main purpose is to transmit and receive serial data.

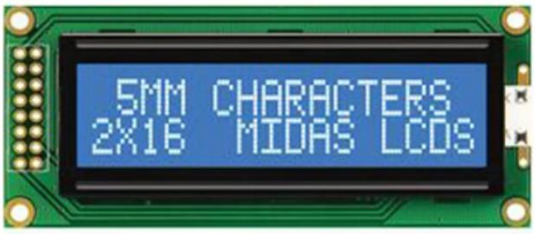


4) I2C Module :

It has an inbuilt chip that converts I2C serial data to parallel data for an LCD. Directly interfacing LCD takes a lot of pins on Raspberry Pi which makes the circuit more complicated. That is why interfacing of LCD and Raspberry Pi is done via the I2C module. It consists of four pins - VCC (Power Supply), GND (Ground), SDA (Serial Data pin),SCL (Serial Clock pin).

5) LCD Screen :

This is a display device that can show messages on the system. The model used in this project is I2C LCD1602, which is a 16x2 character LCD screen that can communicate with the Raspberry Pi 4 via I2C protocol .



Software Components:

The software components of the system are:

We have imported several libraries that provide different functionalities for project of fingerprint attendance system. Here is a brief report of the work of each of these libraries:

- **time:** This library provides various functions to manipulate time values. You can use it to measure the duration of your program, pause the execution, or get the current time. For example, you can use time.time() to get the number of seconds since the epoch.
- **datetime:** This library supplies classes for manipulating dates and times. You can use it to format and parse date and time strings, perform arithmetic operations on dates and times, or get the current date and time as a datetime object. For example, you can use datetime.datetime.strftime(datetime.datetime.now(), "%Y-%m-%d %H:%M:%S") to get the current date and time as a string in the format “YYYY-MM-DD HH:MM:SS”.
- **serial:** This library encapsulates the access to serial ports. You can use it to communicate with devices that use serial communication protocol, such as fingerprint sensors, Arduino boards, or GPS modules. For example, you can use serial.Serial("/dev/ttyUSB0", 57600) to create a Serial object that represents a connection to a serial port with a baud rate of 57600.
- **adafruit_fingerprint:** This library is a library for interfacing with fingerprint sensors from Adafruit. You can use it to enroll, delete, and search fingerprints using the sensor’s protocol. For example, you can use adafruit_fingerprint.Adafruit_Fingerprint(serial) to create a Fingerprint object that communicates with the sensor via a Serial object.
- **tempfile:** This library generates temporary files and directories. You can use it to store temporary data that you do not need to keep permanently, such as images, logs, or intermediate results. For example, you can use tempfile.NamedTemporaryFile() to create a temporary file that has a name and can be opened and closed.
- **rpi_lcd:** This library is a driver for LCD displays that are connected to a Raspberry Pi via I2C. You can use it to display text or graphics on an LCD screen, such as the name of the person who scanned their fingerprint, the date and time of the scan, or a message indicating success or failure. For example, you can use rpi_lcd.LCD() to create an LCD object that represents an LCD display.
- **csv:** This library implements classes and functions to read and write data in comma-separated values (CSV) format. You can use it to store and retrieve data in a tabular format, such as the names and IDs of the enrolled persons, the dates and times of their scans, or the status of their attendance. For example, you can use csv.writer(file) to create a writer object that writes rows to a CSV file.
- **os:**This library provides a portable way of using operating system dependent functionality. You can use it to perform various tasks related to file and directory operations, environment variables, process management, etc. For example, you can use os.path.join(path1, path2) to join two path components intelligently according to the operating system.

Results

The results of the project are as follows:

- The system can successfully enroll, delete, and search fingerprints using the fingerprint sensor and the Raspberry Pi.
- The system can display the name and status of the person who scanned their fingerprint on an LCD screen.
- The system can store and retrieve the attendance data in a CSV file.
- The system can generate a report of the attendance data.

Conclusion

The conclusion of the project is that the fingerprint attendance system is a reliable and efficient way of recording and managing the attendance of students or employees using fingerprint sensors and Raspberry Pi. The system has various advantages, such as:

- It is easy to use and operate.
- It is secure and accurate.
- It is cost-effective and scalable.
- It is portable and flexible.

The system also has some limitations, such as:

- It requires a stable power supply and internet connection.
- It may encounter errors or failures due to hardware or software issues.
- It may not work well with dirty or damaged fingerprints.

The system can be improved by implementing some features, such as:

- Adding a backup battery or solar panel to ensure uninterrupted power supply.
- Adding a wireless module or cloud service to enable remote access and data synchronization.
- Adding a voice recognition or face recognition module to enhance security and convenience.

Figures: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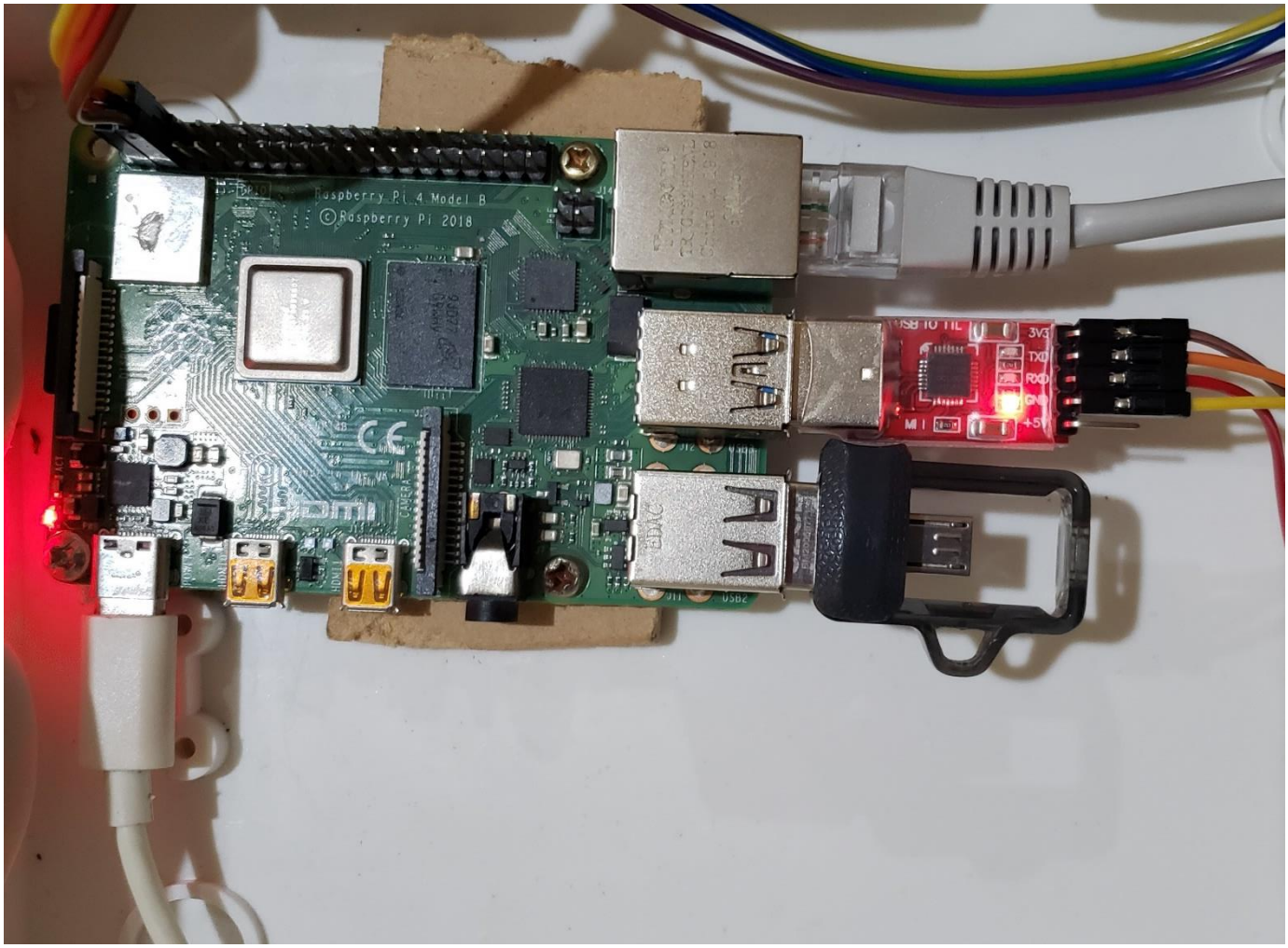
Raspberry Pi 4 Model B
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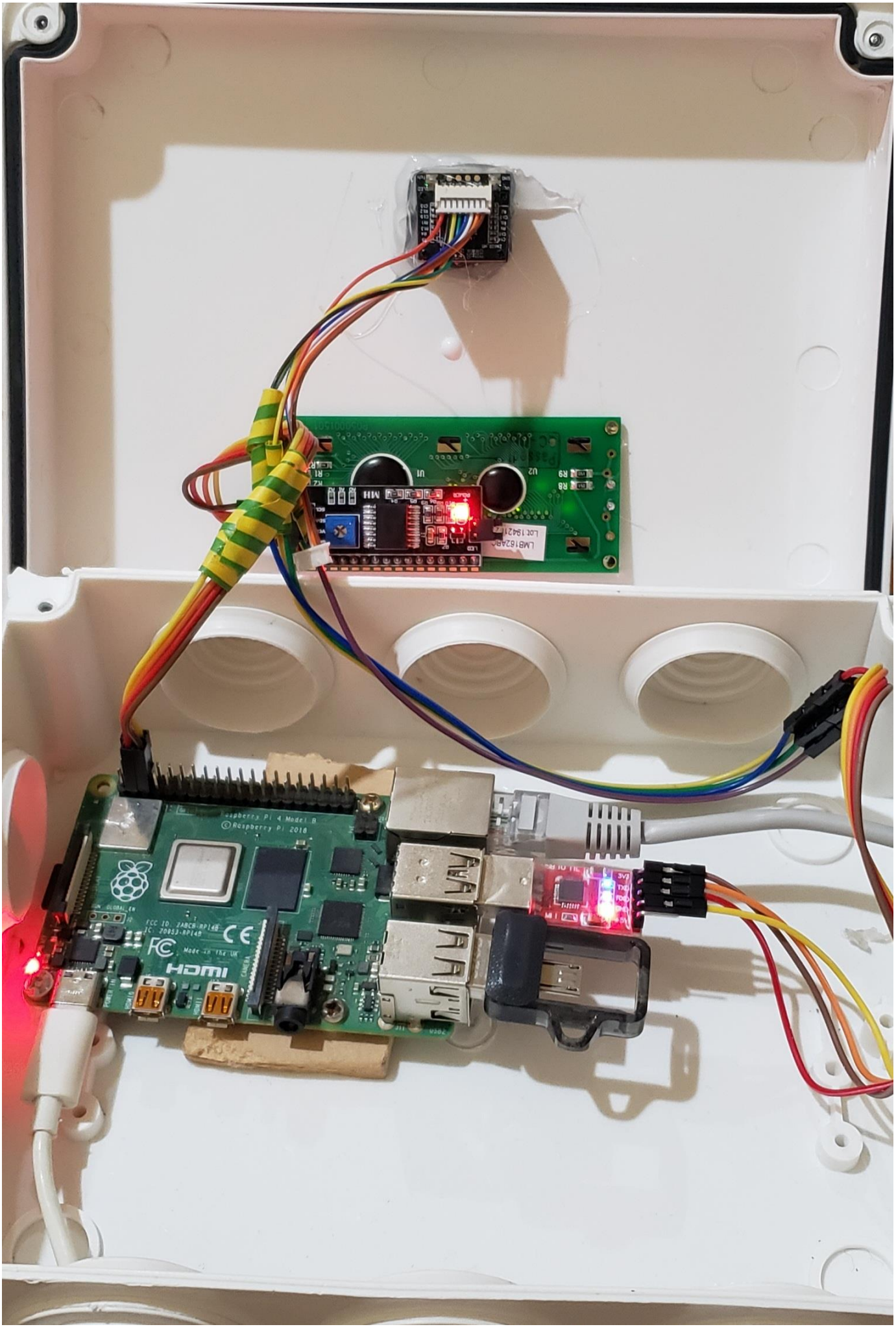
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