Fingerprint & Passcode Based Anti-Theft Vehicle System

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ABSTRACT:A major problem today for vehicle owners is that they are constantly afraid of having their vehicles stolen from a common parking lot or from outside their home. Image processing based real time vehicle theft detection and prevention system provides an ultimate solution for this problem. In this paper, a low-cost extendable framework for smart vehicle security system is proposed, which consists of a FDS (Fingerprint Detection Subsystem), a GPS (Global Positioning System) module, a GSM (Global System for Mobile Communications) module and a control platform. The system described in this project Fingerprint scanned of driver and compares his or her fingerprint with database to check whether he is an authenticated driver or not. The Fingerprint detection sub system bases on optimized PCA algorithm and can Recognize fingerprint in vehicles. The other modules transmit necessary information to users and help to keep eyes on vehicles all the time, even when the vehicle is lost. This system prototype is built on a Microcontroller, controls all the processes. The owner is made able to perform vehicles stopping through the message from his mobile. The GPS module in the vehicle detects the location of the vehicle. by this system the identification of the thief and the location of the vehicle are simply smarter and cheaper than traditional ones and implemented panic button in case of emergency to the passenger India has a high population rate and so is the number of automobiles. With the increase in the automobiles comes the increase in their theft and the present systems lack a few parameters which isn't being helpful in dealing with this important concern of the vehicle owner. In this time of taking off vehicles, vehicle security has turned into a question of Prime significance, especially in urban cities, where these incidents take place each and every day. Agents owe this expansion in burglaries to the lack of appropriate parking spots in neighborhood and also absence of accessibility of refined security gadgets. Advancement in technology has been proven to be effective in managing vehicle thefts. There is a need to reduce these burglaries/thefts using the required means for vehicle security. Therefore, anti-theft systems play a vital role in reduction of vehicle thefts. Implementation of biometric anti-theft security system has been operational.

Keywords: Engine, Arduino Uno, Fingerprint Sensor, Keypad, GPS/GSM, Hardware's.

I. INTRODUCTION

In today's rapidly evolving technological landscape, every individual and industry strives to keep pace with the latest advancements. The automobile sector is no exception. With vehicle ownership becoming increasingly common, consumers are now more concerned than ever about incorporating advanced technologies into their vehicles. As vehicles are significant investments, buyers are particularly interested in user-friendly and innovative features. Automobile manufacturers have responded to this demand by enhancing vehicle automation and integrating smarter security features. Numerous technologies have been introduced for vehicle security, ranging from traditional anti-theft alarms to modern electronic devices. However, many of these solutions have failed to fully address customer concerns—particularly in scenarios where the keyless remote is lost, making it difficult to lock, unlock, or even start the vehicle.

One promising solution is the GSM-based vehicle security system, which allows vehicle tracking through location data in the event of theft. Despite this advancement, the issue of controlling the vehicle—especially engine ignition—without the keyless remote remains largely unresolved. To address this gap, this paper presents the development of an electronic vehicle security system. Leveraging Raspberry Pi technologies, the proposed system integrates several advanced techniques including biometric recognition, image processing, and communication modules to enhance security and user control. Despite these innovations, vehicle theft and unauthorized access still persist. Therefore, a practical vehicle security system must be efficient, robust, and highly reliable. Traditional systems often rely heavily on numerous sensors, increasing cost and complexity. Moreover, once a vehicle is lost, conventional systems offer limited feedback for recovery. This work introduces face detection technology as a core component of the vehicle security system. This technique offers rapid and accurate identification, providing an effective solution for vehicle access control. A GPS module is used to determine the vehicle's precise location by parsing satellite signals, while a GSM module transmits real-time updates—such as location data and driver images—via SMS. All system operations are managed by a central Raspberry Pi controller, which handles image capture, facial recognition, GPS data processing, and SMS transmission.

II. LITERATURE REVIEW

Ajinkya Kawale's research presents an innovative fingerprint-based vehicle locking system that leverages biometric technology for secure access. The system, powered by a PIC16F876A microcontroller, eliminates the need for traditional keys or passwords by relying solely on pre-registered fingerprints. It features added security measures such as an alarm system for unauthorized access attempts, GPS-GSM-based alerts, and fuel injector deactivation to prevent engine ignition by unauthorized users. The paper emphasizes the accuracy and dependability of minutiae-based fingerprint recognition and proposes the vision of a "Keyless World," highlighting its potential for widespread security applications. [1]

Another study explores a **Fingerprint-Based Ignition System** designed to enhance vehicle security by replacing key-based access with biometric authentication. This system comprises fingerprint analysis software, a hardware interface, and an ignition module. Ignition is granted only when the fingerprint matches a stored entry in the system's database. The authors stress the uniqueness and consistency of fingerprints as biometric identifiers, proposing this prototype as a foundation for future real-time fingerprint-based vehicle security systems. [6]

Further advancing the concept, the **Fingerprint & Passcode Based Anti-Theft Vehicle System** proposes a cost-effective, integrated solution. This system combines a Fingerprint Detection Subsystem (FDS) that uses a Principal Component Analysis (PCA) algorithm for recognition, along with GPS and GSM modules for real-time location tracking and communication. An Arduino Uno microcontroller coordinates all components. Additional features include remote vehicle control through mobile messaging and an emergency panic button. The paper calls for the integration of biometric recognition, image processing, and wireless communication technologies to create more efficient and secure anti-theft systems. [8]

Addressing a different but equally important concern, another study examines **vehicle over-speeding**, a major cause of road accidents. The paper introduces a technology-based solution using Arduino, IR sensors, and an LCD display to detect and alert drivers about excessive speed. It reviews several existing methods, such as RF-based speed control, camera-based systems, and intelligent transport networks. The proposed system offers a low-cost, automated alternative to traditional manual enforcement, contributing to improved traffic monitoring and road safety. [9]

In response to the global surge in vehicle thefts, another research paper proposes a **password-protected vehicle initiation system** as a supplementary layer of security. This low-cost module incorporates a 4x4 matrix keypad, LCD, relay switch, and is controlled by an Arduino processor. Acting as an additional digital keylock, the system aims to prevent unauthorized engine startups. The study discusses future enhancements, including Wi-Fi-based data transmission and a mobile application for real-time vehicle tracking and remote system override. The literature draws from previous work on biometric systems, RFID technologies, GPS-based tracking, and affordable vehicle security solutions, situating this contribution within the broader context of advanced, integrated security systems.

III. HARDWARE AND SOFTWARE

A. Hardware System Components

1)FingerprintModule

The fingerprint module serves as the primary authentication mechanism for initiating the vehicle ignition system. Upon scanning, the system verifies the input against stored fingerprints, activating the ignition only when an authorized fingerprint is recognized.

The module includes functionality for both enrolling new users and deleting existing ones. These actions are restricted to the system administrator or "master" fingerprint ID, ensuring only trusted users can modify the authentication database.

When a fingerprint match is successful, the ignition system is activated, allowing the vehicle to start. Conversely, if an unauthorized fingerprint is detected, the system responds by sounding a buzzer and sending an alert notification to the authorized user via the communication module. This feature enhances both access control and real-time security monitoring.

Fig 1- Optical Fingerprint Sensor

2)Anti-TheftRelay

The Anti-Theft Relay functions as a critical component in enhancing vehicle security by preventing unauthorized access and operation. When activated, the relay interrupts either the ignition circuit or the fuel supply, effectively immobilizing the vehicle and making it inoperable.

This security mechanism acts as a strong deterrent against theft by ensuring that even if physical access is gained, the vehicle cannot be started without proper authorization. By integrating this feature into the system, the overall protection of the vehicle is significantly improved. The presence of such a safeguard offers vehicle owners a heightened sense of security and peace of mind, knowing that their assets are protected by a reliable and responsive anti-theft solution.

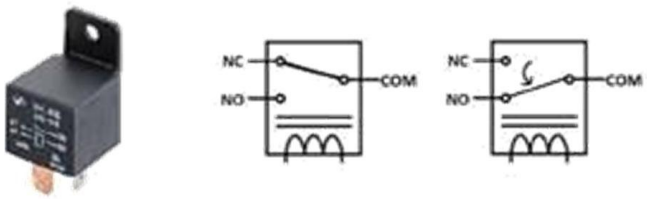

Fig 2 – Anti-Theft Relay and Symbol

3)MicrocontrollerUsed

The **Arduino Uno** microcontroller is employed as the central control unit for the system. Known for its versatility and open-source nature, the Arduino Uno is widely adopted in both educational and professional environments for developing embedded electronic projects.

Its user-friendly programming interface, combined with robust community support and extensive documentation, makes it an ideal choice for integrating various hardware components. The Arduino Uno seamlessly interfaces with a wide range of sensors and modules—including biometric, GPS, GSM, and relay systems—facilitating smooth communication and system operation. Its reliability and ease of use make it a powerful tool for rapid prototyping and real-time control in vehicle security applications.

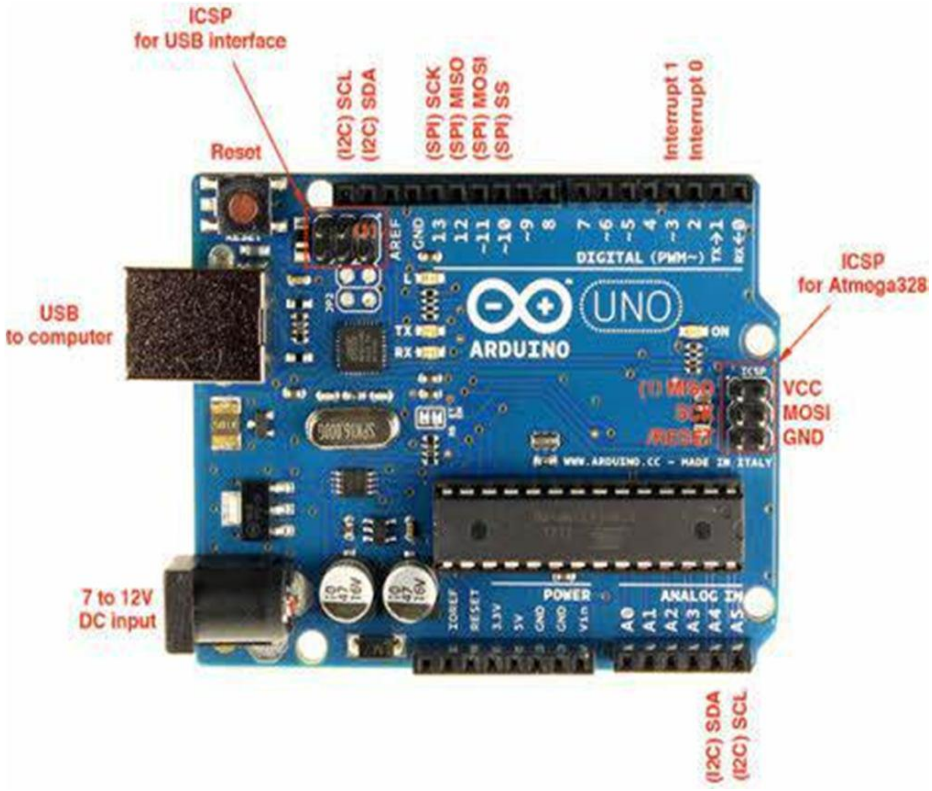

Fig 3 – Arduino Uno

4)IRSensor

The **Infrared (IR) sensor** is used to detect the presence of objects by identifying changes in infrared radiation. It comprises two main components: an IR emitter, which emits infrared light, and an IR receiver, which detects the reflected or interrupted signal.

When an object passes between the emitter and receiver or reflects the emitted IR rays, the sensor registers a change, signaling the presence or movement of the object. This functionality makes IR sensors highly useful in automation, object detection, and security systems.

In the context of this project, IR sensors can be implemented for proximity detection or intrusion sensing, contributing to the overall security and intelligent behavior of the vehicle system

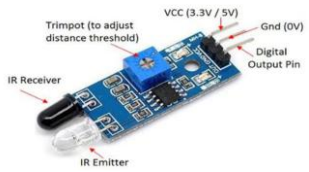

Fig 4 – IR Sensor

5)LCDCrystalDisplay

The **LCD (Liquid Crystal Display)** is a key output component used in this system to present real-time information to the user. It operates using liquid crystals that modulate light, controlling its passage through a matrix of pixels to display characters and images.

In this project, the LCD is primarily used to display system status messages—such as authentication success or failure, system alerts, and operational prompts. Its low power consumption, compact design, and ease of interfacing with microcontrollers like the Arduino Uno make it highly suitable for embedded applications.

Due to its efficiency, clarity, and versatility, LCD technology is widely adopted in various electronic devices, including monitors, smartphones, control panels, and embedded systems like the one discussed in this project.

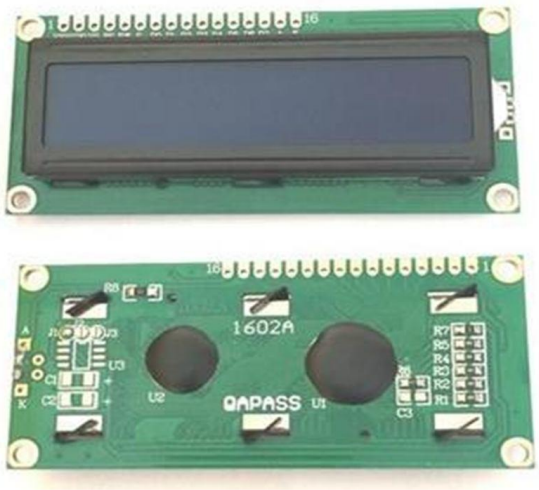

Fig 5 – Performance Monitor: LCD-Display

B. Software System Components

1) Arduino-IDE

Arduino-IDE is a GUI based software that supports all Arduino based microcontrollers. This is a cross platform an application written in the C programming language. It is open-source software (IDE) that makes it very easy write the code and also upload it to the board. Program written using the Arduino IDE is called "sketch".[12]

2) Virtual Server

A virtual server, developed through HTML and CSS, is implemented for mobile installation, facilitating speed control and obstacle detection notifications. The system is designed to alert users when a driver exceeds speed limits, triggering notifications on the server and activating a buzzer. Additionally, the speed of the vehicle can be controlled through a switch, providing a means to address and manage potential safety concerns.

IV. BLOCK DIAGRAM

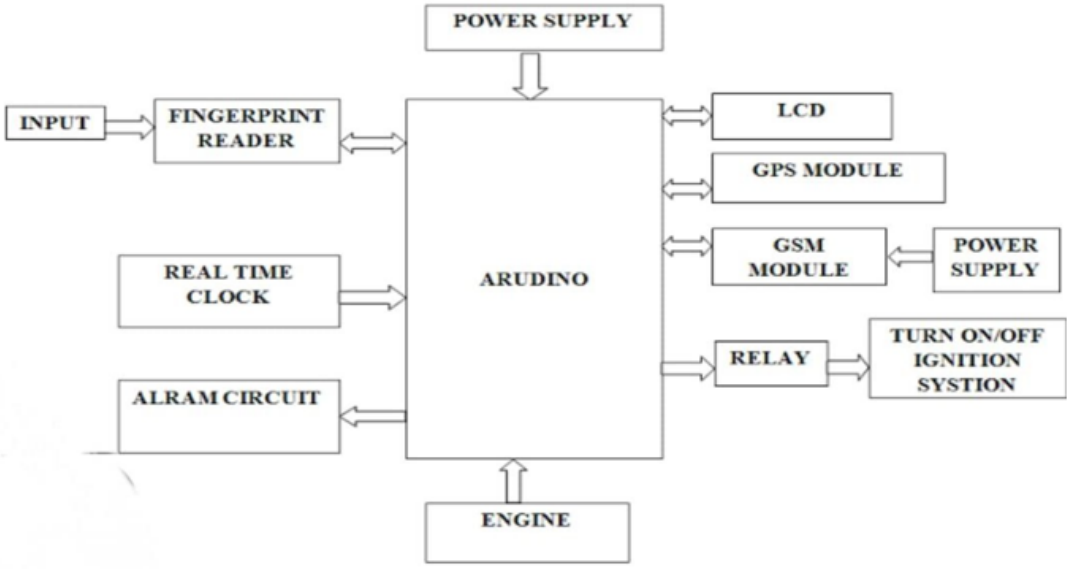

Fig6 Block Diagram of our System

V. SYSTEM IMPLEMENTATION

This section outlines the practical implementation of the **Fingerprint and Passcode** system, including key functionalities, interface elements, and testing outcomes. It bridges the gap between theoretical design and real-world execution, detailing the software and hardware integration necessary to bring the system to life.

5.1 Implementation Details

The implementation of the **Fingerprint and Passcode** system involves programming the Arduino microcontroller, configuring the GSM communication module, and establishing connections between various hardware components. This process combines software development with hardware integration and precise configuration.

5.1.1 Arduino Programming

The Arduino microcontroller is programmed using the **Arduino IDE**, where custom code is developed and uploaded to manage all hardware interactions and logic processes. The key functions of the code include:

- **Sensor Reading**:

Continuously monitors the inputs from the fingerprint sensor, keypad, and other modules. It reads data at regular intervals to detect user interactions and system status.

- **Data Processing**:

Processes input from the fingerprint and passcode systems. This includes verifying fingerprints against stored templates and matching entered passcodes with saved credentials.

- **Alert Management**:

Manages security alerts by prioritizing notifications and routing them to predefined emergency contacts. It ensures timely delivery of alerts and monitors for acknowledgment of received messages.

- **Communication**:

Interfaces with the **GSM module** to send SMS alerts to registered users or caregivers when unauthorized access attempts or emergency conditions are detected.

- **User Interface**:

Updates the **LCD display** to show real-time system status, authentication results, sensor data, and emergency contact information, providing the user with continuous feedback and control.

5.1.2 GSM Module Configuration

The **GSM module** is configured to enable SMS-based communication with designated emergency contacts. Configuration involves:

- Setting and storing recipient phone numbers in memory.
- Defining SMS message formats for different alert conditions (e.g., unauthorized access, security breach, system status).
- Establishing communication protocols between the Arduino and the GSM module for reliable message delivery.

This configuration ensures that, in the event of suspicious activity or system alerts, real-time notifications are sent to the appropriate individuals, enhancing the system's reliability and responsiveness. 5.1.3 Hardware Connections: The various hardware components are connected together using connecting wires and a breadboard. The connections must be made according to the circuit diagram to ensure that the system functions correctly. Proper wiring and connections are crucial for the system to function correctly.RESULT :

VI OUTPUT:

GSM:A fingerprint and pass code-based anti-theft vehicle system using GSM (Global System for Mobile Communication) technology enhances security by integrating biometric authentication, real-time location tracking via GPS, and remote alerts through mobile communication Fingerprint and pass code verification ensures only authorized users can access the vehicle's ignition system. The system uses GSM to communicate with the user's mobile phone, sending alerts or commands for vehicle control. GSM enables the system to send alerts to the owner's mobile phone in case of unauthorized access or suspicious activity. The owner can also remotely control certain vehicle functions, such as locking or engine through GSM communication

GPS: In fingerprint and pass code-based anti-theft vehicle system, GPS technology plays a crucial role in real-time location tracking Real-time Location Tracking: GPS technology allows vehicle owners to monitor their vehicle's location in real-time, providing peace of mind and facilitating recovery in case of theft. and remote alerts, enhancing

security and enabling vehicle recovery in case of theft.

Example System:

A system might use a fingerprint sensor for authentication, a GPS module for location tracking, and a GSM module for communication.

When an unauthorized person attempts to start the vehicle, the system can trigger an alarm and send a notification to the owner, while also locking the engine remotely. The owner can then use the mobile app to track the vehicle's location and contact authorities.

Fingerprint Sensor: The fingerprint sensor is a crucial component of a fingerprint and pass code-based anti-theft vehicle system. This system is designed to provide an additional layer of security to prevent vehicle theft. The fingerprint sensor is used to capture and recognize the unique patterns found on an individual's fingertips, while the pass code provides an additional layer of authentication. In this article, we will explore the fingerprint sensor's role in this system and its benefits. A fingerprint sensor is a type of biometric sensor that captures and recognizes the unique patterns found on an individual's fingertips. The sensor uses a optical sensing technology to capture the fingerprint image. The captured image is then processed to extract unique features, such as ridges, valleys, and minutiae points. These features are used to create a unique template, which is stored in the system's database.

Pass-code Keypad: The pass-code keypad is a critical component of a fingerprint and pass code-based anti-theft vehicle system. It provides an additional layer of security beyond fingerprint authentication, making it more difficult for unauthorized users to access the vehicle. In this article, we will explore the pass-code keypad's role in this system and its benefits. The pass-code keypad is a secure entry system that allows users to enter a pass-code to access the vehicle. It is designed to provide a convenient and secure way for users to access the vehicle, while also preventing unauthorized access. The pass-code keypad is a critical component of a fingerprint and pass code-based anti-theft vehicle system. It provides an additional layer of security beyond fingerprint authentication, making it more difficult for unauthorized users to access the vehicle. While there are some disadvantages to consider, the benefits of the pass-code keypad make it a valuable addition to vehicle security systems.

Coaxial Antenna : The coaxial antenna is a critical component of a fingerprint and pass code-based anti-theft vehicle system. It plays a crucial role in transmitting and receiving signals between the vehicle's security system and the user's device, such as a smartphone or key fob. In this article, we will explore the coaxial antenna's role in this system and its benefits. The coaxial antenna is a type of antenna that uses a coaxial cable to transmit and receive signals. It is designed to provide a reliable and secure way to communicate between the vehicle's security system and the user's device.

LCD: The LCD (Liquid Crystal Display) is a critical component of a fingerprint and pass code-based anti-theft vehicle system. It provides a user-friendly interface for users to interact with the system, displaying important information such as authentication status, system alerts, and vehicle status. In this article, we will explore the LCD's role in this system and its benefits. The LCD is a type of display technology that uses liquid crystals to block or allow light to pass through a matrix of pixels. It is commonly the LCD is a critical component of a fingerprint and pass code-based anti-theft vehicle system. It provides a user-friendly interface for users to interact with the system, displaying important information such as authentication status, system alerts, and vehicle status. While there are some disadvantages to consider, the benefits of the LCD make it a valuable addition to vehicle security systems used in a wide range of applications, including vehicle security systems.

Relays: Relays are electromagnetic switches that play a crucial role in fingerprint and pass code-based anti-theft vehicle systems. They are used to control the flow of electrical current to various components, such as ignition systems, fuel pumps, and alarm systems. In this article, we will explore the role of relays in fingerprint and pass code-based anti-theft vehicle systems. Relays are used in vehicle security systems to control the flow of electrical current to various components. They are designed to be highly reliable and durable, making them suitable for use in vehicle security systems. Relays play a crucial role in fingerprint and pass code-based anti- theft vehicle systems. They offer several benefits, including high current handling, low power consumption, and high reliability. Relays are used in a wide range of applications, including vehicle security systems, industrial control systems, and

automotive systems.

Switch: Switches are critical components in fingerprint and pass code-based anti- theft vehicle systems. They are used to control the flow of electrical current to various components, such as ignition systems, fuel pumps, and alarm systems. In this article, we will explore the role of switches in fingerprint and pass code-based anti-theft vehicle systems. Switches play a crucial role in fingerprint and pass code-based anti- theft vehicle systems. They offer several benefits, including high reliability, low power consumption, and high security. Switches are used in a wide range of applications, including vehicle security systems, industrial control systems, and automotive systems.

Battery: Batteries are a critical component in fingerprint and pass code-based anti- theft vehicle systems. They provide power to the system's components In this article, we will explore the role of batteries in fingerprint and pass code-based anti-theft vehicle systems. Batteries play a crucial role in fingerprint and pass code-based anti-theft vehicle systems. They provide power to the system's components and offer several benefits, including reliability, affordability, and convenience. While batteries have some disadvantages, they remain a popular choice for vehicle security systems.

Arduino: Arduino is a popular micro controller platform used in a wide range of applications, including vehicle security systems. In this article, we will explore the role of Arduino in fingerprint and pass code-based anti-theft vehicle systems. Arduino is an open-source micro controller platform that allows users to create interactive projects. It consists of a micro controller board, a programming language, and a development environment. The below figure shows the overall prototype of our project fingerprint passcode and anti-theft vehicle system.

Fig: 7 FINGERPRINT AND PASSCODE BASED ANTI THEFT VEHICLE SYSTEM

When the finger print placed on the fingerprint sensor , it verifies the fingerprint or passcode and read by the Arduino board and displayed on the LCD. In this state ,the motor turns on and runs continuously

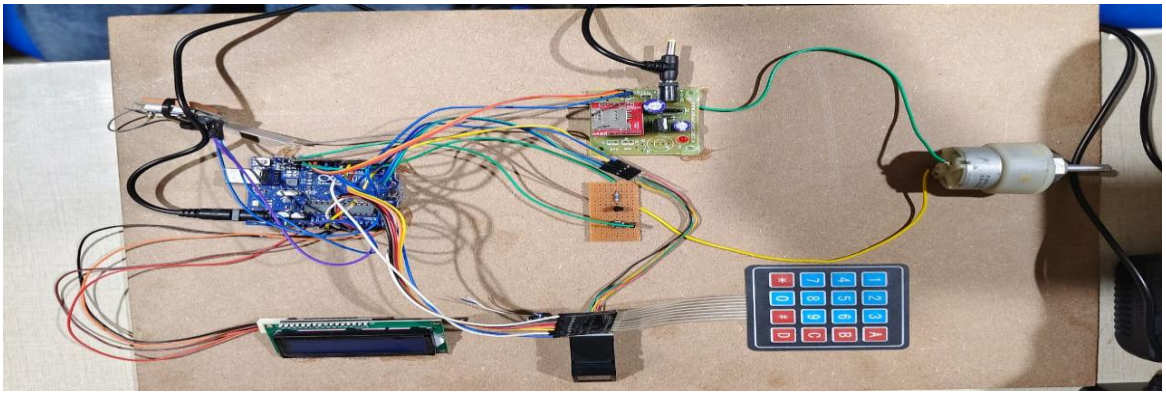

Fig: 8 Input of FINGERPRINT AND PASSCODE

When a finger placed on a fingerprint sensor, the Arduino checks the fingerprint and displays it on the LCD (63.2 gms). In this case the motor runs continuously 10 sec.

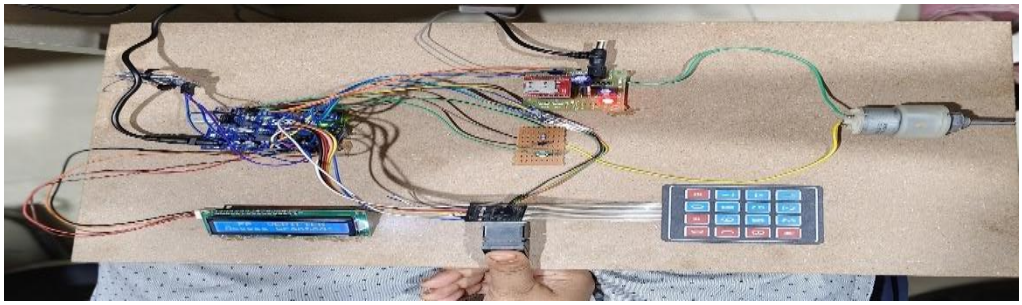

Fig9 5.3 LCD Display

The FINGERPRINT AND PASSCODE BASED ANTI THEFT VEHICLE SYSTEM project aimed to develop a comprehensive and affordable solution that provides real-time monitoring, alerts, and support for individuals with physical disabilities. The system utilizes GSM technology for tracking and alerts, a flex sensor for posture and movement detection, a buzzer alert system, an emergency push button, and an LCD screen for user interface. The system was designed to address the limitations of existing systems by providing a cost-effective, user-friendly, and comprehensive solution that promotes the safety, independence, and well-being of physically disabled individuals. It sought to create a system that is accessible, reliable, and effective in supporting the well-being of its users.

Real-Time Fall Detection: The system provides real-time fall detection using a flex sensor and a fall detection algorithm.

Alert Notification System: The system sends SMS alerts to caregivers or emergency services in case of a fall or other emergency.

Emergency Assistance: The system allows the user to manually trigger an alert in case of an emergency by pressing the emergency push button.

User-Friendly Interface: The system provides a user-friendly interface with an LCD screen that displays system status, sensor readings, and emergency contacts.

Cost-Effective Design: The system is designed to be affordable and accessible to a wide range of users, utilizing low-cost hardware components and open-source software.

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