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Ms. RADHA MANE

Ms. SUMAYYA DARUGAR

Ms. MEGHA ALAGAWADI

Ms. SURABHI HEGADE

</div>

ABSTRACT

This concept which is of Fingerprint door locker is related to the security issues in the day today life, the physical key can be made as duplicate in very cheap cost and the key can lost somewhere or the key can steal, to overcome these issues we can use biometric security gadgets and try improvise the security much more because it can never be stolen it cannot be lost and the stealing chance of duplication are very low to break the security. From the old times the security is the big issue for the company's houses and other places and every person is worried about the security now a days. So, a solution to such problems can be by combining door lock with biometrics. Biometric verification is any means by which a person can be uniquely identified by evaluating one or more distinguishing biological traits.

The fingerprint sensor will take the fingerprint of the user and forward it to the microcontroller to match with its records. If the print matches with one of the fingerprints of the microcontroller's memory, the microcontroller will lock or unlock the latch, based on its current state. If the fingerprint do not match then nothing happen. The door lock is unlocked and the user have to retried. The system will be reset once a known print will be entered.

This project has fingerprint for biometric verification as it is one such thing which is unique to every individual and the use of fingerprint as the key to door locks can overcome the security problem of unauthorized people trespassing to our homes, shops, offices, etc. to a great extent as duplicate in such key is not possible. Also, this system will not lead to problems like losing keys because we do not require carrying keys if this system is used instead of traditional locks. So, using Arduino we will try to implement the system with features which will increase the security level.

LIST OF FIGURES

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Introduction to fingerprint door lock system

Fingerprint door lock systems are advanced security solutions that utilize biometric technology to provide access control to homes, offices, and other secure spaces. These systems offer a convenient and secure alternative to traditional lock and key mechanisms or keypad-based entry systems. By scanning and analyzing an individual's unique fingerprint pattern, they can accurately identify and authenticate authorized users, granting or denying access as necessary.

Electronic lock using fingerprint recognition system is a process of verifying the fingerprint image to open the electronic lock. This project highlights the development of fingerprint verification. Verification is completed by comparing the data of authorized fingerprint image with incoming fingerprint image. Then the information of incoming fingerprint image will undergo the comparison process to compare with authorized finger print image.

1.2 Motivation

The motivation for implementing fingerprint door lock systems lies in their ability to provide a higher level of security, eliminate the risks associated with lost or stolen keys, offer convenience and ease of use, maintain an audit trail for accountability, accommodate scalability, and integrate with other security systems. These motivations collectively contribute to a more secure and efficient access control solution for both residential and commercial applications.

1.3 Advantages

- Fingerprint door locks offer a much higher level of protection than traditional keyed locks.
- Fingerprint door locks are one of the most affordable biometric security systems available today.
- Biometric security systems are the most accessible of all security systems. They're easy to use and don't require a key or code to operate.
- they're less likely to break or malfunction. They're durable and easy to maintain.
- Another advantage of fingerprint door lock system is that they are much more convenient than keyed locks.

1.5 Applications

- Personal computer security

- e-commerce / e-business security

- Electronic transaction

- Office security

- Banking and financial system

- Medical information system

- ATM, cell phones, laptops, offices, cars etc.

- Door lock system
  Fingerprint security systems in car

1.6 Project Report Organization

Chapter 1 Presents introduction to the overall projrct and the overview of the project. In the project overview a brief introduction of fingerprint door lock system using arduino and its applications and advantages are discussed.

Chapter 2 Presents the literature survey which has research papers of the projects. Related background and concept , problem statement and block diagram.

Chapter 3 Stages of development, Flowcharts, Block diagrams, Methodologies and Techniques to be used, Hardware and Software tools

Chapter 4 This chapter explains the system implementation and software development, working procedure and steps involved in the project.

Chapter 5 Explains the work done, future scope, limitations, results, conclusion

Reference

2.FINGERPRINT DOOR LOCKING SYSTEM MODEL

2.1 Literature Survey

Afolabi and Alice (2014) Proposed a design door security system with a fingerprint sensor SN-FOR-UART and microcontroller PIC16F648A. Microcontroller is used to controls all of the door security system. An LCD status display is employed to show the operating status of the system. A door movement mechanism is used in the design to make the automated door system move in clockwise and anti-clockwise direction, then fingerprint input stage was implemented using the SN-FPR-UART. The development of system guarantees security for illegal intrusion into any entity to the room , the mechanism can be implemented in a broader sense of a door where there is restriction of access. But in this system there is no mechanism for home monitoring[1]

Zhou, Huang, and Zhao (2013) presented the architecture of smart home management system by developing an Android-based application that connects to a smart gateway, smart jacks, and smart interview terminal. The system had a reasonable structure, easy expanding, and satisfying the need of smart home management. The system supports common communication protocols, and as well as running on different devices. The results of their experiment suggested that the system is stable and easy to operate. [2]

Kaur (2010) designed a microcontroller-based home automation system which focusing on the home security. The home security comprised of a password based locking system, an au-tomatic switching system, a temperature controlled cooling system, a lighting system, and fire and smoke sensors.[3]

Gangi and Gollapudi (2013) implemented a locker security system that used fingerprint, pass-word and GSM technology for activating the locking system. The system authenticates and val-idates the user, then unlocks the door in real time for the locker secure access.[4]

2.2 Related Background and Concepts

A fingerprint door lock utilizes an electronic locking system to gain access. It is a type of intelligent lock with which you don't have to have a key or a magnetic card to be in your possession when entering locked premises. Instead, you will present a registered biometric fingerprint. This is done by sticking your finger on the device to verify authorized entry. It's a convenient aspect because unlike keys, it's impossible to lose your fingerprint.

2.3 Problem Statement

The problem statement which is the biometric system sometimes is sensitive and will not be able to sense the biological pattern of the employer's fingerprint due to sweat and other factors. Next, people tend to misplace their key or RFID card. Apart from that, people tend to forget their pin number for a door lock.

2.4 Block Diagram

A block diagram of a fingerprint door lock system generally consists of several key components that work together to provide secure access control. Here's a simplified block diagram outlining the main components of such a system:
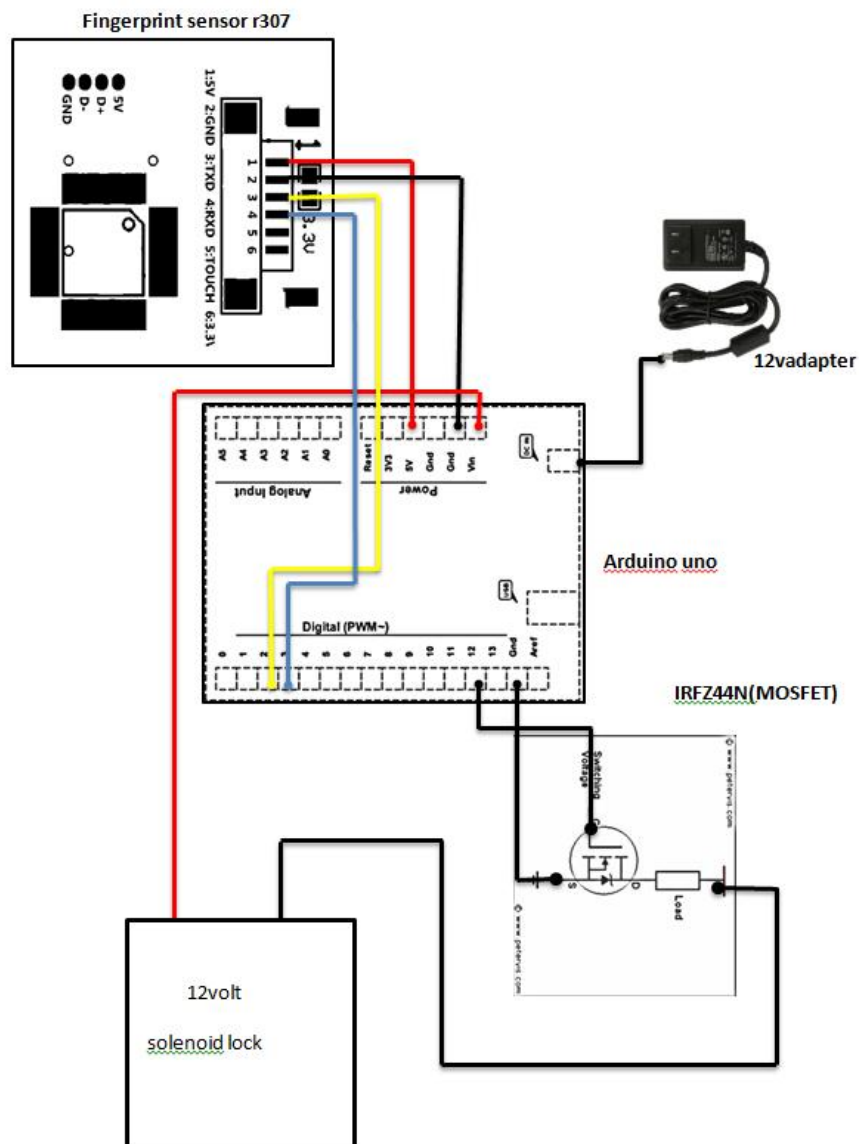

Figure 1: Block Diagram

3. METHODOLOGY

3.1 Methodology

The methodology section describes the design and implementation of the fingerprint door lock system using Arduino Uno microcontroller. The system consists of hardware and software components. The hardware components include Arduino Uno, fingerprint sensors module, relay module, solenoid door lock, some jumper wires, and an adapter. The software components include a program for interfacing the fingerprint sensor with Arduino. The system was designed and implemented using the Arduino IDE software.

3.2 Analysis Of Existing System

- Functionality: The fingerprint door lock system should allow authorized users to access the door by scanning their fingerprints. It should have the ability to store and manage multiple fingerprints and grant access accordingly.

- Technology: The system would likely consist of an Arduino Uno microcontroller, a fingerprint sensor module, a servo motor or electronic lock for physical door control, and appropriate wiring.

- User Interface: The user interface should be intuitive, allowing users to enroll their fingerprints, delete or update existing fingerprints, and easily trigger the door lock/unlock mechanism.

- Security: The primary goal of the system is to enhance security. It should employ secure fingerprint authentication methods, and the fingerprint data must be securely stored and encrypted to prevent unauthorized access.

- Reliability: The system should be reliable and accurate in fingerprint recognition to minimize false positives and negatives during authentication.

- Power Consumption: Since the system may run continuously, power efficiency should be considered to ensure prolonged operation without frequent battery replacements.

- Durability: The hardware components should be robust and durable to withstand daily usage and environmental conditions.

- Cost-effectiveness: The overall cost of the system should be reasonable and justifiable based on its features and performance.

- Maintenance: The system should have low maintenance requirements, with periodic checks for any technical issues or updates.

- Compatibility: Consider the compatibility of the system with other devices or technologies, such as the ability to integrate with home automation systems.

- Documentation and Support: Availability of comprehensive documentation and support resources for users and developers is essential for troubleshooting and understanding the system's functionalities.

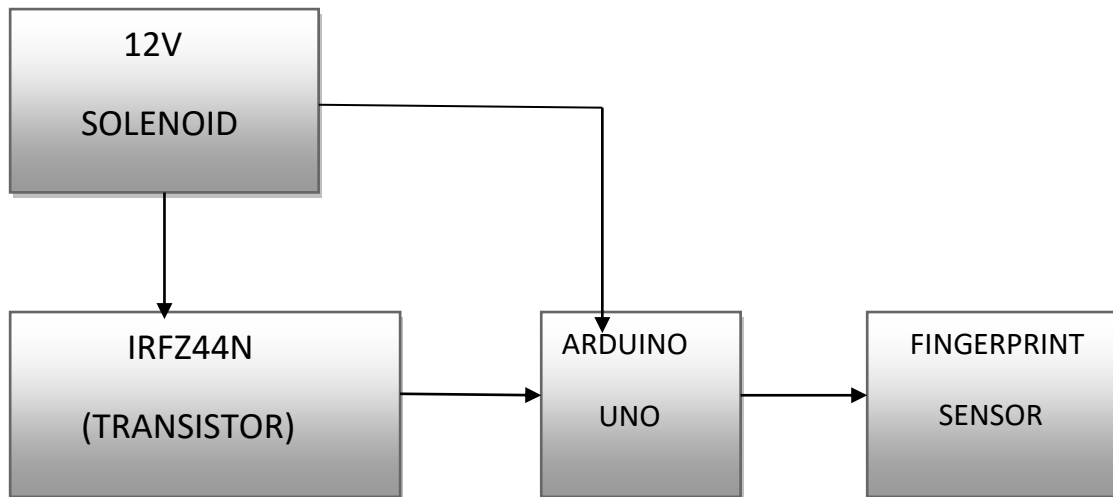## 3.3 System Block Diagram

Figure 2 : System Block Diagram

3.4 Principle Of Operation

Fingerprint processing includes two parts fingerprint enrolment and fingerprint matching (the matching can be 1:1 or 1:N).

When enrolling, user needs to enter the finger two times. The system will process the two time finger image, generate a template of the finger based on processing result and store the template. When matching , user enters the finger through optical sensor and system will generate a template of finger and compare it with templates of the finger library. For 1:1 matching, system will compare the live finger with specific template designated in the module; for 1:N matching, or searching system will search the whole finger library for the matching finger. In both circumstances, system will return the matching result, success or failure.
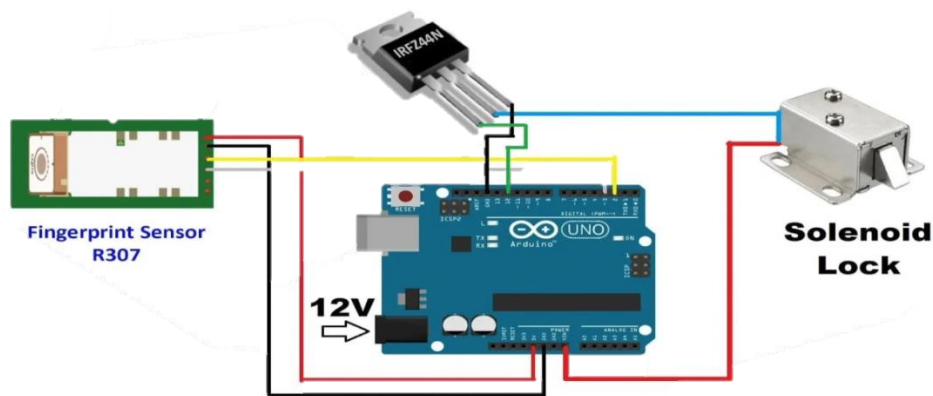
3.5 Circuit Diagram

Figure 3 : Circuit Diagram

3.6 Circuit Description

The gate and the source pins on MOSFET are connected to the Arduino Uno on GND and digital pin 12 respectively. The drain pin is connected to the solenoid lock. The Tx and Rx pins on the fingerprint sensor are connected to the digital pins 2 and 3 respectively. 5V is connected to 5V and GND to GND.The positive terminal on the solenoid lock is connected to the Vin on the Arduino Uno.

3.7 Description Of Components / Requirements

3.7.1 Hardware

1. 12v solenoid lock:

This DC 12V strong and rigid door lock, Electric Lock Assembly for Solenoid which is used for locking the sellmachine, storage shelves, file cabinets etc. The hidden way of unlocking it is used for an emergency purpose. The lock will work as when the circuits disconnect, and it unlocks as the instant power-on. It is steady, it's durable, and energy-saving relay and had a long lifespan in future.
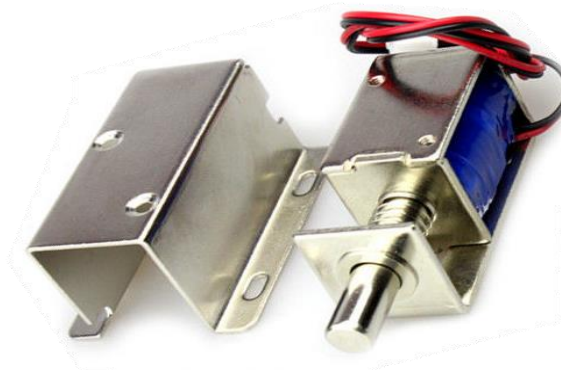
Figure 4 : 12v solenoid lock

2. Fingerprint sensor R307:

R307 fingerprint module is a finger print sensor with TTL UART interface. The user or owner can store the fingerprint data template in the module and can configure it in 1:1 or 1: N mode to identify the authorized or registered person.
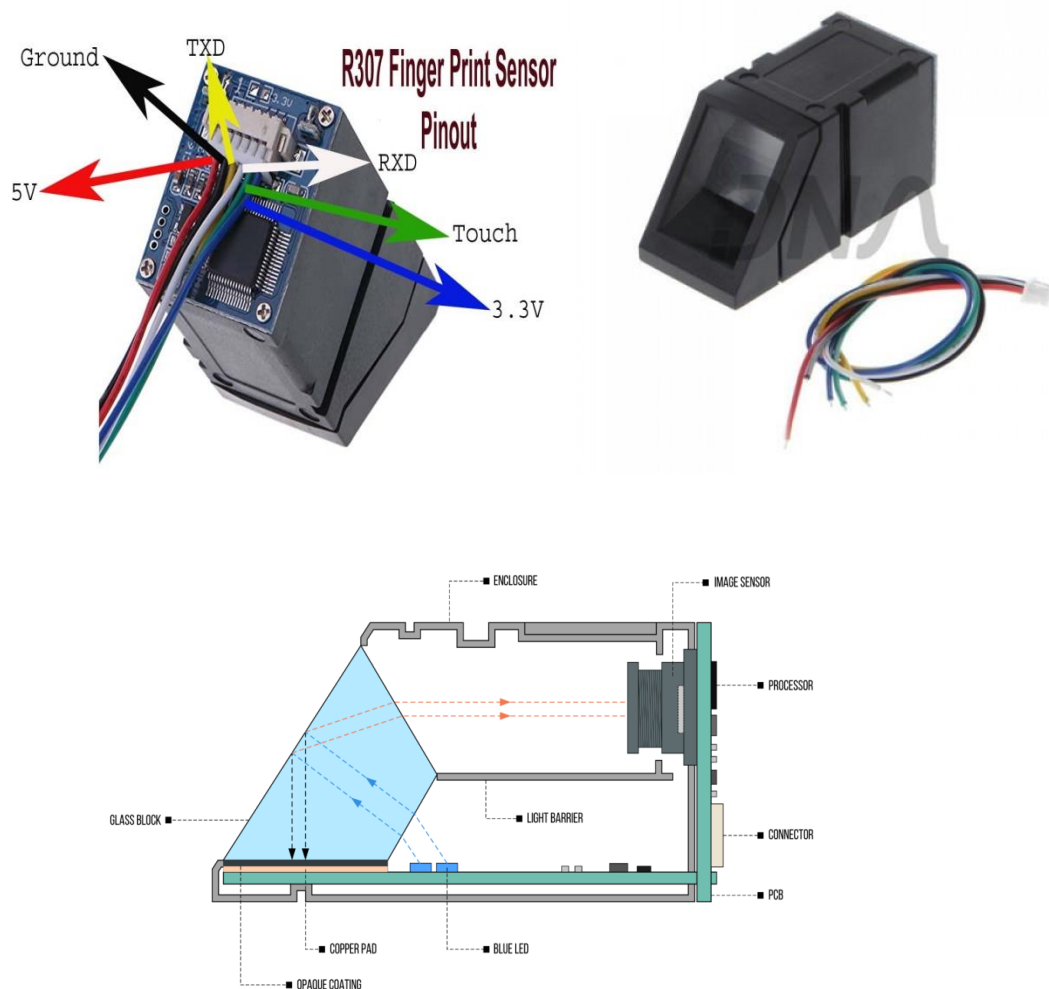

Figure 5 : Fingerprint sensor R307

3. IRFZ44N:

The IRFZ44N is a N-channel MOSFET with a high drain current of 49A and low Rds value of 17.5 mΩ. It also has a low threshold voltage of 4V at which the MOSFET will start conducting. Hence it is commonly used with microcontrollers to drive with 5V.

Features:

- Drain Current –ID=49A@ TC=25°C

- Drain Source Voltage- : VDSS= 55V(Min)

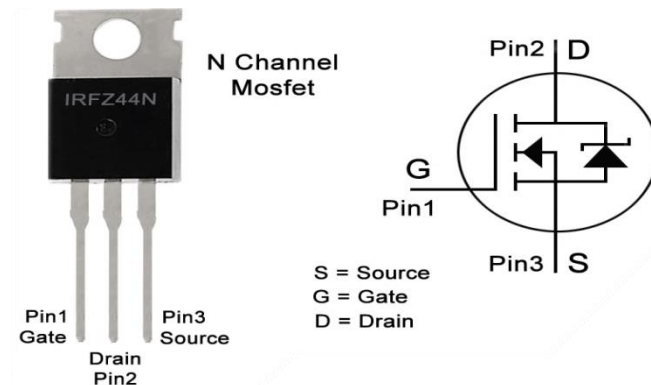- Static Drain-Source On-Resistance : RDS(on) = 0.032Ω(Max)

- Fast Switching

Figure 6 : IRFZ44N

4. Arduino uno:

The Arduino uno is a microcontroller board based on the ATmega328. It has 20 digital input /output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHZ resonator , USB connection ,power jack , an in-circuit system programming (ICSP) header, and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC to DC adapter or battery to get started.
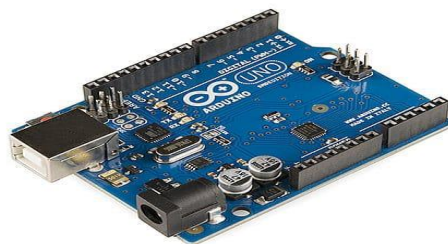

Figure 7: Arduino uno

7. 12v Adapter

An AC adapter, AC/DC adapter, or AC/DC converter is a type of external power supply, often enclosed in a case similar to an AC plug. Other common names include plug pack, plug-in adapter, adapter block, domestic mains adapter, line power adapter, and power adapter. Adapters for battery-powered equipment may be described as chargers or rechargers. AC adapters are used with electrical devices that require power but do not contain internal components to derive the required voltage and power from mains power.

3.7.2 Software :

1. Arduino IDE:

The open source Arduino IDE software makes it easy to use and upload the code to the boards such as Arduino UNO,ESP32,Node MCU etc. The Arduino IDE supports the languages C and C++ using special rules of code structuring.

4. THE SYSTEM IMPLEMENTATION AND SOFTWARE DEVELOPMENT

4.1 Working Of System

As we now know, the fingerprint scanner works in two processes. Fingerprint enrollment and matching. Similarly, it also works in the same way in this project.At first, we have to store the fingerprint in the sensor via fingerprint enrollment. Once the fingerprint is stored, we can start with fingerprint matching.Whenever the enrolled print matches the current fingerprint, the scanner sends those signals to the Arduino Uno. The Arduino in turn sends the signal to the solenoid door lock to unlock if the fingerprint matches.An IRFZ44N MOSFET has been connected between the solenoid lock and the Arduino Uno. A MOSFETis a semiconductor device that is generally used to amplify electronic signals in devices.
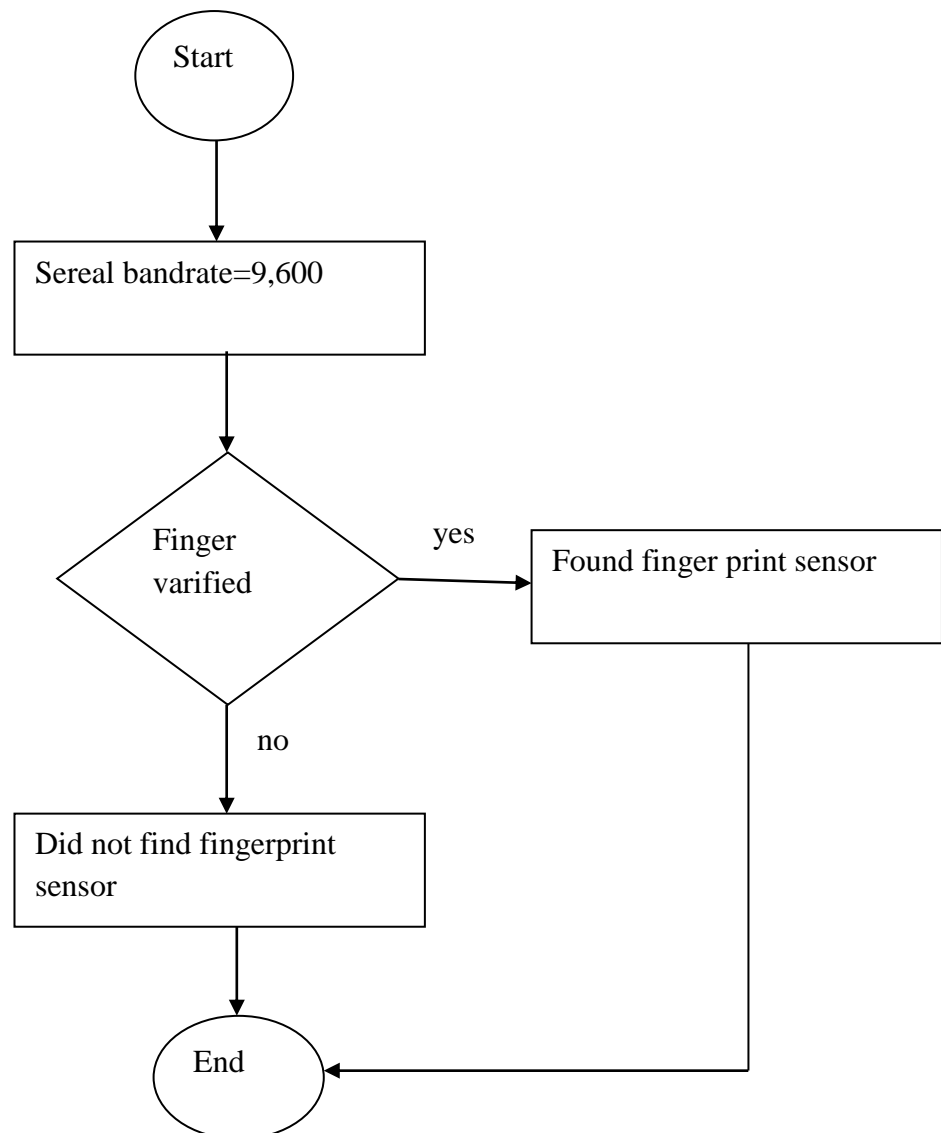
4.2 flowchart

4.2.1 Reading finger
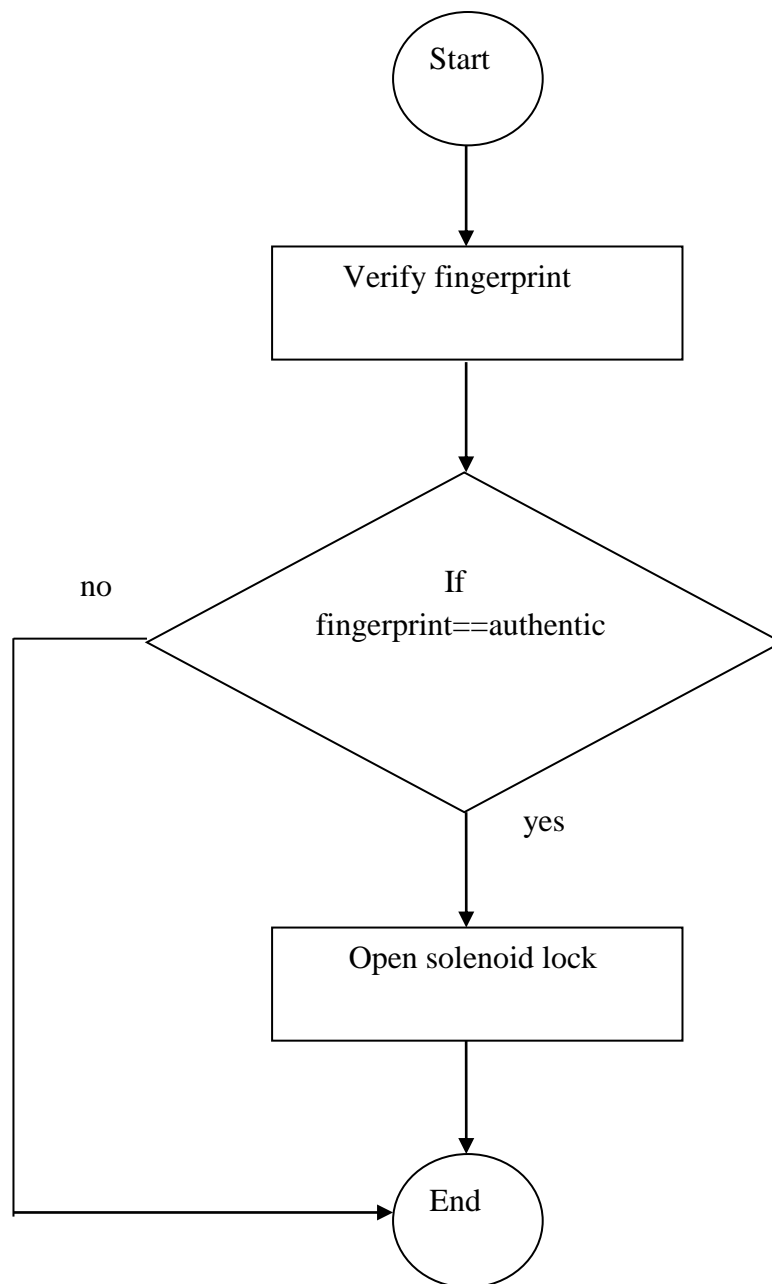
Figure 8: Reading finger flowchart

4.2.2 Finger strorage

Start

Verify fingerprint

If fingerprint==authentic

no

yes

Open solenoid lock

End

Figure 9: Finger storage flowcart

5. RESULTS

5.1 Project Progress

Work Done

1. Detailed research was done on Fingerprint door lock system.

2. Code execution was done in Arduino IDE software.

3. Hardware implementation of fingerprint door lock system using arduino was completed and tested.

Future Scope

- In future there can be a smartphone application enhancement for this project that is creating a smartphone app to give access to guests when person is away from his/her home.

- The others extentions within the app could also be viewing who is passing through the door by adding the camera and sending stream directly to mobile device.

- This can also extents to,if someone is trying to break in the door,alaram will start beeping on mobile device as well.

Limitations

- Fingerprint door locks offer a much higher level of protection than traditional keyed locks.
- Fingerprint door locks are one of the most affordable biometric security systems available today.
- Biometric security systems are the most accessible of all security systems. They're easy to use and don't require a key or code to operate.
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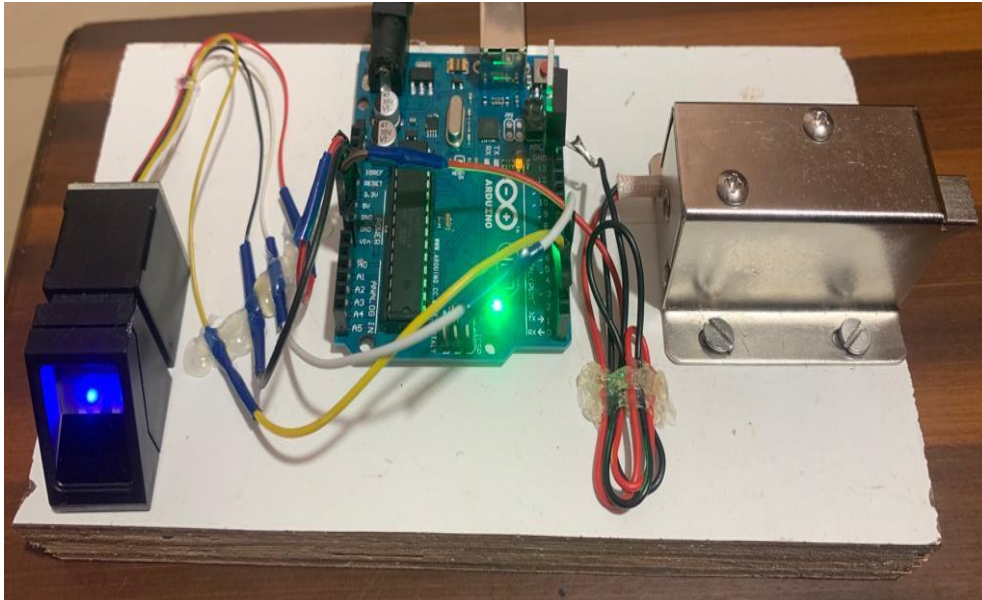
Results

Figure 10: Working Model

CONCLUSION

In conclusion, fingerprint door lock systems offer a high level of security, convenience, and access control. They are a reliable and efficient alternative to traditional lock systems, although they do come with some limitations. When considering the implementation of a fingerprint door lock system, it's essential to weigh the benefits and limitations against the specific requirements and budget of the intended application.

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