# SMART DOOR LOCK SYSTEM

**A PROJECT REPORT**

***Submitted by***

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

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**RAJALAKSHMI ENGINEERING COLLEGE**

**ANNA UNIVERSITY, CHENNAI**

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## BONAFIDE CERTIFICATE

Certified that this Thesis titled **"SMART DOOR LOCK SYSTEM**" is the bonafide work of "**JEFFREY HAMLIN V (2116210701094), HARINI V (2116210701071)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis 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

IoT technology is integrated into the Smart Door Lock System to improve convenience and security in both home and business environments. Without the need for physical keys, users may remotely monitor and control access through smartphone apps or web interfaces thanks to smart locks, sensors, and a central control unit. Remote access management, adjustable access credentials, and real-time notifications are important features. Protection against illegal access is ensured by sophisticated security features like encryption and multi-factor authentication. Furthermore, by adjusting the system to user behaviors, data analytics and machine learning improve user experience and security. All things considered, it offers enhanced security, ease of use, and adaptability for a variety of uses.

# ACKNOWLEDGMENT

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**JEFFREY HAMLIN V**

**HARINI V**

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# CHAPTER 1

# INTRODUCTION

The way we engage with our environment has changed dramatically as a result of the Internet of Things (IoT) technology being incorporated into commonplace products in our increasingly linked world. The smart door lock is one of these breakthroughs that sticks out as a ray of convenience and security, fusing cutting-edge technology with essential elements of everyday life. In the future, keys will be obsolete and be replaced with an advanced system that can recognize and adjust to your demands instantly. The smart door lock offers to open the door to a safer, more intelligent, and more effective way of living.

Fundamentally, the smart door lock uses the Internet of Things to convert a commonplace household item into a proactive digital protector. It creates a thorough network of security by connecting to the internet and interacting with other smart devices in the home environment, like motion sensors and security cameras. This connectivity allows for unmatched ease as well as improved security. Imagine coming home after a long day and not having to worry about misplaced or stolen keycards or scrabbling around for keys in the dark. Access is provided with ease with a single tap on your smartphone or a voice command to your virtual assistant.

Furthermore, the goal of the smart door lock is to give people unmatched control over their living areas rather than just locking and opening doors. With a few taps, users can quickly and easily provide temporary or permanent permissions to family members, friends, or service providers through user-friendly mobile applications that allow for remote monitoring and management of access. With this degree of detail, homeowners can customize access privileges to fit their security and lifestyle preferences, giving them a renewed sense of autonomy.

Essentially, the smart door lock is a paradigm leap in terms of convenience and home security. It represents the coming together of the digital and physical realms, where smart technologies that adjust to the demands and tastes of contemporary life will take the place of conventional locks. The smart door lock is a shining example of innovation in the IoT space, and it bears witness to our continuous pursuit of more intelligent, safer, and networked living spaces.

## 1.1 PROBLEM STATEMENT

In a rapidly evolving technological landscape characterized by the Internet of Things (IoT), traditional door lock systems face challenges in meeting the increasingly sophisticated security needs of residential and commercial environments. Conventional locks, reliant on physical keys, lack the flexibility, accessibility, and advanced security features demanded by modern users. Therefore, there arises a pressing need to develop a Smart Door Lock System leveraging IoT capabilities to address these shortcomings and provide enhanced security, convenience, and accessibility. This project aims to design and implement a Smart Door Lock System that integrates IoT technology to revolutionize traditional door security. The system will employ IoT-enabled devices such as smart locks, sensors, controllers, and mobile applications to enable remote monitoring, access control, and authentication. By harnessing the power of connectivity and automation, the Smart Door Lock System will offer users seamless access control, real-time monitoring, and advanced security features, thereby addressing the limitations of conventional door lock systems.

## 1.2 SCOPE OF THE WORK

Creating, developing, and deploying a safe and easy-to-use system for remote door lock access and control is the extent of the Internet of Things-based smart door lock project. This involves deciding which hardware components and Internet of Things (IoT) technologies, including Bluetooth or Wi-Fi, to integrate. The project includes developing a mobile application that will allow users to easily interface with the smart lock and enable features like access control and keyless entry. Furthermore, rigorous validation and testing procedures ensure the system's scalability, security, and reliability. The project's overall goal is to provide an inventive way to use IoT-enabled smart door locks to improve convenience and home security.

## 1.3AIM AND OBJECTIVES OF THE PROJECT

Through the debut of an advanced, networked system that improves convenience and safety, the smart door lock project, which makes use of IoT, aims to completely transform conventional home security measures. Developing a smart door lock system that does away with physical keys and offers real-time monitoring capabilities is the main goal. Users will be able to regulate entry to their houses remotely through a mobile application. In order to maximize user experience and interoperability, the project also intends to enable smooth integration with current IoT ecosystems, such as smart home hubs and devices.

## 1.4 RESOURCES

A smart door lock system utilizing IoT (Internet of Things) technology requires a combination of hardware and software components. The hardware typically includes a smart lock device equipped with sensors, a microcontroller, and wireless connectivity modules such as Wi-Fi, Bluetooth, or Zigbee. These components enable the lock to communicate with other devices and servers over the internet.

The following prospectus details a list of resources that will play a primary role in the successful execution of our project:

- A properly functioning workstation (PC, laptop, net-books etc.) to carry out desired research and collect relevant content.
- Raspberry Pi, NodeMCU, and ESP8266/ESP32. These kits usually come with development boards, sensors, and networking modules, providing a good starting point for creating the project.
- Unrestricted access to the university lab in order to gather a variety of literature including academic resources (for e.g. Prolog tutorials, online programming examples, bulletins, publications, e-books, journals etc.), technical manuscripts, etc.

## 1.5 MOTIVATION

The IoT-powered smart door lock project was inspired by the need to meet the changing demands and difficulties of contemporary life. Modern lifestyles place a greater focus on security and convenience than ever before, and traditional door locks frequently can't keep up. This project aims to offer a solution that boosts home security measures while simultaneously improving door lock accessibility and usability through the use of IoT technologies. One of the main motivators is the possibility of doing away with the hassle of physical keys, providing remote access and monitoring, and easily integrating with other smart home appliances. The ultimate objective is to provide consumers with a dependable, effective, and cutting-edge technical solution that improves their general quality of life.

# CHAPTER 2

# LITERATURE SURVEY

[1] summarizes that in today's internet-driven world, security and comfort are paramount. IoT offers solutions that provide both, with smart locks emerging as vital components. Traditional locks are evolving into contactless smart systems, addressing limitations of mechanical locks. This article proposes a Smart Door Unlock System, integrating Face Recognition, Fingerprint, RF card, Password, and IoT for enhanced security. A camera captures faces, matched via an image algorithm, while a fingerprint sensor eliminates key management issues. Designed with accessibility in mind, this system benefits the elderly, offering ease of use and heightened security for all.

[2] focuses on IoT as it’s reshaping security, notably through smart door locks. However, transmitting sensitive data over networks poses risks. To tackle this, we introduce a highly secure door lock system, blending password-based access with cryptographic shielding. Our solution includes an Android app, leveraging cryptographic algorithms for secure communication, and programmable hardware with sensors and actuators to thwart unauthorized access. Dubbed cryptoLock, it not only safeguards physical valuables but also shields transmitted data. Offering seamless remote access and comprehensive security, cryptoLock ensures peace of mind in an increasingly connected world.

[3] summarizes that IoT devices, like smart door locks, revolutionize security by overcoming traditional limitations. This proposed system, employing Arduino, integrates voice, fingerprint, and keypad unlocking methods for convenience and flexibility. Voice control allows hands-free access, fingerprint recognition ensures reliability, and keypad entry offers simplicity. By combining these methods, the system enhances security in various settings, offering convenience and accessibility to users.

From [4] we can understand that smart homes, leveraging IoT, offer convenience but face data security challenges, especially regarding door lock access. Ensuring the integrity of this data is crucial for homeowner safety. Blockchain emerges as a solution due to its immutable and non repudiable properties. This study employs Ethereum blockchain and smart contracts to securely store and manage door lock access data. Testing reveals a high security level, with an average avalanche effect index of 96%, indicating the proposed system's efficacy in safeguarding sensitive information and enhancing home security.

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The author of [5] focuses on usage of IoT-enabled smart door lock systems that has revolutionized the security of homes, workplaces, and banks. Compared to traditional locking systems, door lock systems with IoT have significantly improved and are currently among the most effective ways to keep unauthorized people out of the building. Most homes and workplaces nowadays have this smart door installed. We can access and keep an eye on illegal individuals' entries with this smart door lock system from anywhere in the world.

# CHAPTER 3

# SYSTEM DESIGN

## 3.1 GENERAL

In this section, we would like to show the general outline of how all the components end up working when organized and arranged together. It is further represented in the form of a flow chart below.

## 3.2 SYSTEM ARCHITECTURE DIAGRAM

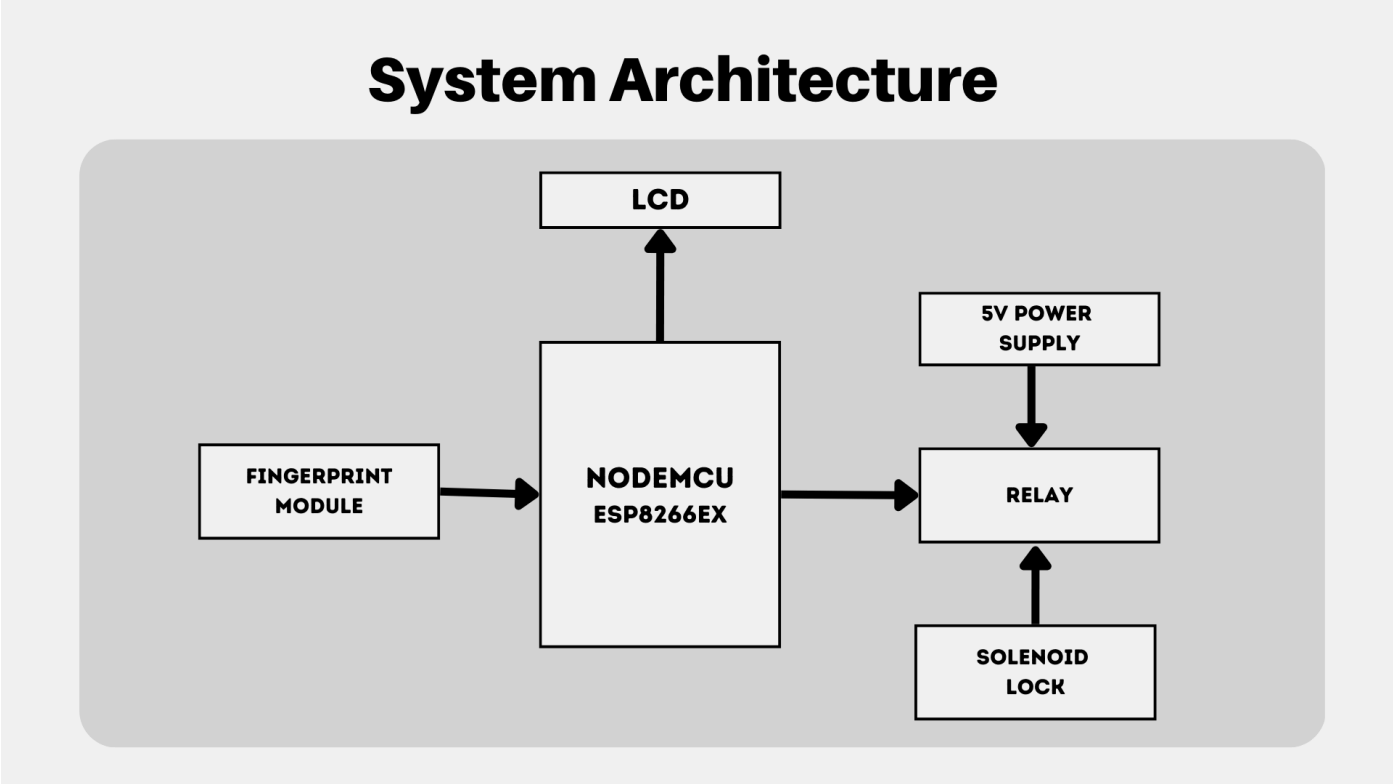



**Fig 3.1: System Architecture**

## 3.3 DEVELOPMENTAL ENVIRONMENT

### 3.3.1 HARDWARE REQUIREMENTS

The hardware requirements may serve as the basis for a contract for the system's implementation. It should therefore be a complete and consistent specification of the entire system. It is generally used by software engineers as the starting point for the system design.

| COMPONENTS | SPECIFICATION |
|---|---|
| PROCESSOR | Intel Core i5 |
| RAM | 8 GB RAM |
| GPU | NVIDIA GeForce GTX 1650 |
| MONITOR | 15" COLOR |
| HARD DISK | 512 GB |
| PROCESSOR SPEED | MINIMUM 1.1 GHz |
| NodeMCU | ESP8266EX |
| SOLENOID LOCK | 12V DC |
| POWER SUPPLY | 5V DC |
| RELAY | Electromechanical 5V DC |
| LCD | 50mm x 20mm |

**Table 3.1 Hardware Requirements**

### 3.3.2 SOFTWARE REQUIREMENTS

The software requirements document is the specifications of the system. It should include both a definition and a specification of requirements. It is a set of what the system should rather be doing than focus on how it should be done. The software requirements provide a basis for creating the software requirements specification. It is useful in estimating the cost, planning team activities, performing tasks, tracking the team, and tracking the team's progress throughout the development activity.

**ARDUINO IDE,** and **Chrome** would all be required.

## 3.4 SEQUENCE DIAGRAM

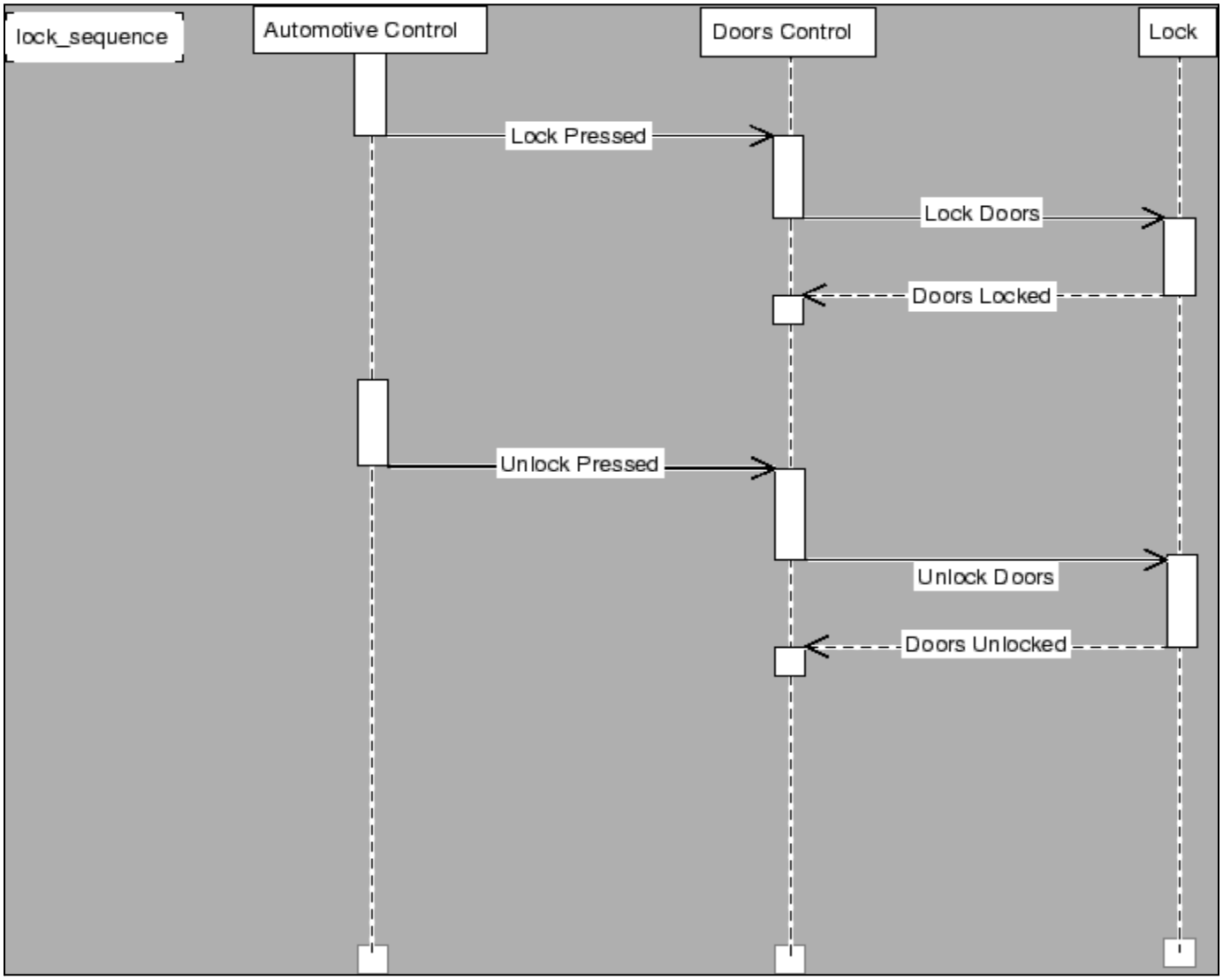



**Fig 3.4: Sequence Diagram**

# CHAPTER 4

# PROJECT DESCRIPTION

## 4.1 METHODOLOGY

The creation of a smart IoT door lock system with biometric authentication that was designed with smart cities in mind required a number of crucial procedures. First, methods for fingerprint scanning and verification were implemented in order to enable user identification through the integration of fingerprint recognition technology. Simultaneously, a keypad interface was integrated with a passcode-based authentication mechanism to give consumers another way to gain access. Assembling components including the fingerprint scanner, keypad interface, locking mechanism, and IoT connectivity module was part of the hardware development process. Software-wise, passcode validation and fingerprint recognition algorithms were developed, together with microcontroller firmware and an interface for user settings.

## 4.2 PROPOSED WORK

The Smart Door Lock IoT project utilizes Arduino microcontroller technology and biometric scanning capabilities to revolutionize traditional door security. At its core, the system employs biometric sensors, such as fingerprint scanners or facial recognition modules, interfaced with Arduino boards to authenticate users securely.The Arduino microcontroller initiates actuators that regulate the door's locking and unlocking mechanisms when the user verifies the information. The system also incorporates Internet of Things concepts to allow for remote access and control through a web interface or mobile application. Users can remotely monitor door status, authenticate themselves using biometric scans, and grant access to authorized individuals from anywhere with an internet connection. Robust security measures, including encryption of communication channels and secure storage of biometric data, safeguard the system against unauthorized access or tampering. Through thorough testing and validation, the system ensures reliability, performance, and adherence to stringent security standards, ultimately providing users with a seamless, secure, and convenient door access solution for residential and commercial applications.

## 4.3 MODULE DESCRIPTION

Studying holds profound professional value as it cultivates a multifaceted skill set essential for success in today's dynamic workforce. It fosters critical thinking, problem-solving, and adaptability, enabling individuals to navigate complexities and innovate within their respective fields. Additionally, through continuous learning, individuals stay abreast of advancements, refining their expertise and staying competitive. Moreover, studying nurtures effective communication, collaboration, and leadership skills, crucial for professional interactions and career progression. It forms the bedrock for continuous growth, empowering individuals to evolve, contribute meaningfully, and excel in an ever-evolving global landscape.

### 4.3.1 FINGERPRINT MODULE

Incorporating a fingerprint module into the project enhances security by enabling biometric authentication. The fingerprint module is authenticated using a software application that runs on a separate device, such as a smartphone or PC. Users enroll their fingerprints in the module using an application installed on a different device. This app communicates with the fingerprint module via a wired or wireless connection. The software walks users through the enrollment process, urging them to lay their finger on the sensor several times for capture. Once enrolled, the application transfers the collected fingerprint data to the module for storage.When a user wishes to open the door, they start with the authentication process using the software application.The application captures the user's fingerprint using either the device's built-in fingerprint sensor or an external sensor that is attached to it.The acquired fingerprint data is subsequently transmitted to the fingerprint module for verification.The fingerprint module checks the captured fingerprint to the stored templates and returns the authentication results to the application.

# CHAPTER 5
# RESULTS AND DISCUSSIONS

## 5.1 OUTPUT


**Fig 5.1 Home**

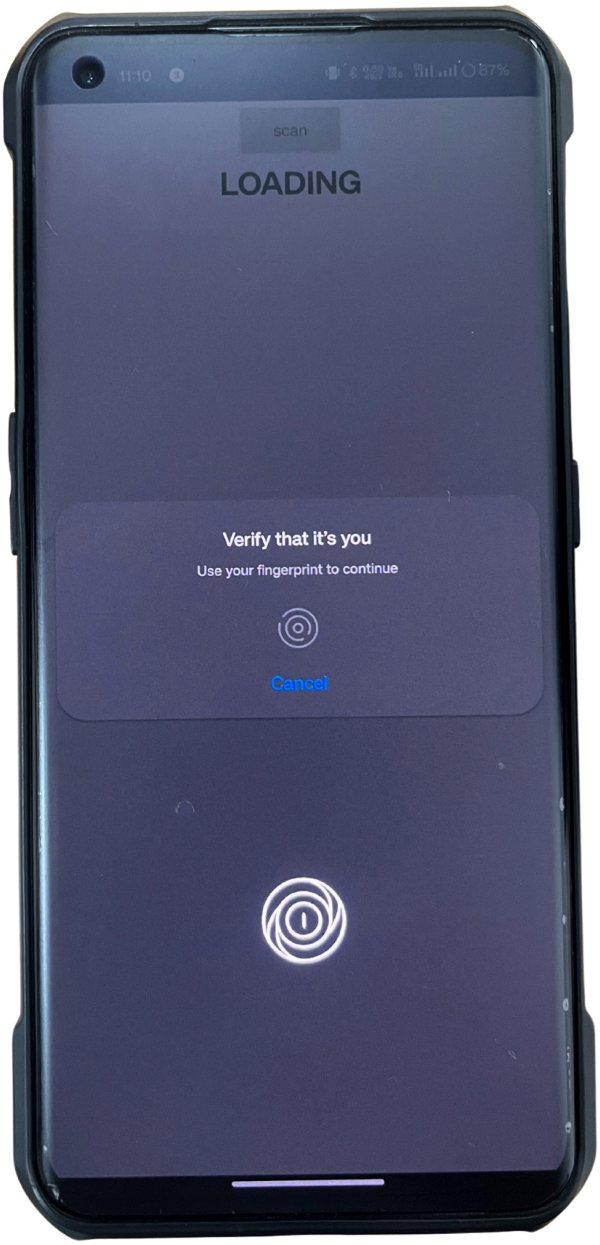
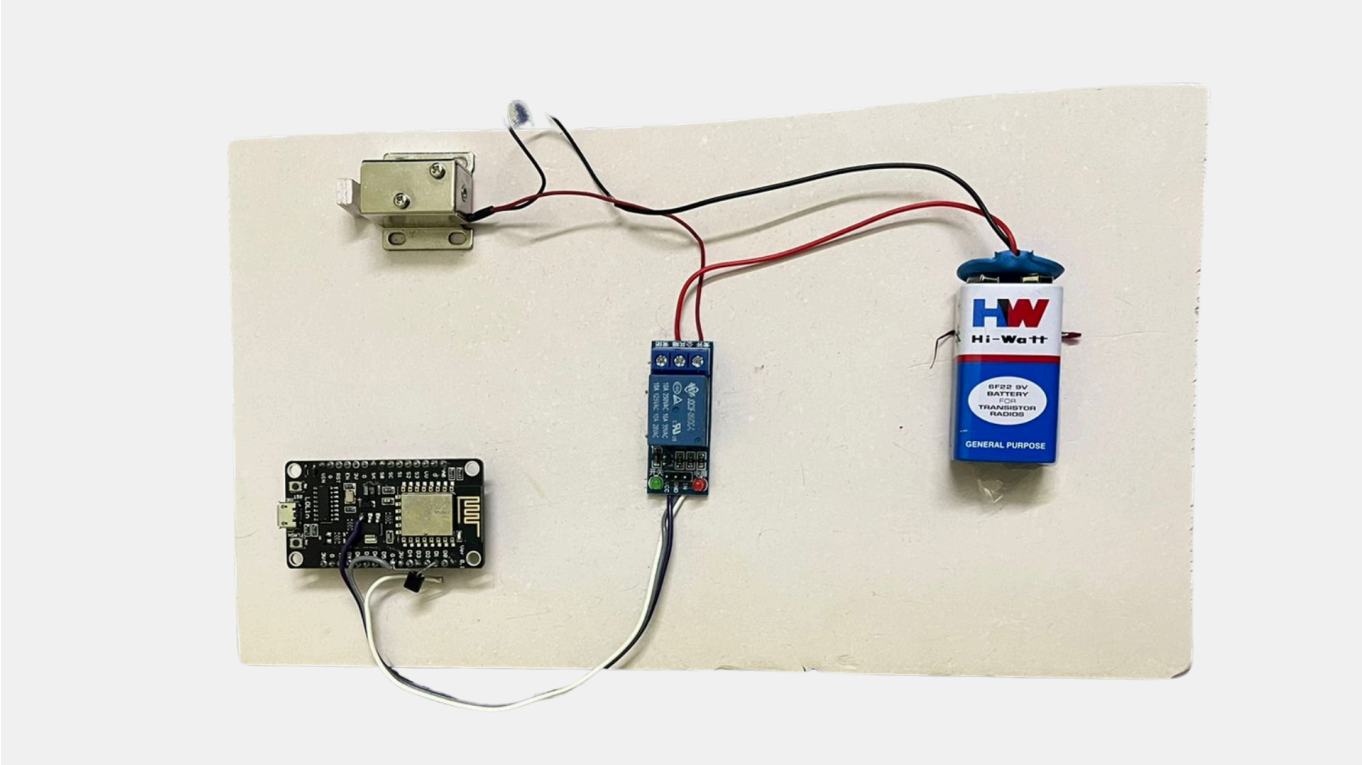



**Fig 5.2 Verification**


HW
Hi-Watt
9F22 9V
BATTERY
FOR
TRANSISTOR
RADIOS
GENERAL PURPOSE

**5.3 circuit**

## 5.2 RESULT

The smart door lock project, consisting of a fingerprint module, small LCD, and NodeMCU, culminated in a highly functional and safe access control system. With biometric authentication at its core, the system ensures strong identification without the use of traditional keys or passwords. Users no longer have to carry keys or remember credentials. Fingerprint authentication makes access simple and rapid, saving time and avoiding the annoyance of missing or forgotten keys. Users can easily enroll their fingerprints, and the subsequent authentication is quick and reliable. The small LCD interface provides basic feedback through determining the state of the authentication method, which enhances user interaction. The system may simply be linked into the Internet of Things (IoT) using the NodeMCU, which permits remote access and monitoring. Fingerprint recognition is exceptionally reliable and efficient, with validation taking less than a second. This enables quick and dependable access administration while decreasing the chance of false positives or negatives. Upon fulfillment, the system effectively authenticates users and promptly opens the door after verification. Numerous additional enhancements will enhance the system's effectiveness and security, fulfilling users' constantly shifting requirements. Overall, the smart door lock project is a noteworthy breakthrough in modern access control technology, enabling a good combination of security, simplicity, and customization.

# CHAPTER 6

# CONCLUSION AND FUTURE ENHANCEMENT

## 6.1 CONCLUSION

In its entirety, the smart door lock system with a fingerprint module, compact LCD, and NodeMCU represents an important advancement in access control technology. This project provides a strong and convenient approach for managing access to various spaces through the use of biometric authorization and sophisticated technology. The fingerprint module ensures secure and reliable authentication, eliminating the need for conventional keys or passwords. Meanwhile, the small LCD serves as an easy-to-use interface for system status and suggestions, ensuring users are aware of the authentication process. With the NodeMCU as the central control unit, the system is quickly connected to the internet, which enables remote access and monitoring. While the system does not provide significant feedback, its core function of authenticating and unlocking the door effectively accomplishes its objective. Looking ahead, the project allows for future modifications, such as remote access, multi-factor authentication, and communication with smart home ecosystems, to improve functionality and security. Overall, this smart door lock system represents an immense leap in access management, providing a secure, simple, and customizable solution geared to modern needs.

## 6.2 FUTURE ENHANCEMENT

Several additional functions may significantly enhance the smart door lock system's performance, security, and user experience. For instance, bringing together remote access and notifications would allow customers to manage their doors from anywhere, receive real-time alerts, and provide remote access via their cellphones. A focused mobile application might streamline these aspects by providing an easy-to-use interface for enrollment, authentication, and access control, as well as user management and access logs. Additionally, adding speech recognition software would provide hands-free access, increasing convenience and accessibility. Multi-factor authentication, which incorporates fingerprint recognition with PIN codes or recognition of facial features may improve security.Time-based access control might enable users to define specified time slots for access, hence enhancing adaptability. Combining the system with existing smart home platforms, such as Amazon Alexa or Google Home, would enable uniform connection with other smart devices. A battery backup system enables currently underway functioning during power outages, while tamper detection features alert users of unlawful attempts. Enhanced data encryption and privacy safeguards would protect sensitive information, while personalized user profiles with various access permissions would provide flexibility. Finally, linking the system with CCTV cameras would allow for visual authentication of access attempts, improving safety and accountability. These future upgrades promise to make the smart door lock system more versatile, user-friendly, and secure, meeting the changing needs of users.

## APPENDIX

## SOURCE CODE:

```
#include <Arduino.h>
#if defined(ESP32)
#include <WiFi.h>
#include <FirebaseESP32.h>
#elif defined(ESP8266)
#include <ESP8266WiFi.h>
#include <FirebaseESP8266.h>
#elif defined(ARDUINO_RASPBERRY_PI_PICO_W)
#include <WiFi.h>
#include <FirebaseESP8266.h>
#endif
#include <addons/TokenHelper.h>
#include <addons/RTDBHelper.h>
#include <Keypad.h>

#define Password_Length 4
char Data[Password_Length + 1] = {0}; //all locations contain 0
const int lock = 13;
byte data_count = 0;
char customKey;
char myPassword[] = "1234";  //pre-stored password

const byte ROWS = 4;
const byte COLS = 4;

char hexaKeys[ROWS][COLS] = {
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};
byte rowPins[ROWS] = {13, 12, 14, 27};
byte colPins[COLS] = {26, 25, 33, 32};

Keypad customKeypad = Keypad(makeKeymap(hexaKeys), rowPins, colPins,
ROWS, COLS);

#define WIFI_SSID "Unknown"
```

```
#define WIFI_PASSWORD "43214321"
#define API_KEY "AIzaSyDCQZOD3P2uDuE7CGYWR2vwsLj9VDh710M"
#define DATABASE_URL "https://project-324f8-default-rtdb.firebaseio.com"
#define USER_EMAIL "project@gmail.com"
#define USER_PASSWORD "123456789"
FirebaseData fbdo;
FirebaseAuth auth;
FirebaseConfig config;
unsigned long sendDataPrevMillis = 0;
unsigned long count = 0;

void setup()
{
 Serial.begin(115200);
 WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
 Serial.print("Connecting to Wi-Fi");
 while (WiFi.status() != WL_CONNECTED)
 {
  Serial.print(".");
  delay(300);
 }
 Serial.println();
 Serial.print("Connected with IP: ");
 Serial.println(WiFi.localIP());
 Serial.println();
 Serial.printf("Firebase Client v%s\n\n", FIREBASE_CLIENT_VERSION);
 config.api_key = API_KEY;
 auth.user.email = USER_EMAIL;
 auth.user.password = USER_PASSWORD;
 config.database_url = DATABASE_URL;
 config.token_status_callback = tokenStatusCallback; // see addons/TokenHelper.h
 Firebase.begin(&config, &auth);
 Firebase.reconnectWiFi(true);
 Firebase.setDoubleDigits(5);
 pinMode(D1, OUTPUT);
}
```

```
void loop()
{
  Serial.printf("Get string... %s\n", Firebase.getString(fbdo, F("/finger2/data")) ?
fbdo.to<const char *>() : fbdo.errorReason().c_str());
  String a=Firebase.getString(fbdo, F("/finger2/data")) ? fbdo.to<const char *>() :
fbdo.errorReason().c_str();
  int y=a.toInt();
  if(y==1)
  {
    digitalWrite(D1, HIGH);
    Serial.printf("Set string... %s\n", Firebase.setString(fbdo, F("/finger2/data"), 2) ?
"ok" : fbdo.errorReason().c_str());
    delay(1500);
    digitalWrite(D1, LOW);
    delay(1500);
  }
}
```

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