

**SMART LOCK SYSTEM WITH BIOMETRIC AUTHENTICITY AND WIRELESS
CONTROLLING**

BY

Md.Shahinur Rahman

ID: 152-15-541

Md.Mahfuz Zaman

ID: 152-15-527

AND

Md. Miraj Mahmud

ID: 152-15-570

This Report Presented in Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science in Computer Science and Engineering.

Supervised By

Dewan Mamun Raza

Lecturer

Department of CSE

Daffodil International University

Co-Supervised By

Toufik Ahmed Emon

Lecturer

Department of CSE

Daffodil International University



DAFFODIL INTERNATIONAL UNIVERSITY

DHAKA, BANGLADESH

APRIL 2019

APPROVAL

This Project titled “**Smart Lock System with Biometric Authenticity and Wireless Controlling**”, submitted by Md. Shahinur Rahman ID No: 152-15-541, Md. Mahfuz Zaman ID No: 152-15-527 and Miraj Mahmud ID No: 152-15-570 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 6th April, 2019.

BOARD OF EXAMINERS

Dr. Syed Akhter Hossain
Professor and Head

Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Chairman

Dr. S M Aminul Haque
Assistant Professor & Associate Head

Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Internal Examiner

Saif Mahmud Parvez
Lecturer

Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Internal Examiner

Dr. Mohammad Shorif Uddin
Professor

Department of Computer Science and Engineering
Jahangirnagar University

External Examiner

DECLARATION

We hereby declare that this project has been done by us under the supervision of Dewan Mamun Raza, lecturer, department of CSE department International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by:

Dewan Mamun Raza

Lecturer

Department of Computer Science and Engineering

Daffodil International University

Co-Supervised by:

Toufik Ahmed Emon

Lecturer

Department of Computer Science and Engineering

Daffodil International University

Submitted by:

Md. Shahinur Rahman

ID: 152-15-541

Department of Computer Science and Engineering

Daffodil International University

Md. Mahfuz Zaman

ID: 152-15-527

Department of Computer Science and Engineering

Daffodil International University

Md. Miraj Mahmud

ID: 152-15-570

Department of Computer Science and Engineering

Daffodil International University

ACKNOWLEDGEMENT

First and foremost, I would like to thank Almighty God for giving us the strength, knowledge, ability, and opportunity to complete the final year project successfully.

We would like to express our sincere gratitude to our honorable supervisor **Dewan Mamun Raza, Lecturer, Department of CSE Daffodil International University, Dhaka** and **Co-supervisor Toufik Ahmed Emon Lecturer, Department of CSE Daffodil International University, Dhaka** for their time, generous guidance, patience and encouragement throughout the whole dissertation project, from which we have learned a lot regarding our title.

We would like to express our heartiest gratitude to **Dr. Syed Akhter Hossain, Professor and Head, Department of CSE,** and **Dr. S. M. Aminul Haque , Associate Professor and Associate Head Department of CSE** for their kind help to finish our project and would like to extend my deepest appreciation to faculty member, all our course mate who took part in this discuss while completing the course work and staff of CSE Department of Daffodil International University for kind support and help on the technical and the administrative aspect of the study.

Finally, we must have acknowledged with due respect the constant support and patience for our parents. Their love, encouragements, and continuous pray have made us stronger each and every day on completing this study.

ABSTRACT

“Smart Lock System with Biometric Authenticity and Wireless Controlling” is a device which is basically, designed for the Local Area Network and Biometric reader for user authentication. This device reduces the user’s trouble to carry the lock/unlock keys. User can easily unlock with fingerprint and also control lock system using local area network without user’s presence. Particularly wireless unlock controlling system of this device now a days a lot of interest as this system is very much useful and time consuming on movement within a little area. Biometric authenticity is one of the greatest ways for identifying the authorized user’s and we think it’s more secure than any other security. This device can be considered as a trustworthy medium of our daily life locking/unlocking purpose at anywhere.

TABLE OF CONTANT

CONTENTS	PAGE NO
Board of examiners	ii
Declaration	iii
Acknowledgement	iv
Abstract	v
List of Figures	viii
List of Tables	ix
CHAPTER	
CHAPTER 1: Introduction	1-3
1.1 Introduction	1
1.2 Motivation	2
1.3 Objectives	2
1.4 Expected Outcome	2
1.5 Report Layout	3
CHAPTER 2: BACKGROUND	4-6
2.1 Introduction	4
2.2 Related Works	4
2.3 Comparative Studies	5
2.4 Scope of the Problem	5
2.5 Challenges	6
CHAPTER 3: REQUIREMENT SPECIFICATION	7-19
3.1 Lock System Process Modelling	7
3.2 Requirements Collection and Analysis	8
3.3 Use Case Modelling and Description	19
CHAPTER 4: DESIGN SPECIFICATION	20-24
4.1 Front-end System Design	20
4.2 Back-end System Design	23
4.3 Interaction Design and UX	23
4.4 Implementation Requirements	24
CHAPER 5: Implementation and Testing	25-30
5.1 Implementation of Database	25
5.2 Implementation of Front-end Design	25
5.3 Implementation of Interactions	28
5.4 Testing Implementation	29
5.5 Test Results and Reports	30

CHAPTER 6: CONCLUSION AND FUTURE SCOPE	31-31
6.1 Discussion and Conclusion	31
6.2 Scope for Further Development	31
REFERENCES	32
APPENDIX	33-37

LIST OF FIGURES

FIGURES	PAGE NO
Figure 3.1: Lock System Processing Model	7
Figure 3.2: Overview of Arduino Uno Rev3	8
Figure 3.3: Overview of Super strong metal core Servo MG-995	10
Figure 3.4: Overview of 16x2 Character LCD Display	12
Figure 3.5: Overview of HR7U3C Fingerprint Sensor	13
Figure 3.6: Overview of Ethernet Shield Module	14
Figure 3.7: Overview of push button	15
Figure 3.8: Overview of Breadboard MB-102	16
Figure 3.9: Overview of Potentiometer	17
Figure 3.10: Overview of Lithium ion 9V 6F22 rechargeable battery	18
Figure 3.11: Use Case Diagram of Lock System	19
Figure 4.1: Circuit Diagram of LCD display System	20
Figure 4.2: Circuit Diagram of Push Button System	21
Figure 4.3: Circuit Diagram of Fingerprint System	22
Figure 4.4: Circuit Diagram of Ethernet System	22
Figure 4.5: UX	23
Figure 5.1: Welcome Display	25
Figure 5.2: Server IP	25
Figure 5.3: Welcome User	26
Figure 5.4: Place Finger	26
Figure 5.5: Matching Fingerprint	26
Figure 5.6: Check Fingerprint	26
Figure 5.7: Add User	27
Figure 5.8: Place Finger	27
Figure 5.9: Remove Finger	27
Figure 5.10: Place Finger Again	27
Figure 5.11: Stored	28
Figure 5.12: Delete User	28
Figure 5.13: User Deleted	28

LIST OF TABLES

TABLES	PAGE NO
Table 3.1: Technical Information of Arduino Uno	9
Table 3.2: Technical Information of Servo MG-995	11
Table 3.3: Technical Information of LCD Display	12
Table 3.4: Technical Information of Fingerprint Sensor	13-14
Table 3.5: Technical Information of Ethernet Shield	15
Table 3.6: Technical Information of Tactile Switch	16
Table 3.7: Technical Information of Breadboard	17
Table 3.8: Technical Information of Potentiometer	18
Table 3.9: Technical Information of rechargeable battery	18
Table 5.1: Testing Implementation	29-30

CHAPTER 1

INTRODUCTION

1.1 Introduction

The project titled “**Smart Lock System with Biometric Authenticity and Wireless Controlling**” is developed using Embedded System along with its programming Embedded C. Safety is a basic requirement of every living being. We have been taking several measures in order to attain it to live a worry-free life. Likewise, for our houses, we have a traditional method of using locks and keys. But now, as humans are getting busier day by day, the use of traditional locks and keys can be cumbersome. There can be a lot of problems if we don’t advance to smarter technology. For example, with a traditional lock, you cannot allow any of your friend or guest to get to your place if your doors are locked to get to your home and unlock it. Or if you lost your keys, you either have to find a locksmith or break the very lock itself. This is where our smart locking device come to the scene. A lock which is authorized by a person’s Fingerprint using a Biometric reader. This ensures that only people with registered fingerprint IDs can access the doors. Not just that, the person can wirelessly open his door from any part of the local area network. Before going into its description, an introduction is needed to the requirements or parts involved in it. This project is centered around the field of automation and use of embedded programming system to run.

This lock system contains some features and primary two features are

- Fingerprint control
- Wireless control

Fingerprint control:

In this feature, there will be specific users who can controls lock system with their own finger which is stored before on database.

Wireless control:

Through this feature a specific admin only can control the lock system from a specific distance using web server.

1.2 Motivation

Our project motivation based on the user's demand who wants to have high security and friendly user interface. Sometime in analog lock system people lost their keys and without breaking the lock they can't access. But our systems need not any key and have no scope to loss or break the lock system. As we are living in a modern civilized world, we need to think about the security of people's property and ensure a trustworthy and safe environment.

1.3 Objectives

Our objective is to give user's an optimum solution only using our lock system device. So, if we point out our initial objectives briefly then we can say:

- a. We want to develop our system that can lock our property using our user's fingerprint.
- b. And also develop our system as a second option to lock the door virtually over a little area using local area network.
- c. We try to solve the problem of those users who forgot to carry the lock/unlock keys.
- d. We can ensure the user's safety by using a biometric reader as we can register a new user and this information stored and can be detected by the registered user.

1.4 Expected Outcome

we are developing a project not only focusing our undergraduate final but also to make this project as a future business startup and we mainly select for its huge market value and learning scope while developing this whole system fully. if we can give our best by the grace of God, we are expecting these outcomes will be gained before our projection submission date.

- Friendly user interface
- Fingerprint sensor will work only with user given data
- Wireless Controlling saves user's time
- System should be worked smoothly and free of bug

1.5 Report Layout

This report has been divided into six main chapters where

Chapter 1: Introduction

This chapter has segmented with the introduction objectives motivation and expected outcomes.

Chapter 2: Background

The chapter has segmented do with the background of this project related works comparative studies problems and challenges of this project.

Chapter 3: Requirement Specification

Third chapter has segmented with requirement specification who is contains business process modelling, block diagram with the description of parts of our project and use case Modelling and description.

Chapter 4: Design Specification

Chapter four focuses on design specification and future implementation of “Smart Lock System with Biometric Authenticity and Wireless Controlling”

Chapter 5: Implementation and Testing

Here we discuss about how implement our processed system and its testing with results.

Chapter 6: Conclusion and Future Scope

And lastly, Chapter six is about counselling and our future scope what we will do in next and what we add in recent future.

CHAPTER 2 BACKGROUND

2.1 Introduction

We live in an era of science and technology. Fingerprint-based identification has been one of the most successful biometric techniques used for true identification and also the most reliable criteria for personal identification. Biometric access control is a strong security than keys. Fingerprints are elaborate, unique and stable over a lifetime. It is used for long-term markers of identity. Our project related another factor is the wireless controlling process and we must find out how works a system over a local network without helping any wire. Now a days, wireless controlling system is more popular than analog system. It makes our life easier and more comfortable. Our wireless system helps for home automation. This chapter will also describe some of the related work that is relevant to this thesis project.[11]

2.2 Related Works

In this section, we will try to summarize some previous researches which are related to our project. Following this we will introduce some of the related work done regarding fingerprint locks and wireless access control.

- In 2016, Utkarsh Sundaram, proposed an exploration on brilliant locking framework for homes. On that, which fills in as a passageway to the home or office isn't just about keeping the trouble makers out, it's likewise about giving the opportune individuals access like family, companions. With the Smart entryway get to framework, you can bolt or open entryway from your cell phone over web or Bluetooth and permit section for you family, companions. [14]

- In May-2013, Ajinkya Kawale, said that electronic lock utilizing unique mark acknowledgment framework is a procedure of checking the unique mark picture to open the electronic lock. This undertaking features the improvement of unique mark check. Check is finished by looking at the information of approved unique mark picture with the approaching finger impression picture. At that point the data of the approaching unique finger impression picture will experience the correlation procedure to contrast and the approved finger impression picture. [15]

- In 2016, Abdallah Kassem, proposed and presented a paper on lock framework utilizing Wi-Fi security. In this paper, an imaginative lock framework model utilizing the present advancements will be exhibited. The curiosity of this model depends on the way that utilizing new advances alongside old ones will result in a brilliant and increasingly proficient. We propose a keen advanced entryway lock framework for any lock framework. [16]

Each of the work has some drawbacks and some of are extremely expensive but in our project, simple package with very cheap electronics that would not interact with the lock system. This user-friendly system could achieve sometimes 100% rate and can be used for smart lock system as a new generation.

2.3 Comparative Studies

In the smart lock system, no need to give a lock pattern and we think it's also a hassle for a user. But biometric authentication is very harder and tough to break for thieves and intruders. To safe personal things with this fingerprint lock system can be the best way and wireless system can be helpful to save the time and movement hassle over a short distance. In our lock system, we are tried our best to make all the system together in one way, more reliability and cost efficiency. It will show users to match the biometric finger print. If it matches the fingerprint the system will unlock on the other hand if it will not match then it shows a message on the LCD display fingerprint not matched.[10] [12]

2.4 Scope of the Problem

It can be the important solution to reduce any one hassle. As our lock system is combined with wireless and fingerprint module, so we can give our customer extra advantage which is far controlling. To prove that the persons are authorized to open the lock, they need to scan their fingerprint image. Fingerprint scanning method is an easy and less cost process and there have no possibility to duplication. So, we can find out a great scope of solution for our security.

2.5 Challenges

We are now in primary stage of microcontroller-based project and it's our 1st project workings. So, our main challenge is maintaining time at our daily basis. We add huge data in the database and also keep eye on the security purpose. Others are

- Make sure the system is user friendly
- Make sure about database security
- Make sure the reliable market place
- To ensure the best experience through our lock system

CHAPTER 3

REQUIRMENT SPECIFICATION

3.1 Lock System Process Modelling

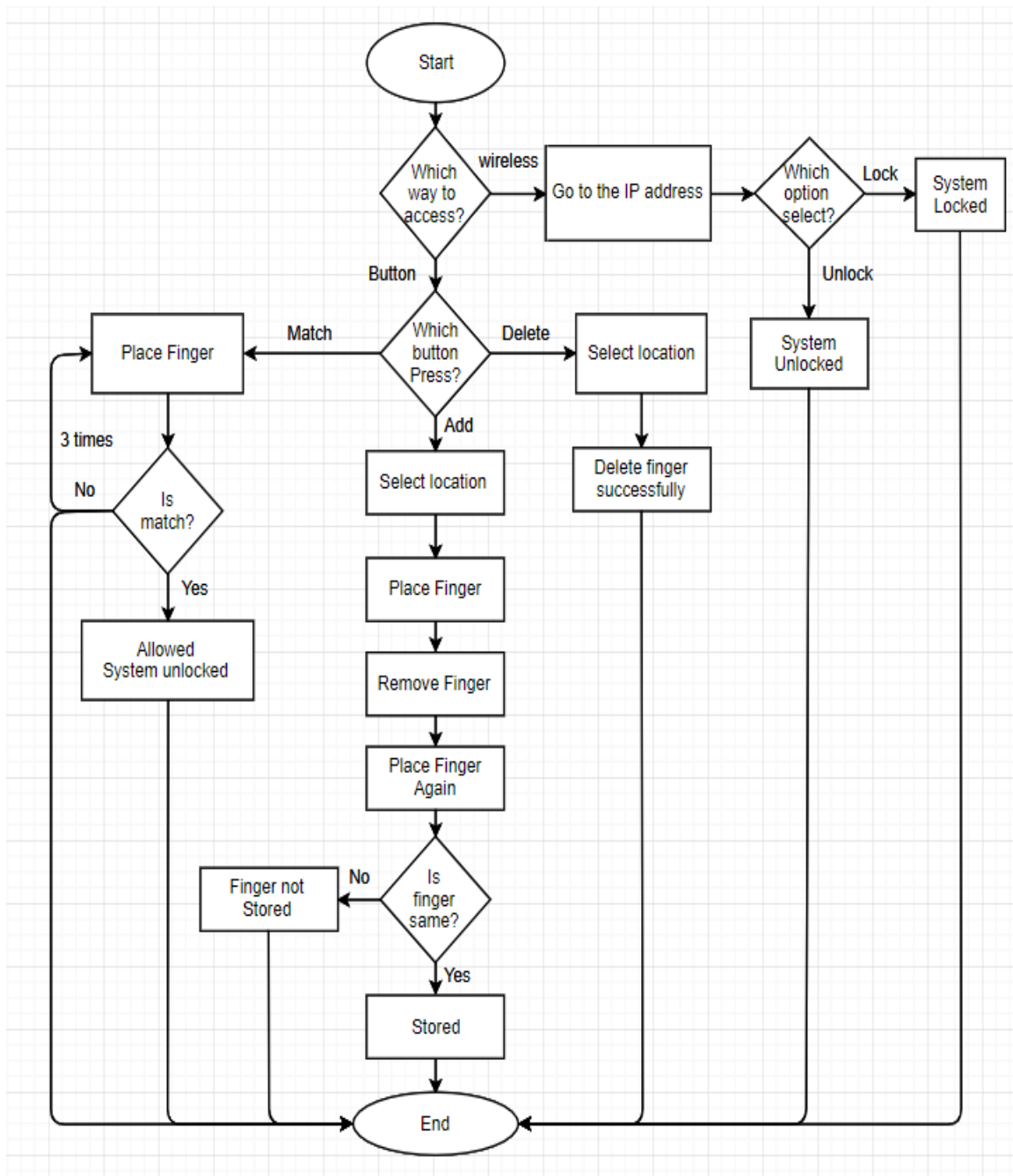


Figure 3.1: Lock System Processing Model

3.2 Requirements Collection and Analysis

To complete our full project, we need different types of requirements. Some of them are given here with description and technical information.

3.2.1 Arduino Uno Rev3:

The Arduino Uno Rev3 is a board of microcontroller dependent on the ATmega328, a 8-bit microcontroller with 32KB of Flash memory and 2KB of RAM. It has 14 computerized info pins, 6 simple information sources, a USB association, an ICSP header, a power jack, and a reset button. It contains which expected to work microcontroller. The Uno board is the first in a progression of USB sheets and it is the reference show for the stage of Arduino. Arduino Uno is the perfect board for beginning with hardware, through fun and drawing in hands-on activities. This board is your entrance to the remarkable Arduino experience: extraordinary for learning the fundamentals of how actuators and sensors work, and a basic apparatus for your quick prototyping needs. Arduino Uno Rev3 is the most utilized and archived board in the Arduino family. [1] [13]

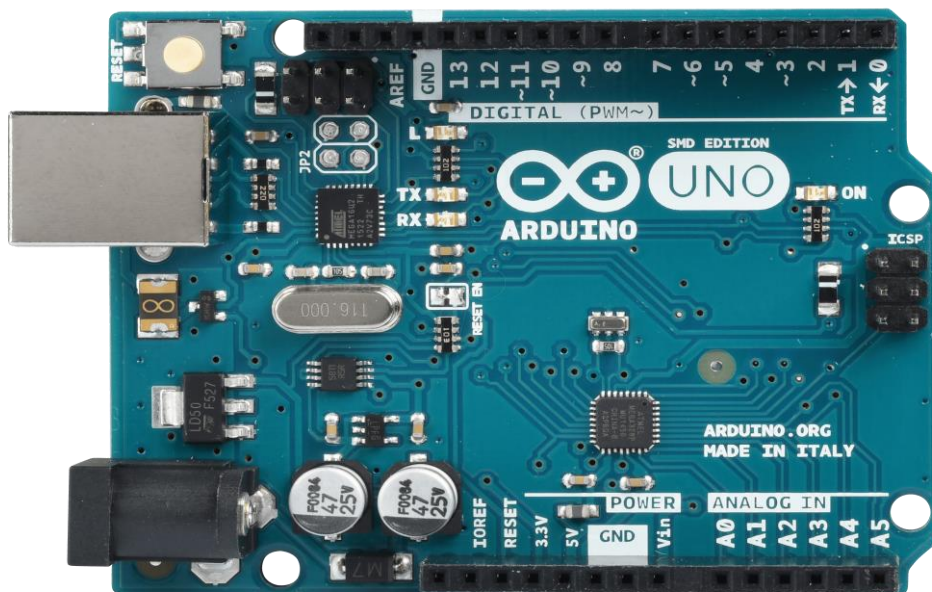


Figure 3.2: Overview of Arduino Uno Rev3

Table 3.1: Technical Information of Arduino Uno

Dimensions	80mm x60mm x25mm
Weight	G.W 50g
Battery	Exclude
Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13

3.2.2 Super strong metal core Servo MG-995:

Servo motor Pro is a high caliber however minimal effort servo for all our mechanical needs. It has a high caliber and high torque. Servo Tower accompanies a 3-stick power and control link. With this two servos and Bracket for servo, you can fabricate a 2 degrees opportunity Servo mount gathering. [2]



Figure 3.3: Overview of Super strong metal core Servo MG-995

Table 3.2: Technical Information of Servo MG-995

Operating Voltage	80mm x60mm x25mm
Operating Current	100mA
Operating Speed	0.17sec/60degree (4.8V) ~0.13sec/60degree (6.0V)
Dead Band Width	4usec
Temperature Range	-30~+60°C
Cable Length	30cm
Brand Model	Analog Servo
Servo Type	Analog Servo

3.2.3 16x2 Character LCD Display:

LCD (Liquid Crystal Display) screen is an electronic showcase module and locate a wide scope of utilizations. A 16x2 LCD show is essential module and is in all respects usually utilized in different gadgets and circuits. These modules are favored more than seven sections and other multi portion LEDs. The reasons being: LCDs are conservative; effectively programmable; have no confinement of showing exceptional and even custom characters (dissimilar to in seven portions), activities, etc. [3]

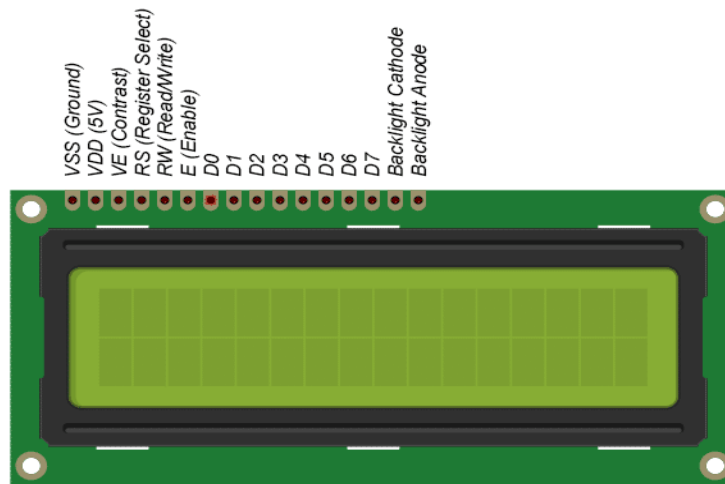


Figure 3.4: Overview of 16x2 Character LCD Display

Table 3.3: Technical Information of LCD Display

Size:	85.0 x 29.5 x 13.5 mm
Viewing area	64.5 x 16.4 mm
Dot size:	0.56 x 0.61 mm
Character size	3.00 x 5.23 mm
Weight	35 g
Viewing area	64.5 x 16.4 mm
Minimum logic voltage	4.5 V
Maximum logic voltage	5.5 V
Typical LED backlight voltage drop	4.5 V
Typical LED backlight current	120 mA
Supply current	mA

3.2.4 HR7U3C Fingerprint Sensor:

Project secure with biometrics - this across the board optical unique mark sensor will make including unique mark location and check very straightforward. These modules are ordinarily used in safes - there's an amazing DSP chip that does the image rendering, figuring, incorporate finding and looking. Interface with any microcontroller or system with TTL successive, and send packages of data to take photos, recognize prints, hash and request. You can in like manner enroll new fingers direct. Up to 162 fingerprints can be secured in the locally accessible FLASH memory. [4]

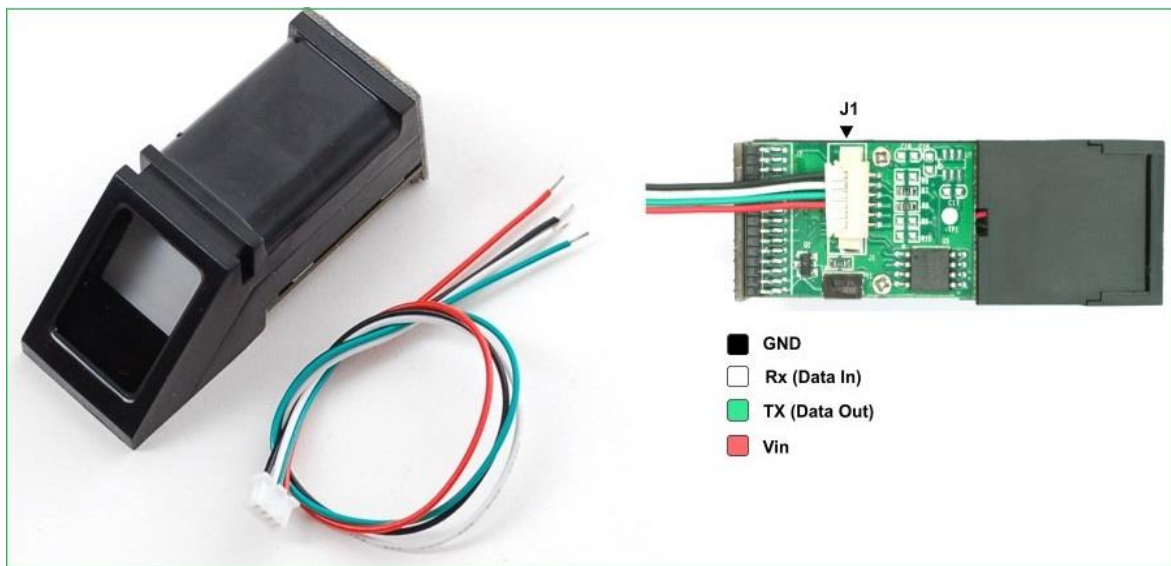


Figure 3.5: Overview of HR7U3C Fingerprint Sensor

Table 3.4: Technical Information of Fingerprint Sensor

Supply voltage	3.6 - 6.0VDC
Operating current	120mA max
Peak current	150mA max
Fingerprint imaging time	<1.0 seconds
Window area	14mm x 18mm

Signature file	256 bytes
Template file	512 bytes
Storage capacity	162 templates Safety ratings (1-5 low to high safety)
False Acceptance Rate	<0.001% (Security level 3)
False Reject Rate	<1.0% (Security level 3)
Interface	TTL Serial
Working temperature rating	-20C to +50C
Working humidity	40%-85% RH

3.2.5 Ethernet Shield Module:

Arduino board can be utilized to associate with web with this Ethernet Shield. Can be utilized as server or customer. Legitimately plug baffle board, no patching required. This is the most recent adaptation of the Ethernet shield. This Arduino Ethernet Shield which depends on the Wiznet W5100 Ethernet chip gives you a simple method to get your Arduino on the web. [7]

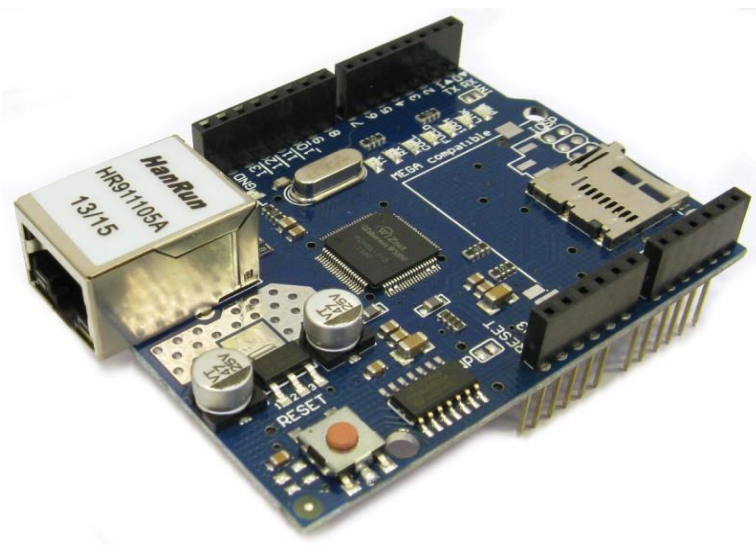


Figure 3.6: Overview of Ethernet Shield Module

Table 3.5: Technical Information of Ethernet Shield

Controller	w5100
Size	7.4 x 5.4 x 2.4 (2.91 x 2.12 x 0.94inch)
MAC address	0xDE, 0xAD, 0xBE, 0xEF, 0xFE, 0xED byte mac [] = {0xDE, 0xAD, 0xBE, 0xEF, 0xFE, 0xED}

3.2.6 push button:



Figure 3.7: Overview of push button

Table 3.6: Technical Information of Tactile Switch

P/N	KAN0652
Dimension	6×6×H/H=4.3mm/5mm
Rating current	12VDC 50mA
Operating force	100gf, 160gf, 260gf(at customers request)
Travel	0.25±0.1mm

3.2.7 Breadboard MB-102:

630 tie point terminal strip, 2 dispersion strips 200, the two sides have two unique spaces, bolster combining. Solderless breadboard is anything but difficult to use for making models and trying different things with circuit structure. With referencing letters imprinted on side for simple reference of individual openings. Twofold side sticky tape back, it is simpler and increasingly helpful to utilize. [5]

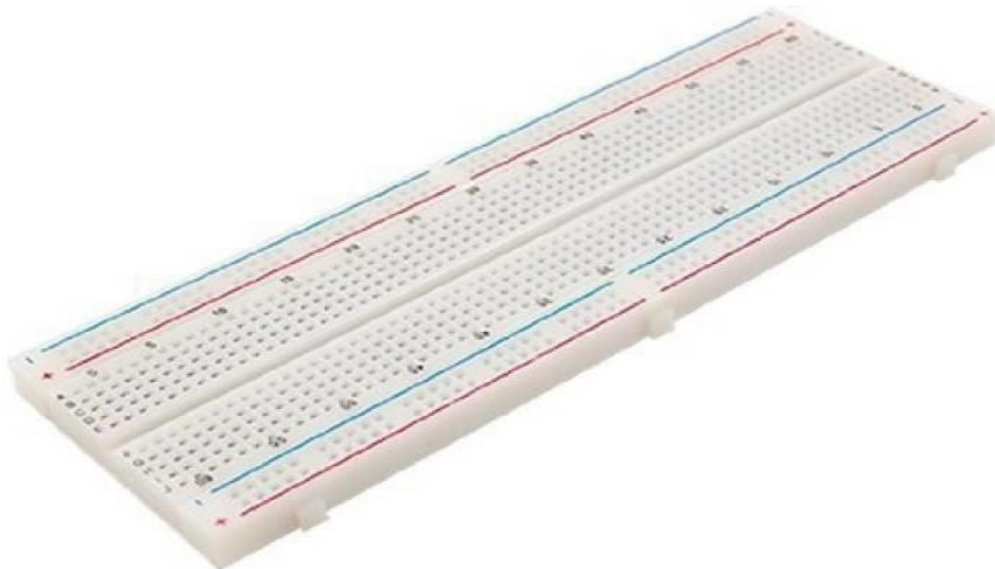


Figure 3.8: Overview of Breadboard MB-102

Table 3.7: Technical Information of Breadboard

Terminal strips	2 (200 contact points total)
Hole Diameter (Approx.)	1mm/ 0.039"
Contact points	830
Breadboard size	16.5 x 5.4 x 1cm/ 6.5" x 2.1" x 0.39" (L*W*T)

3.2.8 Potentiometer - 4.7K Linear, Marshall, 16mm:

Potentiometers are utilized to control tone and volume. We use this potentiometer for display resolution. A potentiometer is a three-terminal resistor with a sliding or pivoting contact that frames a movable voltage divider.[6]



Figure 3.9: Overview of Potentiometer - 4.7K Linear, Marshall, 16mm

Table 3.8: Technical Information of Potentiometer

Brand Name	Marshall
Item Volume	245.00 cubic inches
EAN	0609722158756

3.2.9 Lithium ion 9V 6F22 rechargeable battery 6LR61 Battery 600mAh: [10]



Figure 3.10: Overview of Lithium ion 9V 6F22 rechargeable battery

Table 3.9: Technical Information of rechargeable battery

Brand Name	DOUBLEPOW
Model	DP-9V 250mAh
Dimension	48*26*16mm
Net Weight	35g
Nominal Voltage	9V

3.3 Use Case Modelling and Description

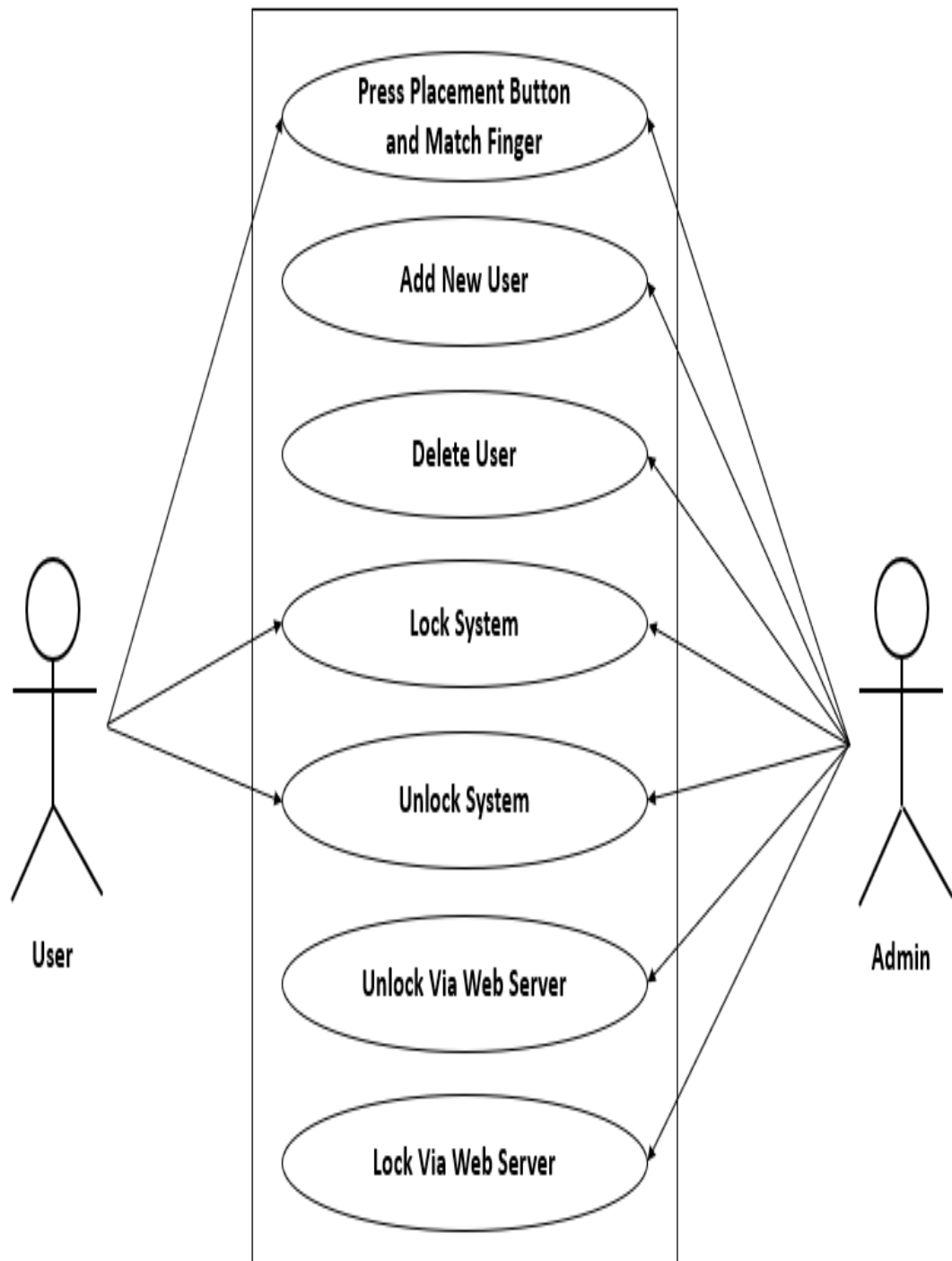


Figure 3.11: Use Case Diagram of Lock System

CHAPTER 4

DESIGN SPECIFICATION

4.1 Front-end System Design

We have used many hardware and software components for completing our full project. These components are based together to a significant circuit that works for our ideal framework.

4.1.1 LCD display System:

For making this system user friendly, we have used a display to show the system of a process in this lock system. This usually shows the instruction messages of every step of our system that needs a user to know. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. We have used a 10k potentiometer to control the brightness of the system display.

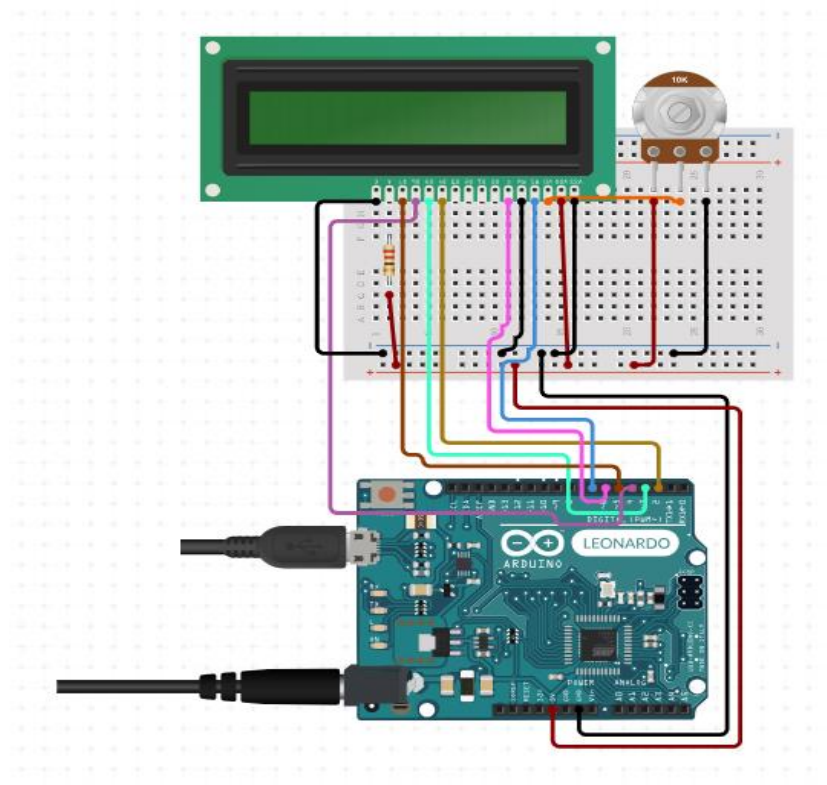


Figure 4.1: Circuit Diagram of LCD display System

4.1.2 Push Button System:

We have used several push button/tactile buttons for our system

- Enroll button/Add button works for adding new user.
- Delete button works for stored fingerprint.
- Placement button indicate user to scan his/her fingerprint.
- Up and down button works for fingerprint Id location.
- Ok Button is for permission.

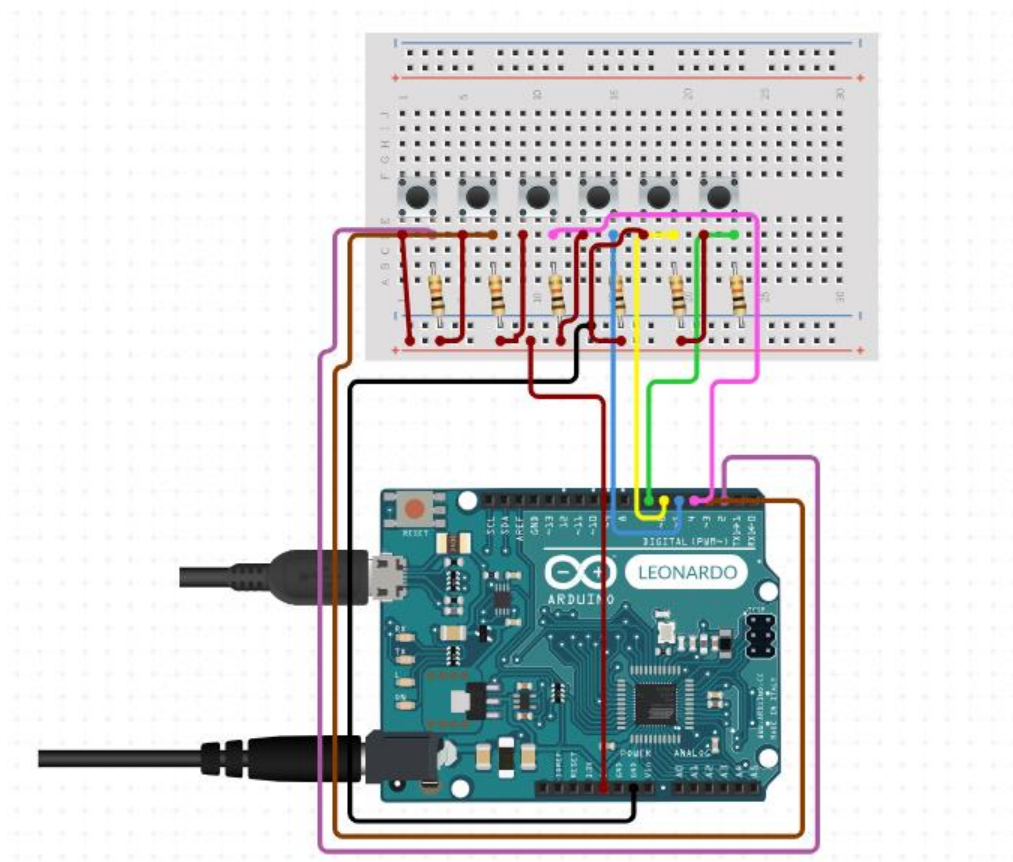


Figure 4.2: Circuit Diagram of Push Button System

4.1.3 Fingerprint System: This is one of the crucial parts for our system. This is the heart of our security system. Our fingerprint module is r307. Which is a new product and it bringing a great security with accuracy. This model can store 127 fingerprints.

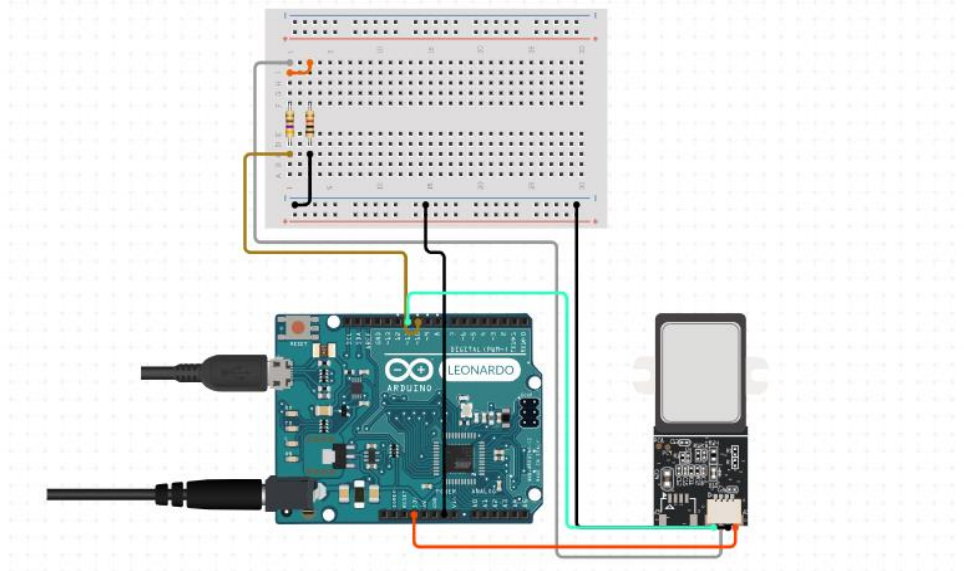


Figure 4.3: Circuit Diagram of Fingerprint System

4.1.4 Ethernet System: Mainly this ethernet system is used for connecting several numbers of computer system within the local area network.

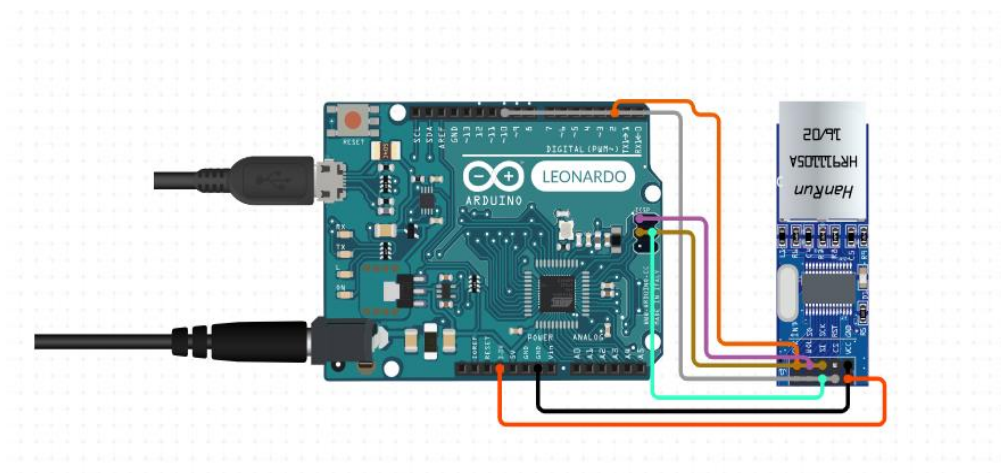


Figure 4.4: Circuit Diagram of Ethernet System

4.2 Back-end System Design

System's back-end is a main part of any system. It requires a lot of work and time for a hardware-based system to design the back-end system. Now the user doesn't know the back-end part. The user only knows how to use the system. The user doesn't need to know the back-end to use the system.

The display we have used is a 16x2 display for showing the messages of important things. It is not as simple as it shows in the display. It's not liked the ordinary display system or output system for showing the message as we can see in the Serial monitor. It takes a lot of configuration to set up a display.

Now the main security system in our system is fingerprint system. The fingerprint module is not user friendly to code it. It took almost two weeks to only code it.

We use ethernet system to run our system through server in a local area network. It takes a huge code to configure the system.

4.3 Interaction Design and UX

Design of interaction is an important part with user experience (UX). We should focus how conveniently our system works. System should be easy to use. In short, the user should not have any difficulties to understand the system at any way.

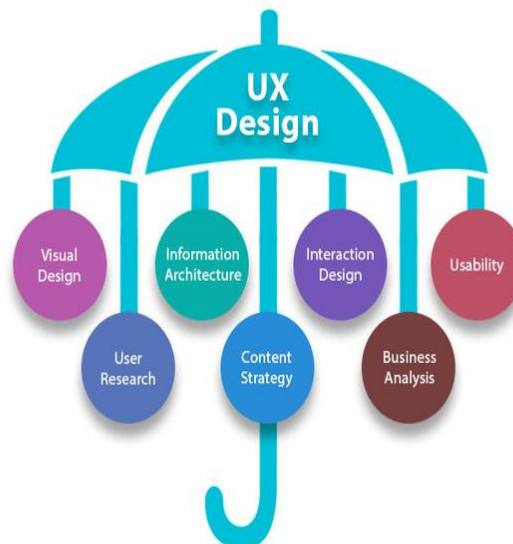


Figure 4.5: UX

4.3.1 Home Page Interaction Design and UX:

We have designed one home page for a user and admin. The user can only use a limited function like opening the door through giving an authorized fingerprint. The admin has to login to access other features. It's an easy system to understand. So, the user or an admin will not have any confusion about the system.

4.3.2 Admin Page Interaction Design and UX:

When the admin wishes to change anything in the system, like adding a new finger print or deleting one old user. An admin can easily interact with the system as it's designed for better user experience.

4.3.3 User Page Interaction Design and UX:

A user can be anyone who has been given privilege by the admin. This page shows that the user to place the finger or if he is on server then it shows on web page to lock the door and unlock the door. So, the user will not have any trouble using the system.

4.4 Implementation Requirements

The main implementation requirement was to make a system which is very secure and easy to use design. One should understand that how to use this system at a glance.

The list of implementation requirement is given below:

- Two way to unlock
- User friendly
- Admin to maintain the system
- Time convenience
- Faster response
- Detection of an unauthorized access
- Reliable system.

CHAPER 5

Implementation and Testing

5.1 Implementation of Database

The system has not used any database like XAMPP or real-time database firebase. Then the question arises how the fingerprint or other related data will be saved. We have used a hybrid fingerprint module. Which has a memory to keep the data of fingerprint with an id which will be inputted by the admin in this case. It saves a lot of time which would be used to design and maintain the database.

Now, this fingerprint module r306 can store the data as itself so, the security measure grows even higher. So, there will be a lot of extra security. As we can handle the data easily by using some command then we can easily manipulate the data system as we wish to use it. We can handle our system using web server which have same get way of local Network IP.

5.2 Implementation of Front-end Design

For implementing our whole system, we followed some stapes and designed according to stepwise process. Here we demonstrate the system of our project in the physical world.



Figure 5.1: Welcome Display

When system admin powerup the system for the first time then it shows the message “Welcome To ... Door Lock System”.



Figure 5.2: Server IP

Then it automatically shows the connected local area server IP address.



Figure 5.3: Welcome User

Display shows a message to the user to press the button for placing users finger on the fingerprint sensor.



Figure 5.4: Place Finger

According to previous message a user places their finger on the sensor to unlock the system.



Figure 5.5: Matching Fingerprint

System reads user fingerprint and unlock if matched then shows the message "Finger Matched. System Unlocked".



Figure 5.6: Check Fingerprint

If not matches with recorded fingerprint then shows the message “Finger Not Found Try Later”.



Figure 5.7: Add User

If we want to add a new user then we must push the add button. Then display shows us new user Id. To finish this adding process system needs to follow some steps which is given below on display message.



Figure 5.8: Place Finger



Figure 5.9: Remove Finger



Figure 5.10: Place Finger Again



Figure 5.11: Stored

After finishing above process, system store a new fingerprint



Figure 5.12: Delete User

If we want to delete any user fingerprint from our system then with the help of up and down button, we target the specific user ID and delete that ID.



Figure 5.13: User Deleted

Display present us above message “User Deleted Successfully”.

5.3 Implementation of Interactions

Interaction of our smart lock is simple. The system includes the messages for the user so that the user can understand what is going on, in every step. It will help the user to interact with the system easily. We have placed all the necessary thing to see on the display. And we did not show any kind of message that could hamper any security issues of the system. It's just convenient for the user to use.

5.4 Testing Implementation

Testing implementation is process of testing the implementation of a system, where tester or system architect will see various cases and specification, is it implementable or it has limitations.

Table 5.1: Testing Implementation

NO.	Tested Case	Test Input	Expected Outcome	Actual Outcome	Result	Tested On
1	Display	Power on	Show initial message on display	Show given input message	passed	11.12.2018
2	Button	Push the placement indicator button	Blinking fingerprint sensor light	Show the message 'Place Finger'	passed	12.12.2018
3	Servo Motor	Rotation	Rotated servo motor without any hassle	Rotated perfect angle	Passed	25.12.2018
4	Fingerprint	Power up fingerprint module	Scan finger	Read fingerprint and unlock system	Passed	10.01.2019
5	Enroll new fingerprint	Place finger	To read and store fingerprint in the system	Stored fingerprint with a new id	Passed	12.01.2019

6	Delete fingerprint	Deleting a fingerprint by an id	To delete a fingerprint	Deleted a fingerprint	Passed	14.01.2019
7	System unlocks (Fingerprint)	Unlock testing	To read fingerprint and unlock	Unlock system	Passed	20.01.2019
8	Admin control (Web Server)	Unlock testing with IP address	To control system with IP under the local area network	System unlocked	Passed	25.03.2019

5.5 Test Results and Reports

We have tested our Lock systems to see if it works or not as we want to use it. So, the tested result will help us to understand the problem of our system and improve it. We should test every step of our project to make it a successful lock system.

We have tested the 2-step smart door lock for many times with different type of people. It worked smoothly. It did not open for unauthorized people. But it seems to have some problem with recognizing the finger sometimes. It because of the finger placement. Another issue is server based unlock checking, sometimes we did not find our local web server for unlocking our system. It because of electricity problem and LAN connection problem.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 Discussion and Conclusion

Our lock system is mainly based on automation. Day by day our world is going to becoming highly dependent on computer-based systems. Now comes the issue of our smart lock system that can be used to ensure the security of our beloved home. Even small organizations can use it easily. Authorized user can unlock the door directly and only admin can control lock access over local area network. So, no key required in this system. We have shown a simple prototype in this project but in future it can be extended too many other regions.

6.2 Scope for Further Development

There are a lot of scopes to develop in this project like

- we can use GSM module instead of Bluetooth module. It can notify us in case of insecure situation by sending us message or dialing call.
- We can control our home security through worldwide internet connection. By this, we can always check last update of home security.
- A camera module can be added in future to take picture of all users who are going towards the process of the security system.
- A log file of all users can be created and be informed to the admin through Email.
- This project can also be further enhanced with retina scan, voice recognition and etc.

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APPENDIX

It's not possible to show all the code of the system. Here we only shows the some of screenshots of system's code.

This is ethernet declaration code.

```
#include <SPI.h>
#include <Ethernet.h>
// Enter a MAC address and IP address for your controller below.
// The IP address will be dependent on your local network:
|
byte mac[] = { 0xDE, 0xAD, 0xBE, 0xEF, 0xFE, 0xED };

IPAddress ip(192, 168, 0, 177); //here is land line IP

EthernetServer server(80);
String readString;
```

Here is LCD display and servo declaration

```
LiquidCrystal lcd(10, 9, 8, 7, 6, 5);
#include <SoftwareSerial.h>

#include<Servo.h>
Servo myServo;

SoftwareSerial fingerPrint(2, 3);
#include <Adafruit_Fingerprint.h>
uint8_t id;
Adafruit_Fingerprint finger = Adafruit_Fingerprint(&fingerPrint);

// define the analog and digital pins

#define enroll 14
#define del 15
#define up 16
#define down 17
#define opendoor 18
#define closedoor 19
#define servoPin 4
// 10, 11, 12, 13 is for ethernet sheild
// 2, 3 is for finger print module
// 5, 6, 7, 8, 9, 10 attached with LCD display
```

```

// here is all setup function code
void setup()
{
    delay(1000);
    myServo.attach(servoPin);
    myServo.write(90);
    pinMode(enroll, INPUT_PULLUP);
    pinMode(up, INPUT_PULLUP);
    pinMode(down, INPUT_PULLUP);
    pinMode(del, INPUT_PULLUP);
    pinMode(opendoor, INPUT_PULLUP);
    pinMode(closedoor, INPUT_PULLUP);

    Ethernet.begin(mac, ip);
    server.begin();
    Serial.begin(9600);
    Serial.println("Server is at ");
    Serial.println(Ethernet.localIP());

    lcd.begin(16, 2);
    lcd.print(" Welcome To... ");
    lcd.setCursor(0, 1);
    lcd.print("Door Lock System");
    delay(2000);

    finger.begin(57600);
}

```

//Here the web server code

```
if (c == '\n' && currentLineIsBlank) {
  //Serial.println(readString); //print to serial monitor for debugging
  client.println("HTTP/1.1 200 OK"); //send new page
  client.println("Content-Type: text/html");
  client.println();
  client.println("<HTML>");
  client.println("<HEAD>");
  client.println("<TITLE>Smart Lock System</TITLE>");
  client.println("</HEAD>");
  client.println("<BODY>");
  client.println("<H1><B>DOOR</B> control using these button</H1>");
  client.println("<a href='\"/?on\"'><button>Unlock</button></a>");
  client.println("<a href='\"/?off\"'><button>Lock</button></a>");
  client.println("</BODY>");
  client.println("</HTML>");

  delay(1);
  client.stop();
  if (readString.indexOf("?on") > 0) //checks for on
  {
    lcd.clear();
    lcd.print("System Unlocked ");
    lcd.setCursor(0, 1);
    lcd.print("By Admin");
    myServo.write(165);
  }
  if (readString.indexOf("?off") > 0) //checks for off
  {
    lcd.clear();
    lcd.print("System Locked...");
    lcd.setCursor(0, 1);
    lcd.print("By Admin");
    myServo.write(90);
  }
  readString = "";
}
```

//Here is match finger code

```
if (digitalRead(up) == 0 || digitalRead(down) == 0)
{
  for (int i = 0; i < 5; i++) {
    lcd.clear(); lcd.print("Place Finger"); delay(2000); int result = getFingerprintIDez(); if (result >= 0)
    {
      lcd.clear();
      lcd.print("Finger Matched..");
      lcd.setCursor(0, 1);
      lcd.print("System Unlocked ");
      myServo.write(165);
      delay(2000);
      return;
    }
  }
}
```

```
// Button access code
```

```
void checkKeys()
{
  if (digitalRead(enroll) == 0)
  {
    lcd.clear();
    lcd.print("Please Wait");
    delay(2000);
    while (digitalRead(enroll) == 0);
    Enroll();
  }
  else if (digitalRead(del) == 0)
  {
    lcd.clear();
    lcd.print("Please Wait");
    delay(2000);
    delet();
  }
  else if (digitalRead(opendoor) == 0)
  {
    lcd.clear();
    lcd.setCursor(0, 1);
    lcd.print("System Unlocked");
    myServo.write(165);
  }
  else if (digitalRead(closedoor) == 0)
  {
    lcd.clear();
    lcd.setCursor(0, 1);
    lcd.print("System locked");
    myServo.write(90);
  }
}
```