VAULT SECURITY SYSTEM

An Undergraduate CAPSTONE Project
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Under the Supervision of

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Fall Semester 2017-2018,
August, 2018

Faculty of Engineering
American International University - Bangladesh

VAULT SECURITY SYSTEM

A CAPSTONE Project submitted to the Faculty of Engineering, American International University - Bangladesh (AIUB) in partial fulfillment of the requirements for the degree of Bachelor of Science in the respective programs mentioned below.

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DECLARATION

This is to certify that this project is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. Any material reproduced in this project has been properly acknowledged.

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APPROVAL

The CAPSTONE Project titled **TITLE OF YOUR PROJECT** has been submitted to the following respected members of the Board of Examiners of the Faculty of Engineering in partial fulfillment of the requirements for the degree of Bachelor of Science in the respective programs mentioned below on **August, 2018** by the following students and has been accepted as satisfactory.

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ACKNOWLEDGEMENT

In the first place, of all, we might want to thank the almighty for having this support upon us and giving the quality to light up every one of the inconveniences we defied while finishing our endeavor adequately.

We might want to express our critical thankfulness and significant regard to our honorable supervisor of the project, Mr. Nafiz Ahmed Chisty, Associate Professor, Faculty of Engineering, American International University Bangladesh (AIUB), for his determination, bearing, imperative exhortation and untiring again from the particularly beginning to the finish of this degree.

We are additionally grateful to our regarded outside Mr. Raja Rashidul Hasan,Assistant Professor Colleague educator for her assistance all through the work.

We might want to give our thankful to our decent Bad habit Chancellor Dr. Carmen Z. Lamagna and Senior member Prof. Dr. ABM Siddique Hossain for giving us the approval to deal with this endeavor.

Finally, we might want to thank our individual families and sidekicks for their reliable help and support to induce us.

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ABSTRACT

These days security is essential perspective with the end goal to protect our secret belongings. Hence there is a requirement for a capable and effective system. This task intends to exhibit a four steps confirmation framework embedded with raspberry pi innovation which will proficiently shield our property from unapproved people. The framework incepted with the face detection utilizing Open-CV image processing preparing library. The camera module taking ongoing snaps of confirming face followed by a finger mark sensor to coordinate finger check. A client id and RFID card were given to the recognizing visitor to access to rest of the means. The consequences of this framework were observed and hold a strong remark on objectives. This proposed framework can be stretched out to be utilized for home, bank vault room, confidential room etc.

Chapter 1

Introduction

1.1. Overture

In this present world security is a big concern. When it's about a vault of a bank or a confidential room, we have to think a step farther. For the experimental purpose, we want to implement a security system of a vault, because without money and banking system world economy cannot proceed. That's why our project is all about the security system. An effective security solution will defend our possession. It is crucial that an effective protection against an intruder, unauthorized use will be provided. We are going to use face recognition technology to implement the security system. Face recognition is the fastest biometric technology that has one and only purpose to identify the human face. The face recognition system evaluates the appearances of a one's aspect image that were occupied with a digital video camera or camera module connected to a microcontroller. The motive is to protect like the confidential room, vault where confidential file or money or treasure are kept.

1.2.Historical Background

The first locks were believed to have originated in the city of Nineveh in ancient Egypt 4000BC ago. The first Egyptian lock was made of wood and formed. The basis for many locks uses today. In 2000BC the Romans improvised hugely on Egyptian design to create their own lock made primarily of metal. There were also one of the first to invent the combination lock. Around the same time as the Romans, the Chinese independently came up with their idea of the padlock. [1]

English inventor Tildesley was first invented door lock by using a set of chimes in the early 1700s. In 1778 the lever tumbler lock was developed. In the 1800's, the flourishing American economy led to a rise in demand for locks to safeguard personal valuables, as well as padlocks for vaults and banks. Then the chubb lock was introduced in 1818. [2]

The principal electromagnetic caution framework was protected on June,21 by Augustus Russel Pope in Boston, MA. Edvin Holmes purchased the rights to Pope's creation in 1857. He was considered by many to be the originator first organization for an electrical caution framework. [3]

In 1962, A group of Canadian analysts distributed an investigation about the life-sparing capability of warmth and smoke locator. This prompted the advancement of new arrangements and standard for a smoke

identifier in new and existing living arrangements. In 1966, the first home video security system was invented by Nurse Marie Van Brittan Broan. Video surveillance incepted in a home security system in the 1970s. This early show has incorporated a huge mechanized camera that moves down a track to see the outside of a commence. Infrared technology was introduced to the security system in the 1980s to prevent false positives. [4]

1.2.1. Earlier Research

In 2010, Mr. Tomoaki Ohtsuki of Keio University from Yokohama, Japan proposed a system for remote security and observing framework in light of room time flag handling. The framework comprises of only a pair of receiver and transmitter were used to receive and transmit the change of propagation of radio wave signal. [5]

In 2014, students of the American University of science and technology, Lebanon proposed a solution to the face recognition using the digital image processing and algorithm software to use face detection. [6]

In 2014, specialists of Shri Gulabrao Deokar School of Building, Jalgaon, Maharashtra, India proposed a security framework in light of a multi-modal biometric system which was taken a picture from different angles by using proximity sensor and matched with the database. [7]

In 2012, researchers of Modibboadamma University of technology, Adamawa state, Nigeria developed a micro-controller based anti-theft security system experimented on a car using GSM network with a text message as feedback. The framework deactivated the auto by detaching the start framework from the supply utilizing the GSM framework. [8]

In 2013, a Collab of two students of K.J. Somaiya college of engineering, Vidya Vihar, Mumbai came up an idea to develop security system using image processing which encounters image stitching and image steganography method used to transfer secret image and text. The secret image phase in three steps at first one is encryption phase followed by embedding phase and hiding phase. [9]

1.2.2 State of the art technology

The current research on face recognition system which based on infrared camera and AI technology. The face recognition technology using infrared camera introduced by Apple Inc. on September 12,

2017, and only available on the iPhone X release on, November 3, 2017. [10] The process is named face id by apple. The hardware contains three sensors which are flood illuminator, infrared camera, and dot projector. [11]

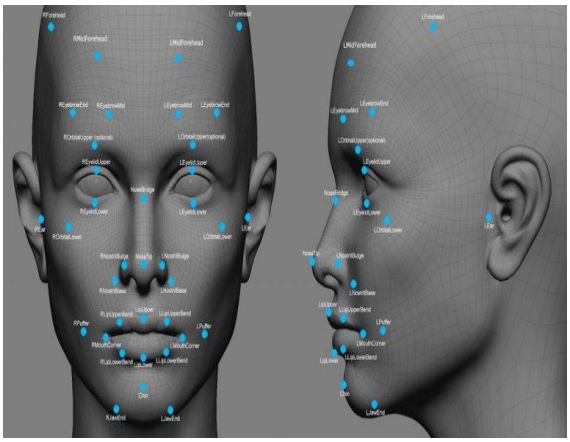


Figure 1.1: Dot projection [13]

Figure 1.2: Infrared light projection [14]

When the user or authorizer wants to unlock the device at first flood illuminator identifies that the eyes of the authorizer are open or not. If the eyes are open then it determines the distance and angle of the face from the device. [12]

Once the measurement is complete it projects infrared light on the face. So that the face is visible. As the system uses infrared light the user cannot detect the light. Once the light projection is done the dot projector starts its operation. It projects 30,000 dots from an array and infrared spectrum high intensity or laser diode is being used to project through a grid of approximately 173 X 173 dots to generate required 30,000. [12]

The infrared camera receives the reflected dot from the user's face and tries to establish a 3D face of dot using the distance from one dot to another dot. As there are massive numbers of dot covering the very small area. So that the distance from one dot to another dot is very short. That's why the 3D image using the dots a pretty accurate. After establishing the 3D image, the processor matches it with the image which is stored in the memory. Once the face is matched the device is unlocked. [12]

Another technology that opens up the surveillance system in a wide range is called the AI technology. The software Faceted develops a new algorithm for this software which takes input from the video stream, encountered the pixels and analyzed in real time. Depend on the individual's position the system aligns the frame for better accuracy hence creates a unique vector matrix for each individual. Then the vectors are stored. These vectors are compared to each-others for sending the data and another system through API. [13]

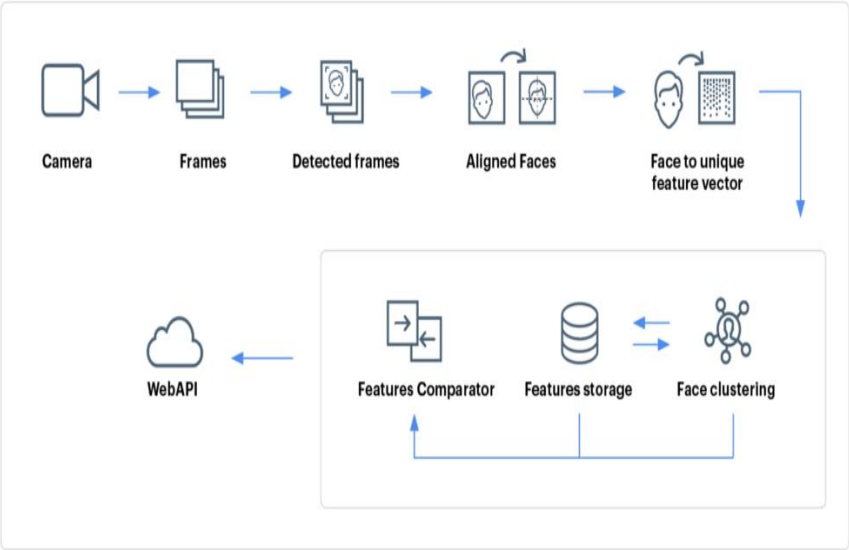


Figure 1.3: facial recognition [13]

1.3 Objective of this Work

The principal objective of our venture is to design an efficient security system for a bank vault. To make this is projected successfully a raspberry pi with a camera module will be used for automatic face recognition. A password as input will be used for two-step verifications.

1.3.1. Primary objectives

Firstly, need to establish a four-digit password which allows the camera module to operate only when the password will match by the person who wants to enter the vault. After matching the password, the camera module will start operating and try to match that image of the authorizer with the image which is previously stored in a folder of a storing device in according with their name. If the image match with that person the servo will operate and unlock the vault door. And if the image doesn't match the person will not allow accessing the vault.

1.3.2. Secondary objectives

There are some extra features that can be added, like full time live monitoring, automatic electric or electronic devices control, monitoring entry & exit time of visitors etc. Live monitoring is possible using the same camera module used to identify a face. Electric devices can be controlled with the help of microcontroller & relay. Monitoring the entry & exit of visitors is also possible with the help of raspberry pi and some simple codes.

1.4. Comparison with Traditional Method

Compare to other methods of the security system is the way of the modern era. Face acknowledgment framework examines the attributes of a man's face picture that was taken by an advanced camcorder or a camera module controlled with a microcontroller. This is the latest method provides no delay and leaves the subject entirely unaware of the process. This method is more secure as compare to fingerprint, pin or pattern lock and voice recognition. It improves our security measurements. We are able to track both the authorizer and any visitors that come to visit the vault or secured zone. People who don't have consent or access in that anchored zone will be caught by confront acknowledgment framework that cautions the director immediately about the trespassing. If an unauthorized person wants to bypass the system it is more difficult as compared to voice or pin-based security system. As we are using two steps security system (pin & face recognition), it provides an extra layer of security as compared to another security system. And as we are going to control the electricity of the vault automatically, it helps to save extra power loss. In case of electricity failure, the system takes power from external so that we can ensure 24 hours non-stop security. So, at last, we can say that, if we consider another security system like voice recognition, pin or pattern-lock face recognition provides an extra layer of security with better power efficiency. [15]

1.5. Impact of Project on Society

Already we mention that this project is based on a two-step security system. This security system provides an extra security layer. 24 hours monitoring is possible so that security never been compromised. It is possible to decrease the rate of bank robbery and money or document stolen. the security system also records real-time video footage and collect data of visitors with entry and exit time so that it helps the authorizer for farther investigation. Automatic electricity control of the vault can help to decrease the loss of electricity. It will help people to save some money from the electricity bill.

Improving technology makes life suitable and more enjoyable without being hassled and stressed.

Finger authentication biometric technology delivers the promise to relay on this system also add a step in the vulnerable security system. People also accepted the promising offering in a positive way.

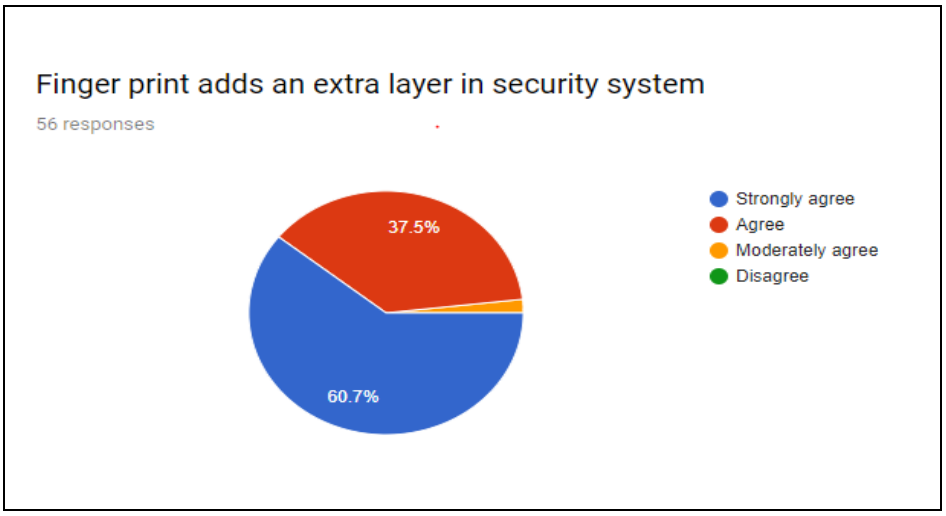


Figure 1.4: Pie chart of survey question no. 01

The additional feature gives more control for the security system, as the system becomes secure and as hard to breach. The biometric facial recognition provides prominent security feels more secure in the society that's why the survey result agreed without the expected result.

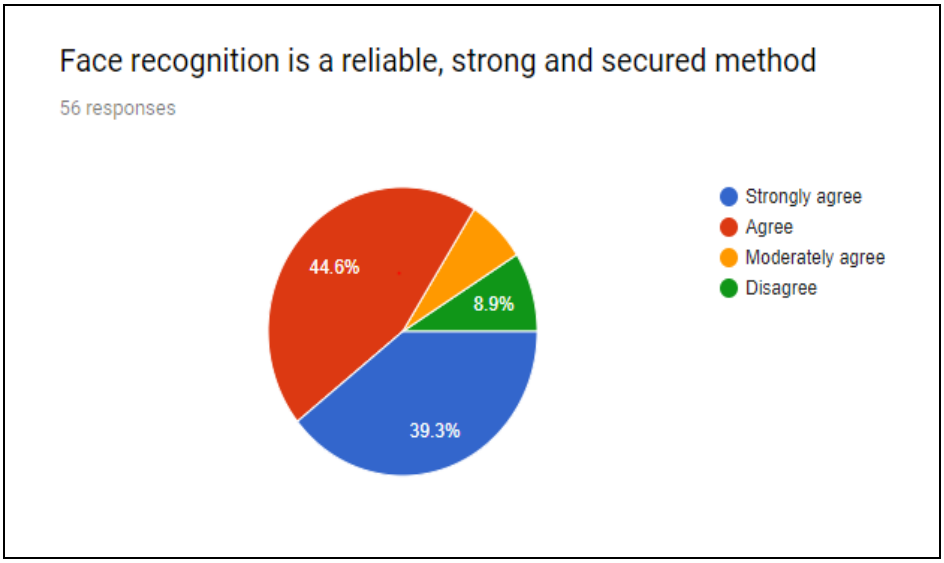


Figure 1.5: Pie chart of survey question no. 02

A strong security system gives confident the consumer in a pleasure and secure manner. A pin-type password security system holds the identical identity for every individual, which build the strong base of the security system.

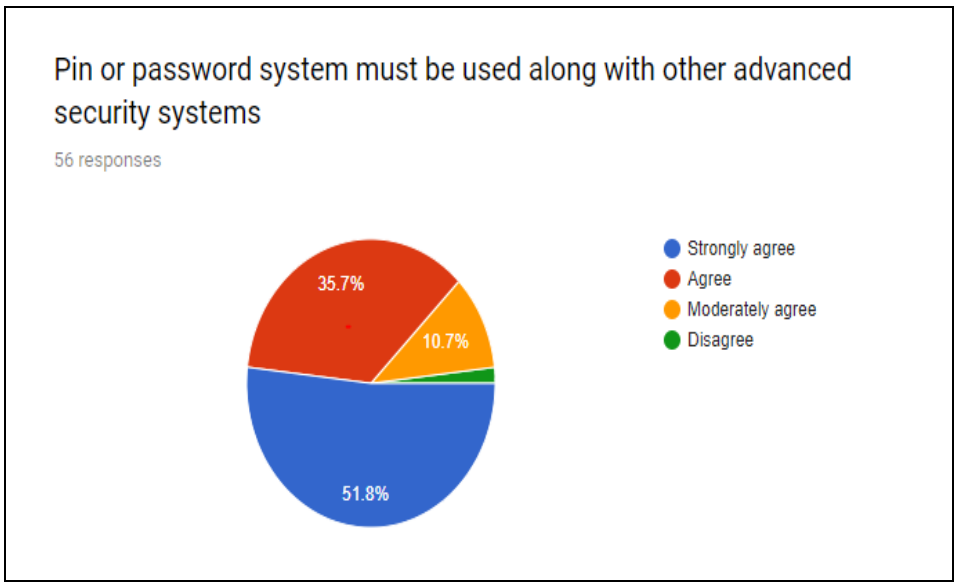


Figure 1.6: Pie chart of survey question no. 04

In the era of modern technology wireless communication system has given the opportunity to access the technology over the distance. Although there is some issue with cybersecurity, people embrace that luxury that also reflected in the survey.

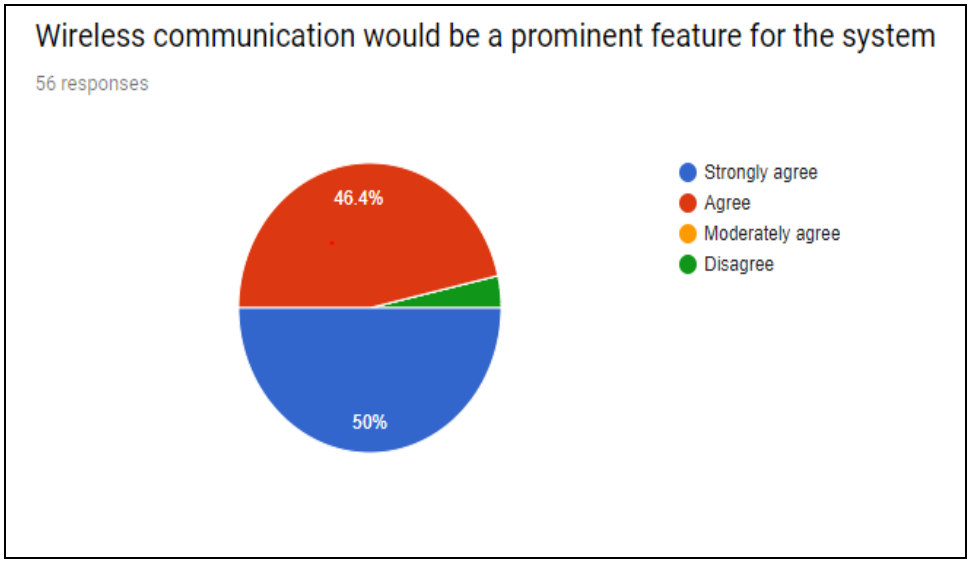


Figure 1.7: Pie chart of survey question no. 06

Energy consumption is one of the primary concerns although it is an abundance of resource but get to difficult in a sustainable position. A compatible automatic light on-off system has the convenient reduce the energy consumption and also the energy bill. consumer accepted this convenience in a positive way.

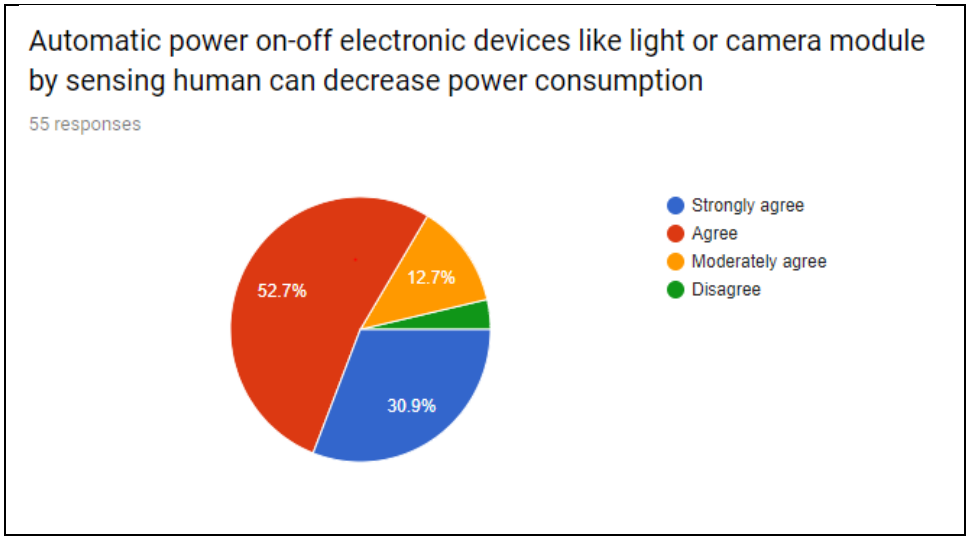


Figure 1.8: Pie chart of survey question no. 14

There is a debate between Arduino and raspberry pie in the modern microcontroller arena. The initiatives have taken with the raspberry pie which more than a microcontroller like a mini computer, designing with raspberry pie offers more secured, convenient system and has a lot of things to do with this device.

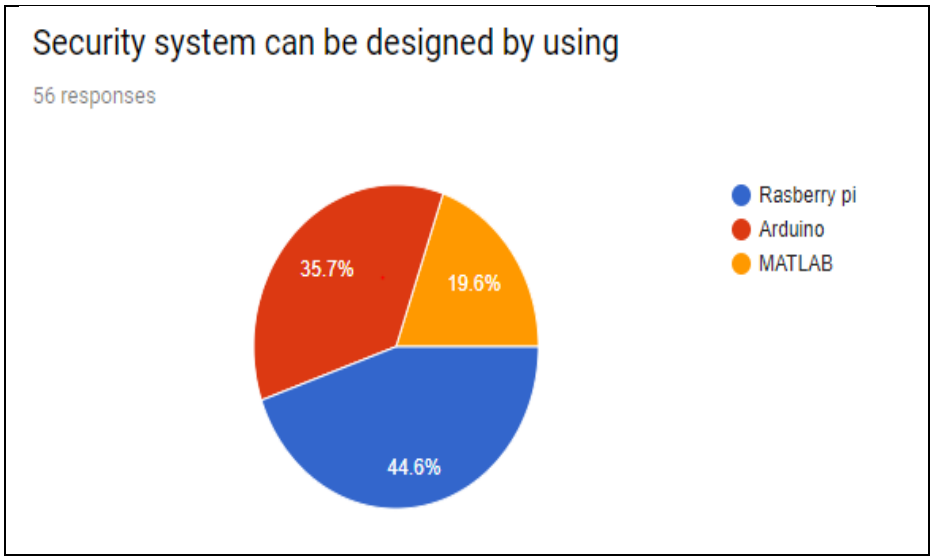


Figure 1.9: Pie chart of survey question no. 15

Electricity failure or load shedding may disrupt system consistency. To avoid this situation extra suppliers may be added to this system which will hold the solidity of the system. This idea also welcomed by the huge survey voters.

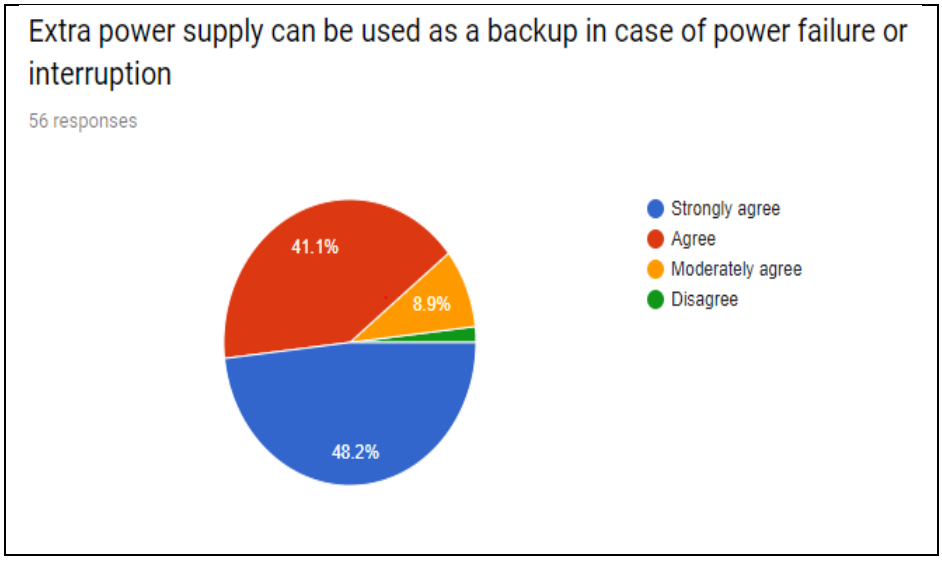


Figure 1.10: Pie chart of survey question no. 5

Data stored can be beneficial to investigate any kind of heist or intruder event which provides video streaming to justify the incident. This feature attains promises from the survey poll result.

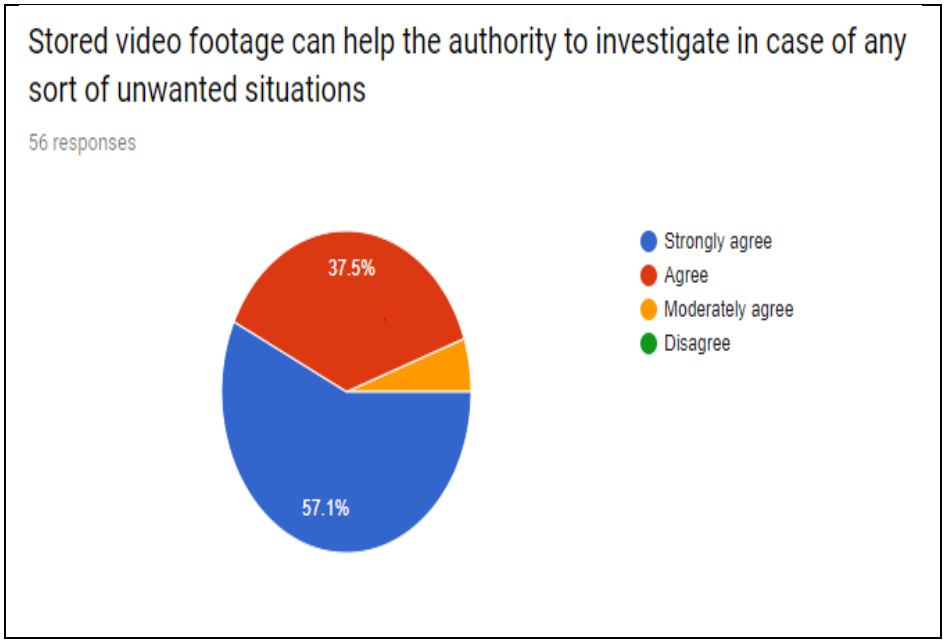


Figure 1.11: Pie chart of survey question no. 13

Emergency panic button becomes worthy when any kind of emergency situation emerges. This leads the system to create an obstructed safer zone for the user that also appreciated by the majority survey voters.

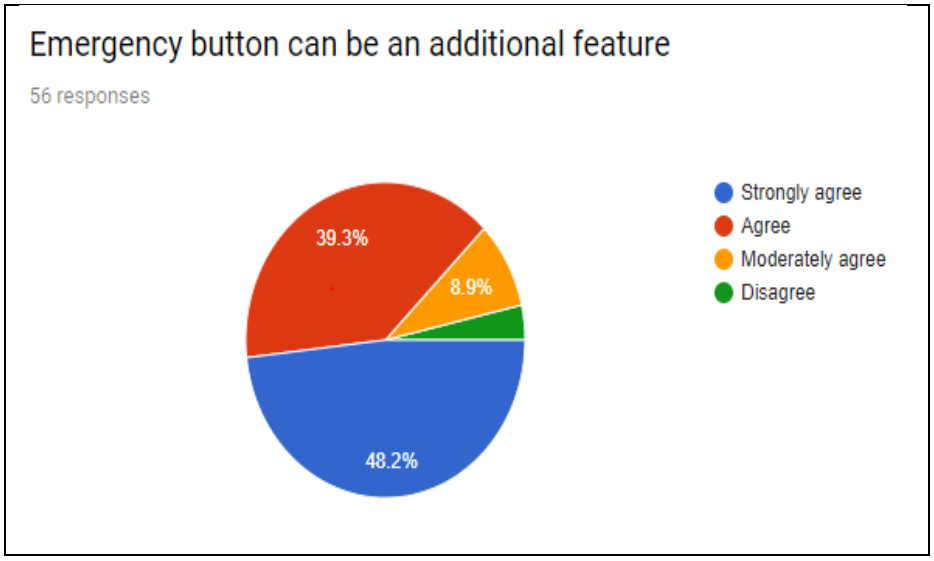


Figure 1.12: Pie chart of survey question no. 9

1.6. Project Management

Tasks	Milestones
Addressing Problem	Proposal Submission
Researching Solutions	Progress Report & Defense
Survey	Project Book Completion
Readjustment of selected solution based on survey results	Poster & Summary Submission
Implement Design	Final Defense
Testing and Results Analysis	
Critical Design Review	

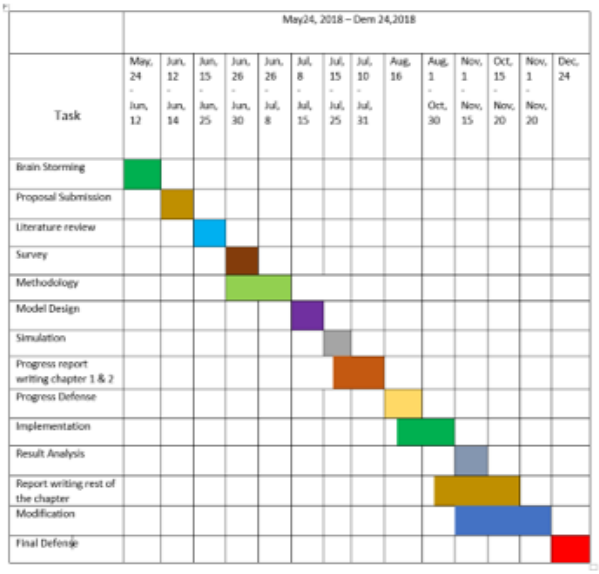


Figure 1.13: Project management of the project

1.7. Organization of Book Chapters

Chapter-2: Literature Review with an in-depth investigation

Chapter-3: Methodology and Modeling

Chapter-4: Implementation of Project

Chapter-5: Results Analysis & Critical Design Review

Chapter-6: Conclusion

Chapter 2

2.1. Overview of the face detection vault security system

In this section, the working strategy of a face discovery security framework is being presented. Basically, the method is microcontroller and coding based. There are so many methods in the image processing unit. In this chapter, we are going to cover the common methods. The use of image processing in the face recognition security system is also being discussed. The method we are going to implement is based on raspberry pi. We also cover the benefits of using raspberry pi instead of using another module. The possibilities of the vault security system and the use of vault security perspective of Bangladesh are also being disused. Basically, our idea is to implement a two-step vault security system which offers a great security solution. In present days there are many security solutions available in the market. Some of them may offer face recognition system but they are very expensive and have very limited functions and not possible to function. The face recognition works on a different stage. Firstly, it captured several images of a single person and saved it into a storing device. Those images will be used later for verification. By matching the pin an authorizer can pass the 1st stage. Only then the camera takes pictures of the authorizer's face and tries to match it with its stored image. Once it matched the two-step verification will complete and the person is allowed to enter the vault, otherwise not. Two types of control board can be used to complete the entire operation.

- Arduino board

  Arduino is a solitary board microcontroller and microcontroller units for building computerized gadgets and intelligent questions in the physical and advanced world. It's an open-source PC equipment and programming organization and client network that plans the controller board. The open source hardware, as well as software products, are licensed under two organization. One, GNU Lesser General Public License (LGPL) and the other GNU General Public License (GPL). [16]

  The Arduino board contains a set of digital and analog input/output pin to interface with various kinds of circuits, devices or sensors. The board is designed using a variety of microprocessors and controllers. [17]

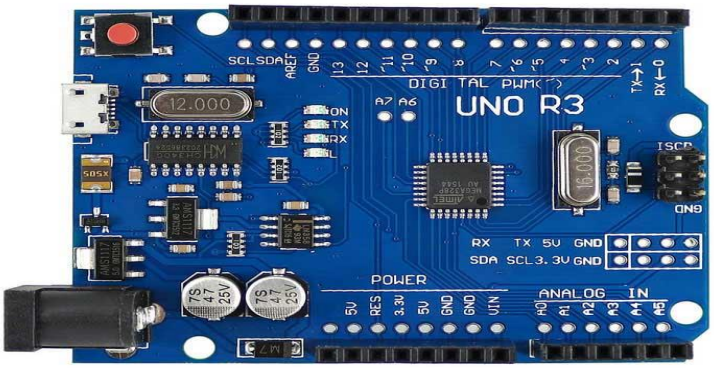


Figure 2.1: Arduino Uno R3 Board [17]

- Raspberry Pi

  It is considered as single-board computers without any peripherals (such as a keyboard, mouse, and monitor). It is created in the United Kingdom by the Raspberry Pi establishment. The primary objective of the establishment to advance the instructing of essential software engineering in school and creating countries License. [18]

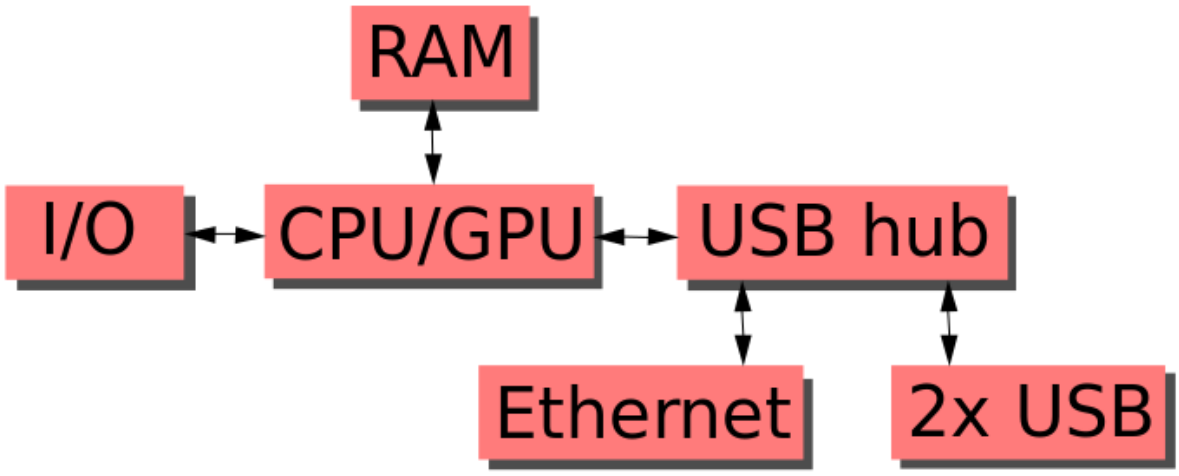


Figure 2.2: Basic Block Diagram of Raspberry Pi Hardware. [19]

The block diagram shows the hardware management of raspberry pi, which is pretty similar to an ordinary computer. [19]

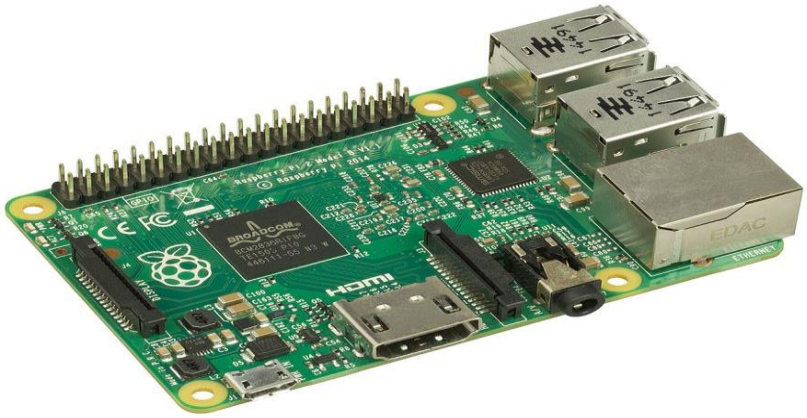


Figure 2.3: Raspberry Pi 2B. [19]

The face acknowledgment framework is a testing and fascinating issue that it has pulled in scientists to take a shot at it. There are fundamentally three kinds of strategies utilized to confront acknowledgment. [20]

1. Holistic Matching Methods:

   In this technique, the total face locale is considered as an info information into confront getting framework. This is the most generally utilized strategy to confront acknowledgment framework. [20]

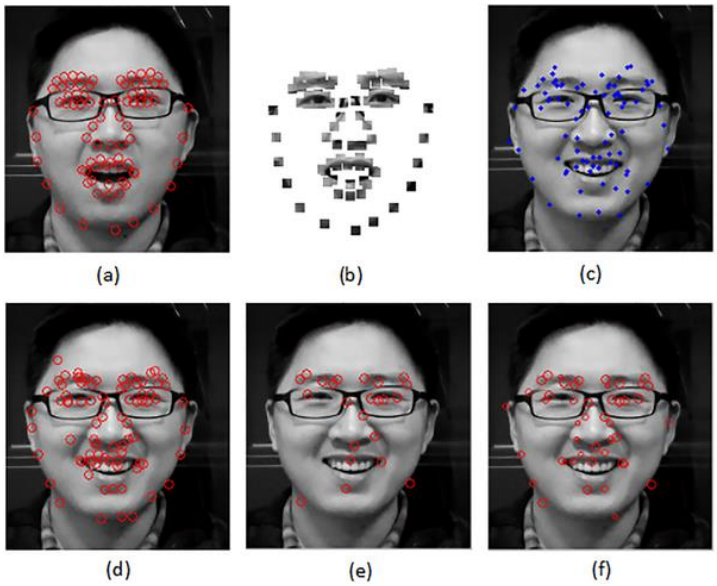


Figure 2.4: working method of Holistic Matching Method. [20]

2. Feature-based (structural) Methods:

   The area of highlights, for example, eyes, nose, and mouth are separated and their area and neighborhood measurements (geometric and appearance) are nourished into an auxiliary classifier to include based strategies. [21]

   In any case, when the framework endeavors to recover highlights that are imperceptible because of substantial contrasts/diverse renditions, head introduce/ask/remain in a conspicuous and phony way when need to coordinate a front picture with a profile picture. It's a test in highlight extraction techniques. [21]

Figure 2.5: working method of Feature-based Method. [22]

3. Hybrid Methods:

   The hybrid method is a combination of holistic and feature extraction method. This method works on 3D images. By using a 3D image, we can determine the curve of eye sockets, the shape of the chin or forehead. The framework utilizes profundity and hub of estimation, which gives enough data of full face. [23]

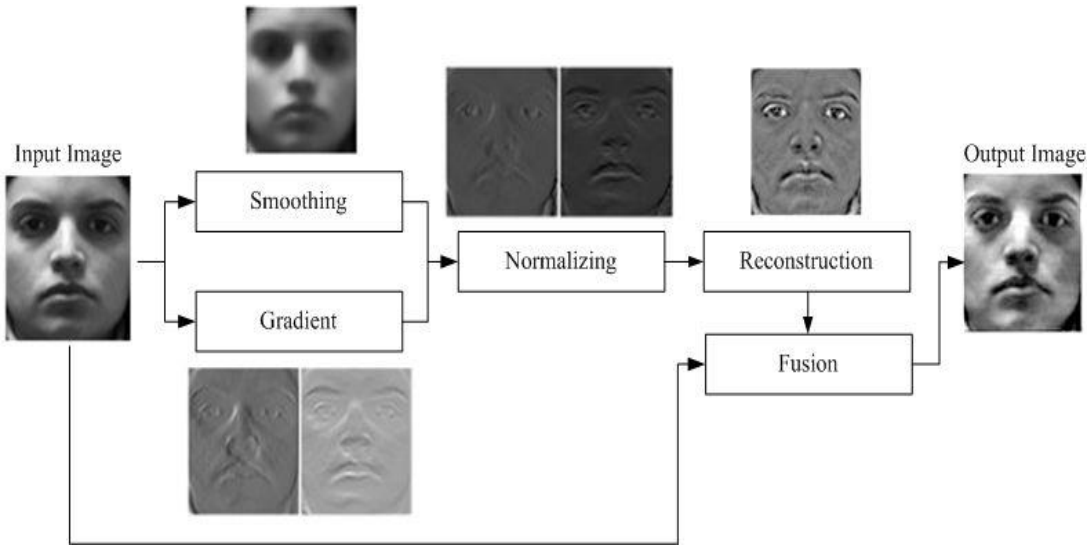


Figure 2.6: working procedure of Hybrid Method. [24]

2.2. Historical Analysis

i) Mr. Tomaki Ohtsuki, Department of data and software engineering from Japan proposed a remote security framework in light of room time flag preparing. Transmitter and receiver are the two part of this system. Changes of electrical waves which were spread in a wide range of an area gave the Received Signal Strength (RSS) in an intrusion event as far as the receiver is concerned. The system experimented on two situation Detection of person intruding based on the environment. While opening the door, inconsistent with the environment, the proliferation of radio waves changed in this manner the principal eigenvector changed also. This phenomenon goes with any kind of detection like baggage, box etc. The system was suggested for implementation in the car or in the security for an older house. The biggest advantages of this system are providing security without invasion of privacy not spying with the camera. The big issue of this system is that the RSS is susceptible to the noise. [5]

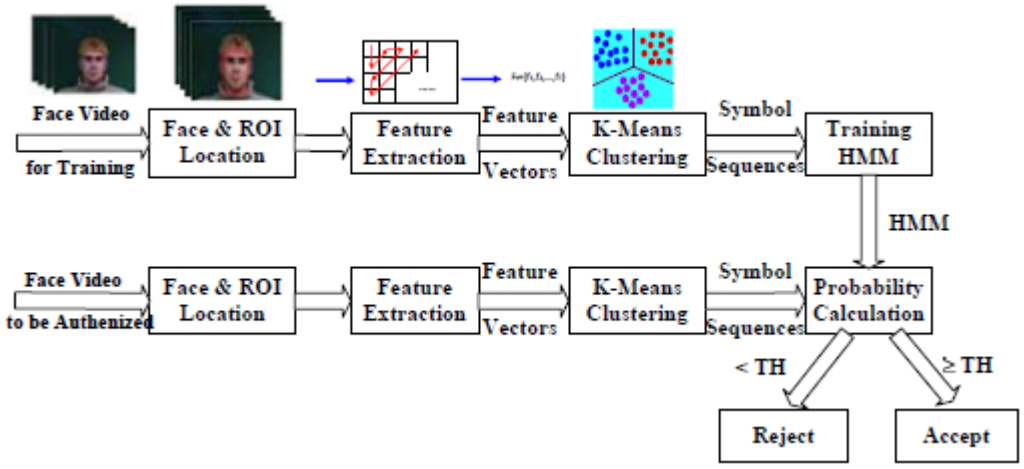
ii) A researcher from Malaysia of University Technology developed a security system based on biometric technology, is growing so fast that lends the researchers to drive this path over pin or password which are preceding core of the typical security system. this paper presents voice algorithm method as an access of controlled key. Voice recognition system was developed in the MATLAB. The time and frequency domain of different letters were analyzed. The hardware part was objected to controlling the door where the matching voice will provide logic high (1) on the contrary logic low (0) will be appeared for mismatching frequency of domain. The communication part was the interface between pc and microcontroller in a parallel

way to ease the programming the controller part mainly based on the microcontroller which has 4k words and ability to translates 1024 instruction. Two voice patterns of the same person were recorded at different time event. The standard deviation of the two voice was 12.7. % and 12.23% respectively. Since the difference between them was less than 15% considered to be an allowable output. [26]

iii) Acoustic intruder detection algorithm system was proposed by a coalition group of students from Korea maritime university and Dankook university the proposal came up with an idea of acoustician over the traditional method for security system where some system refuge to take pin on password and some of are also inadequate and ineffective. The system featured with standard deviation ratio, correction coefficient, Euclidean distance in the time domain and spectral centroid, spectral roll-off, the spectral flux in the frequency domain. [27]

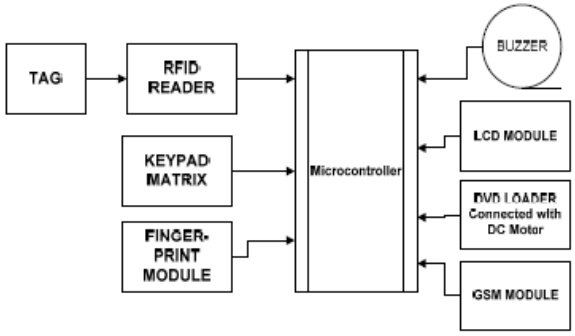
iv) A gathering of analysts from Germany exhibited the improvement of interruption discovery framework for compartment/secret box security. This paper was questioned the advancement of a remote security gadget called intrutag utilized for anchoring particularly flying machine compartment (ULD-Unit Load Device). A low power microcontroller stage coordinated with an alternate sort of sensor for detecting the interruption activity. An RF communication module was used to transmit the data in the transmitter. the microcontroller received the data from 3 axis acceleration sensor. the other disturbances like fire, temperature humidity was identified by their respective sensor. The firmware part was developed using high-level language C using IAR embedded workbench IDE. [28]

v) A team of researchers from National Chung Cheng University, Taiwan proposed video-based person authentication with a random password which featured with extraction and modeling, model synthesis and probabilistic model matching. The accuracy of the biometric system (palm, face, speech) drives them to propose this system in the newer way which is video based authentication.



The proposed system overview incepted with the video authentication followed by the process with face and ROI location to extract the feature vectors hence classified by k means clustering to observe the reduced vectors followed fed in the Hidden Markov Model Classifier (HMM) to captured the classified vector for finding the temporal characteristics of the features. The impact of practical accuracy using random password denying the fixed password method also discussed in this picture. [29]

vi) A group of students from Amity University, India proposed and designed a multistage security system for user authentication. Three stage authentication system sequentially followed by RFID, password, biometric. Three stage authentication combination system emerged as an effective system as compared to the traditional system was shown in this paper. In the first stage, the card was punched in the RFID module for accessing the second stage, if the card was not matched with the stored data then the next stage will not be permitted.



A pin password authentication module was included in the second stage where pin or password took as input if the password did not match the person will be rejected. In the final stage, the fingerprint is taken as a biometric input if fingerprint matched with the stored data then multistage authentication is done. All the data were sending the microcontroller from the module then data were compared with the stored which were stored in the EEPROM. The system was implemented for higher accurate and efficient security system. [30]

2.2.1. Face Identification

As we know, face recognition is a process where the system identifies people by their face images. In other methods like pin or password, there is a chance that the pin or password can be leaked and secondly the authorized person should always need to remember the pin or password. But in face recognition system as the password is faced, it is quite difficult to duplicate anyone face and the authorized person doesn't need to remember any kinds of password. [25]

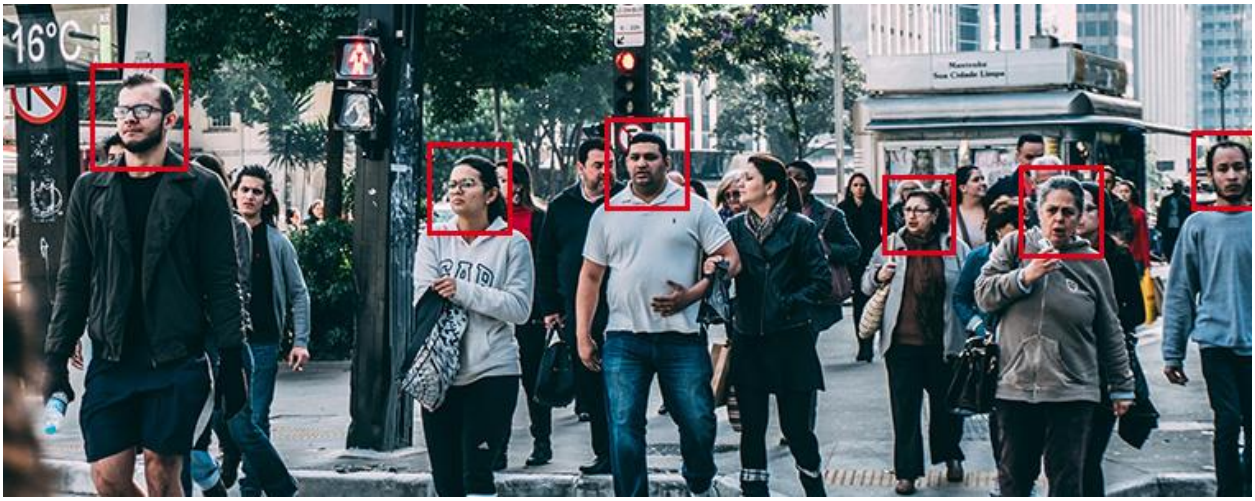


Figure 2.7: Face recognition system in a city street. [23]

2.2.2. Access Control

In different types of access control applications, like bank vault access, office access or computer login a relatively small group of people need to be recognized. The user doesn't need to co-operate with the system because of a natural condition or suitable environments like frontal faces and indoor illumination. In this condition, the accuracy of the face recognition process is very high. For instance, the face acknowledgment can be utilized to screen constantly who is in the vault of an office like a bank, stock trade and so forth. If an authorized person is in front of the vault door, the door will automatically be opened and when he or she exits from the vault the door will automatically close. Then it is quite impossible for any other person to enter the vault without the presence of any authorized person. [27]

Figure 2.8: Face recognition system using in an office. [23]

2.3. Summary

In this chapter, the basic of different type of face recognition methods are introduced. This project paper there is also a simple discussion about the working procedure of face recognition system and the benefits of a positive environment. We mainly focus on raspberry pi-based hardware implementation which allows us to implement and upgrade the system as our requirement. As our project is mainly coding based so the electrical complexity is very less.

Chapter 3

Methodology and Modeling

3.1. Introduction

This section manages the working strategy and the model of the entire framework. In this section, how the entire framework is planned and the modules are incorporated together will be talked about. This section incorporates the insights about the Vault security system. The face recognition is finished by opencv. A camera module is utilized to take a photo of a man who needs to enter the vault. In spite of the fact that the framework will be worked by means of wireless communication, we are utilizing VNC software. An Arduino module is utilized for the password and caution reason.

3.2. System Description

The individual who needs to go into the room the camera module will take photos of that individual. at that point, the framework will dissect the photo and match the individual in the database which will be finished by raspberry pi by utilizing open cv. On the off chance that the photo coordinate framework will send a signal to the Raspberry pi. After that secret phrase will be asked which will be given to that individual by means of SMS. Subsequent to affirming the secret word, unique mark and RFID card ought to be checked for the last advance of security. Subsequent to affirming all the progression the servo engine will begin to work. Any disappointment of that progression framework will caution the specialist by disturbing a signal

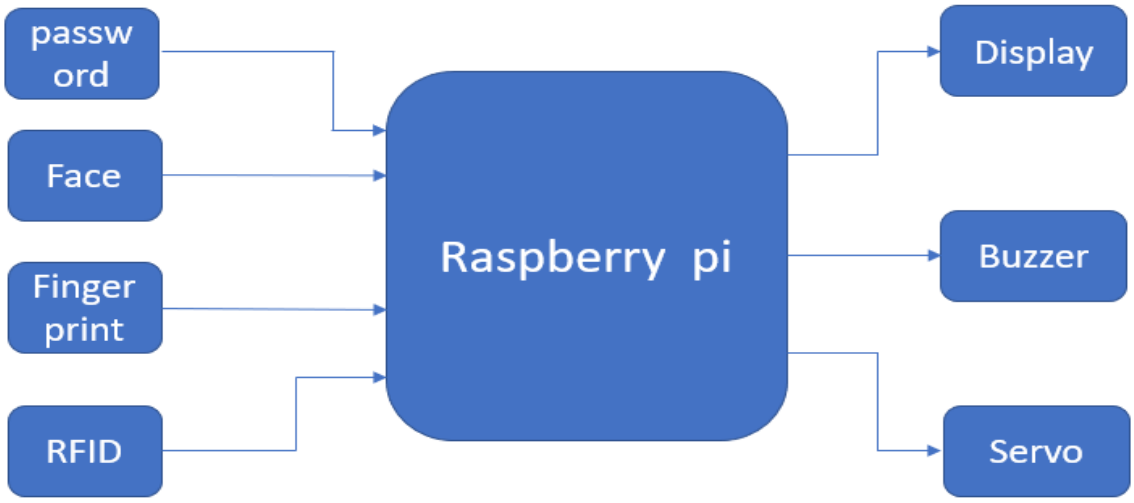


Figure 3.1: Working module

3.2.1. Microcontroller unit

i. Raspberry pi:

The Raspberry Pi 3 Demonstrate B is a little card measure PC. Simply include a console, mouse, show, control supply, smaller scale SD card with introduced Linux Dissemination and we will have a completely fledged PC that can run applications from word processors and spreadsheets to amusements. As the Raspberry Pi 3 underpins HD video, we can even make a media focus with it. The Raspberry Pi 3 Show B is the main Raspberry Pi to be open-source from the get-go, anticipate that it will be the defector implanted Linux board in every one of the gatherings. [31]

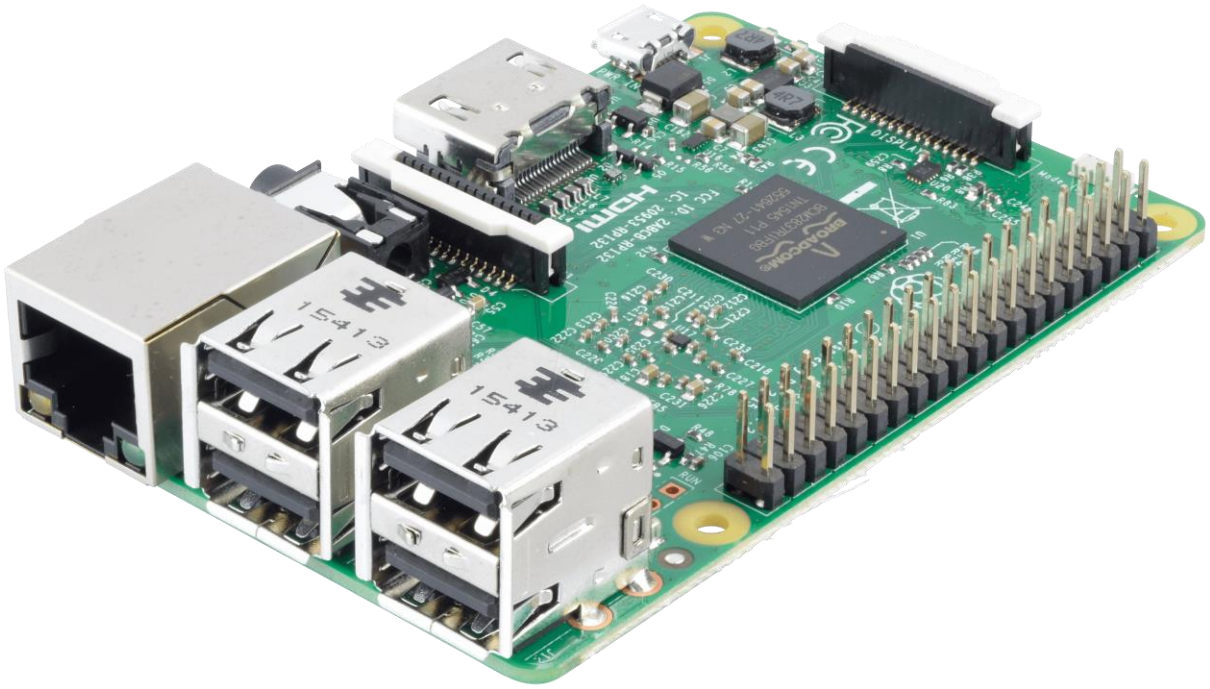


Figure 3.2: Raspberry pi 3 [31]

3.2.2. Supporting equipment

i. Camera Module

The raspberry pi camera module has an 8-megapixel sonyimx sensor for catching. It has additionally settled core interest. it tends to be associated with the raspberry pi by means of a short cable. It is additionally upheld by the most recent Raspbian. [32]

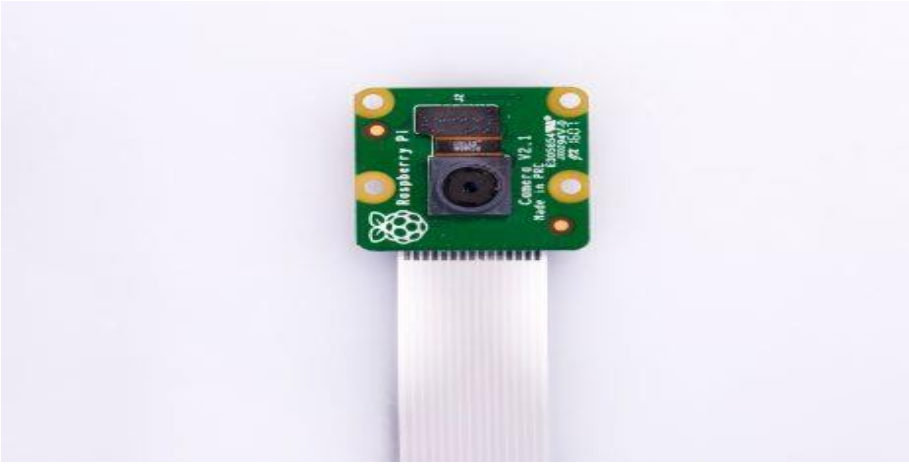


Figure 3.3: Camera module [32]

ii. Keypad

A keypad is a standout amongst the most generally utilized info gadgets in chip applications. In a standard keypad wired as an X-Y switch grid, ordinarily, open switches interface a line to a section when squeezed. On the off chance that a keypad has 12 keys, it is wired as 3 segments by 4 lines. A 16 key cushion would have 4 segments by 4 columns. [33]

Figure 3.4: Keypad [33]

iii. 12V finger print scanner

Mechanized unique mark scanners have been a pillar of government operative spine chillers for a considerable length of time, however, as of not long ago, they were quite intriguing innovation in reality. In a previous couple of years, in any case, scanners have begun springing up all once again the place - in police headquarters, high-security structures and even on PC consoles. [34]

Figure 3.5: Finger print scanner [35]

iii. RFID Card

RFID is an acronym for "radio-recurrence distinguishing proof" and alludes to an innovation whereby computerized information encoded in RFID labels or shrewd names (characterized underneath) is caught by a peruse by means of radio waves. RFID is like barcoding in that information from a tag or name are caught by a gadget that stores the information in a database. RFID, in any case, has a few points of interest over frameworks that utilization scanner tag resource following programming. The most eminent is that RFID label information can be perused outside the viewable pathway, while standardized tags must be lined up with an optical scanner. [36]

Figure 3.6: RFID card [37]

iv. 12V door lock

The power-entryway bolt actuator is a really clear gadget. Inside the power-entryway bolt actuator. This framework is very straightforward. A little electric engine turns a progression of goad equips that fill in as an apparatus decrease. The last apparatus drives a rack-and-pinion gearset that is associated with the actuator pole. The rack changes over the rotational movement of the engine into the direct movement expected to move the bolt**.** [38]

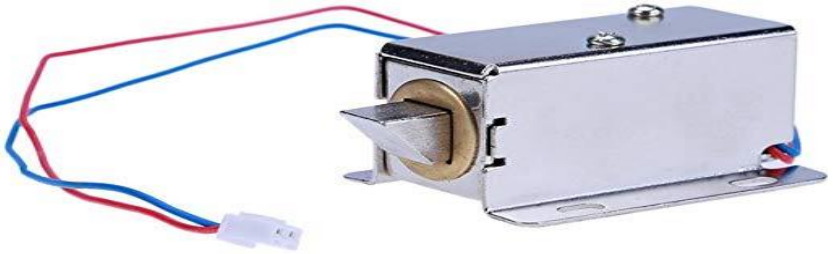


Figure 3.6: 12V door lock [39]

3.3. Summary

This whole section has communicated the essential thought of the task. The underlying prerequisite and the mechanical assembly similarity of vault security system have been talked about quickly here. For every device, their utilitarian structure and the working locale have been demonstrated exclusively in short with Figures. The significance of utilizing this mechanical assembly and the reasons for utilizing these contraptions have been examined in this section.

Chapter 4

IMPLEMENTATION OF PROJECT

4.1. Introduction

Foundation of trustworthy and secure security framework is the fundamental inspiration of this undertaking. To get it going the equipment segment are required. In this section, the equipment segments and hypothetical structure utilized in this task will be portrayed with fundamental connection Raspberry Pi microcomputer is the lance leader of this venture ordering distinctive sensor and peripherals through universally useful information yield stick. Distinctive strides of equipment usage will likewise be contemplated in the section.

4.2. Implementation of hardware

The entire framework has four stages for check recognizing raspberry pi as moderator. A camera module, 4×4 matrix keypad, unique fingerprint sensor, and RFID sensor has implanted with Raspberry pi. Each step has its very own implementation which is portrayed below.

4.2.1. Implementation of camera and finger print sensor

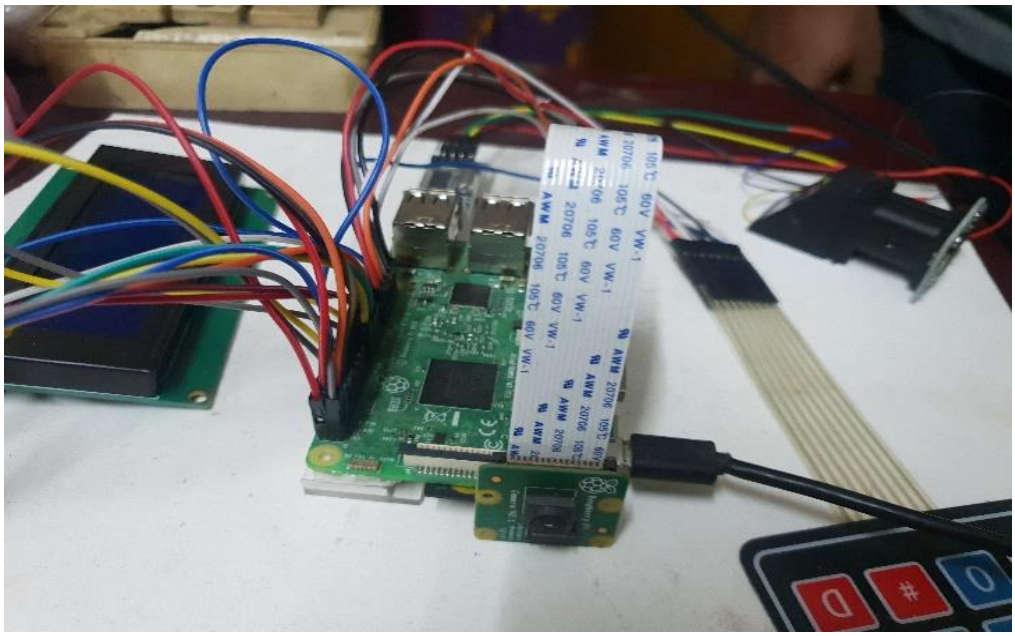


Figure: 4.1(a) implementation of raspberry with camera module

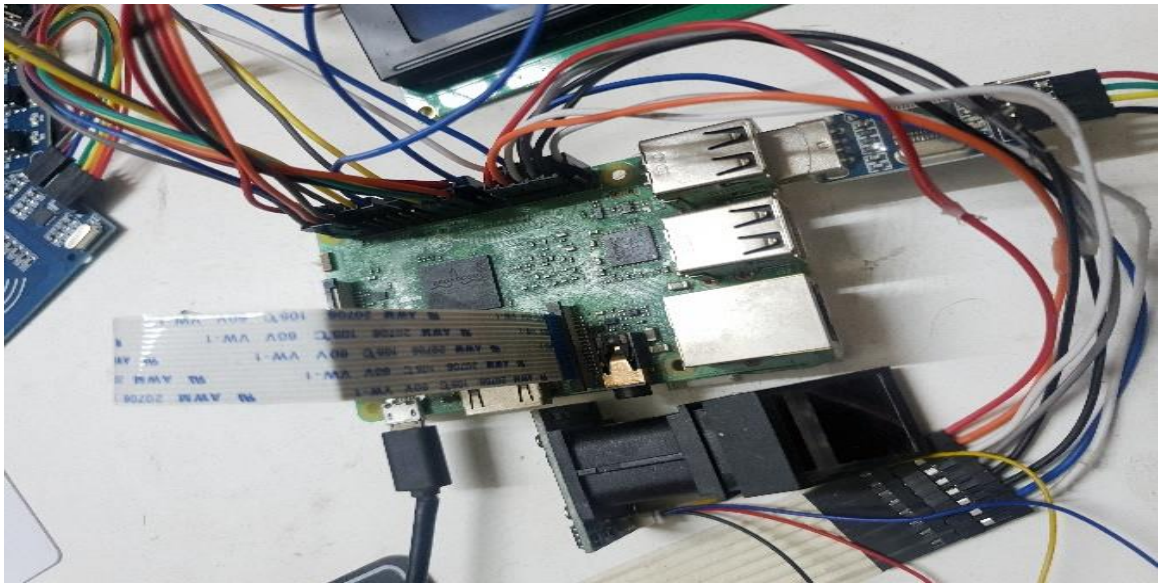


Figure: 4.1(b) implementation of raspberry with fingerprint sensor

Both the camera model and finger-print sensor associated with Raspberry Pi. The raspberry pi camera v2.1 is associated with CSI connector which is situated between Ethernet and HDMI port while the finger sensor r-305 is connected to TTL level 2 converter which is associated raspberry through USB B port, hence the system is ready to active. Individuals are relied upon to join their biometrics to evaluate the venture.

4.2.2 Implementation of RFID sensor and matrix keypad

Figure: 4.2(a) implementation of raspberry with RFID sensor

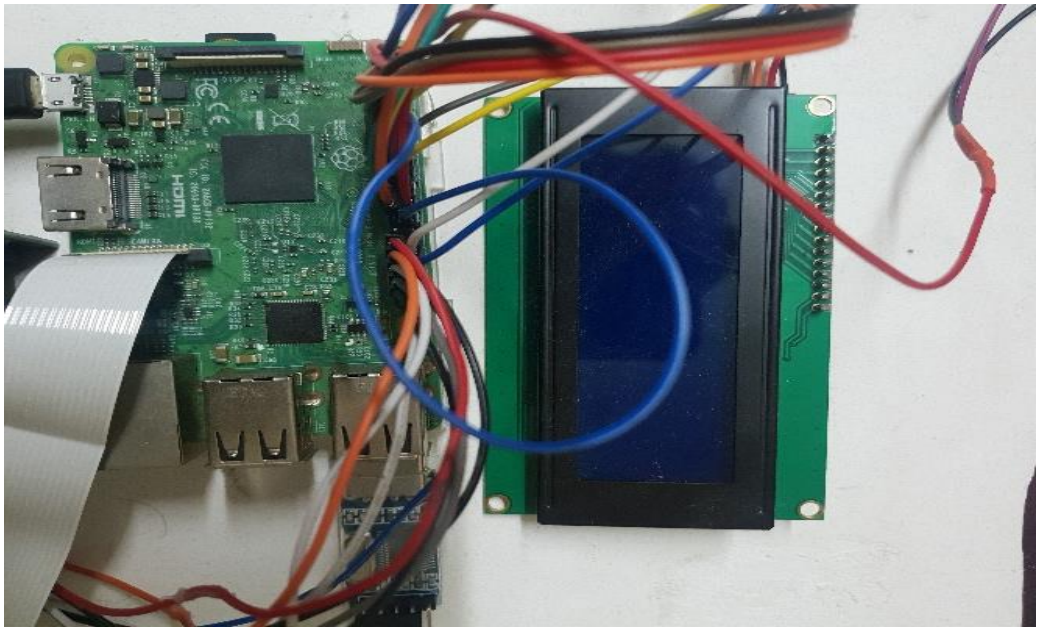


Figure: 4.2(b) implementation of raspberry with led display

With the end goal to quality, the endeavor a 4×4 keypad console is related with the Raspberry Pi through GPIO pin giving another check venture to password coordinating. An RFID sensor was likewise associated through a similar route for checking RFID card. A relay was used to drive the door lock on while all the steps access.

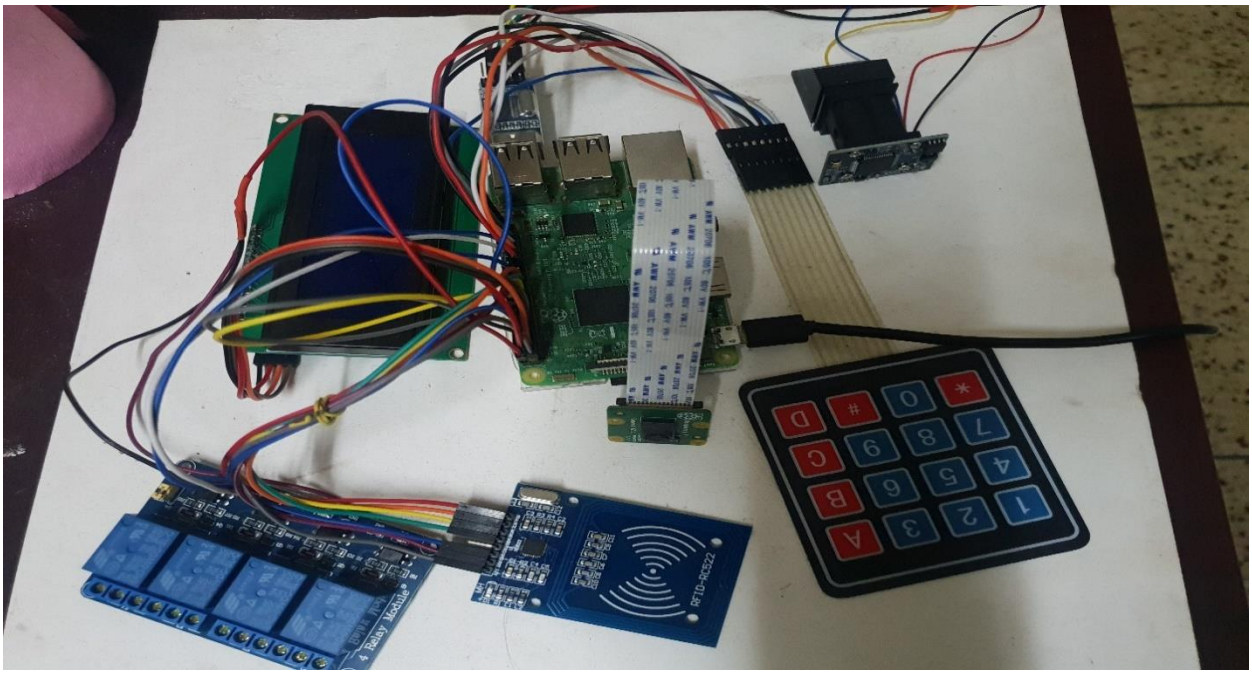


Figure: 4.3 whole implementation of hardware

All the connections are made through male female wires. A 16 Giga byte memory card used as memory register for the raspberry pi, where all the data were accumulated.

4.3. summary

Hardware Implementation was taken enough precaution considering the progress and the value of components. The four stages checked framework driven by Raspberry Pi Alongside the concerned module powered by a low dc volt supply. 12v dc supply powered switch door lock is the observer when the means are confirmed. All the process was done in order to achieve the final goal.

Chapter 5

RESULTS ANALYSIS & CRITICAL DESIGN REVIEW

5.1. Introduction

Every individual dream to have a Safe and cheap security system. A security progression over a highly arcane area at a very low cost and which can it provide a security is appreciable. This project serves to be beneficial to any person/institution who can incur a secure and cheap product. Developments in information technology have made automation very easy in many applications like biometrics. Recent technologies have made the concepts of security very popular. The discourse is all about the block diagram, the investigation of results that reflects as an outcome.

5.2. Circuit design and results analysis

The Section will be examined about circuit structure and result in analysis. Since there is no library accessible for Raspberry Pi as a result of this simulation is undone in this project. Nevertheless, apart from the simulation, the undertaking prevails in Genuine which will be talked about in the examination of the result.

5.2.1. Block Diagram

As the un-accomplishment of simulation, the representations image block diagram helped us to review the design. Raspberry pi functions as a compelling acing doing all the activity with coordinated Arm cortex chip. As appeared in the structure the inserted devices are a camera which caught facial information pursued by unique finger sensor and RFID sensor with initialized the coordinating procedure.

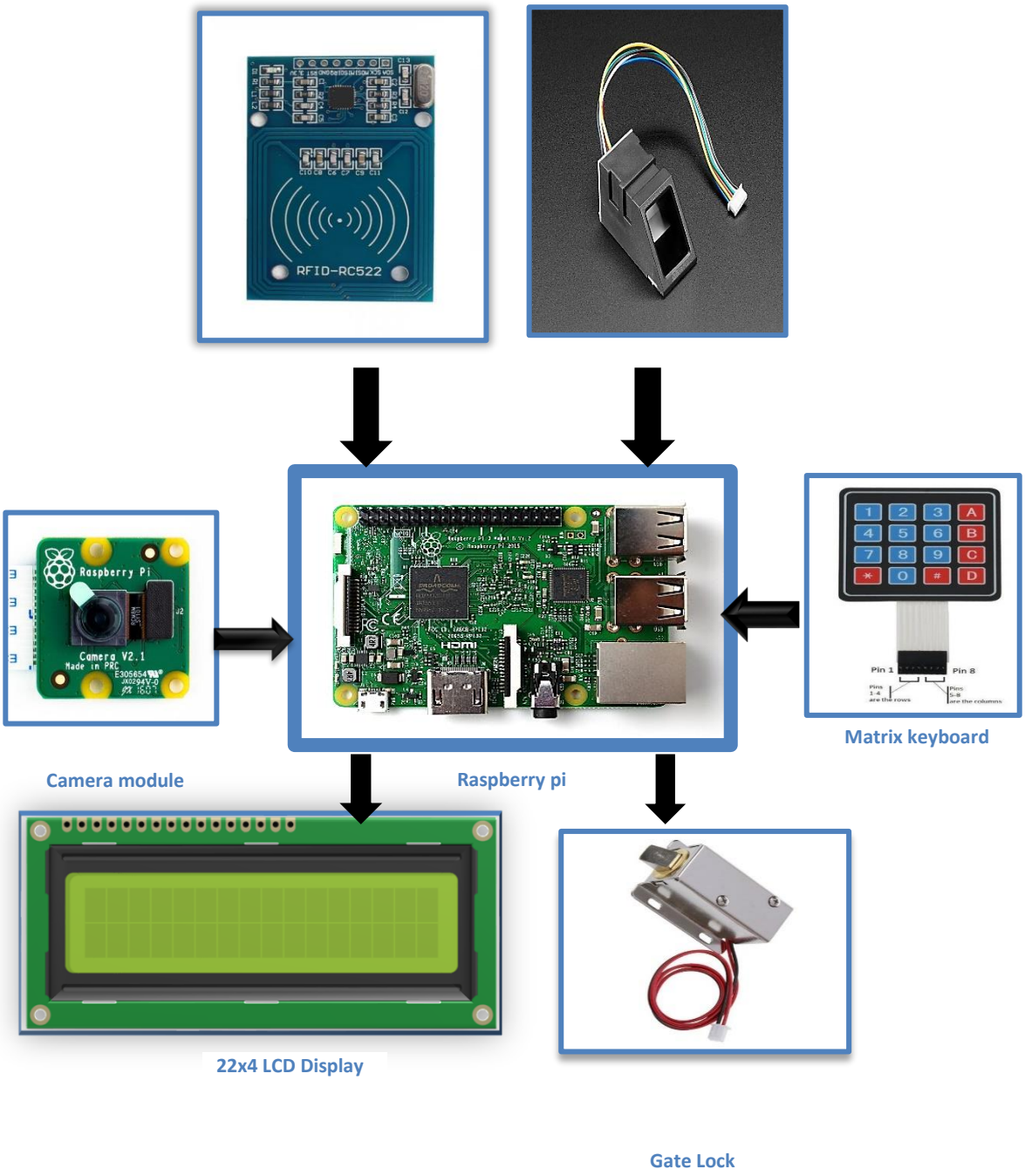


Figure: 5.1 Block Diagram of Whole Security System

5.2.2. Results analysis

Subsequent to finishing all the procedure the task was run. To check the legitimacy and exactness the project was tried on various occasions. Each time the outcomes were resolved to be indistinguishable.

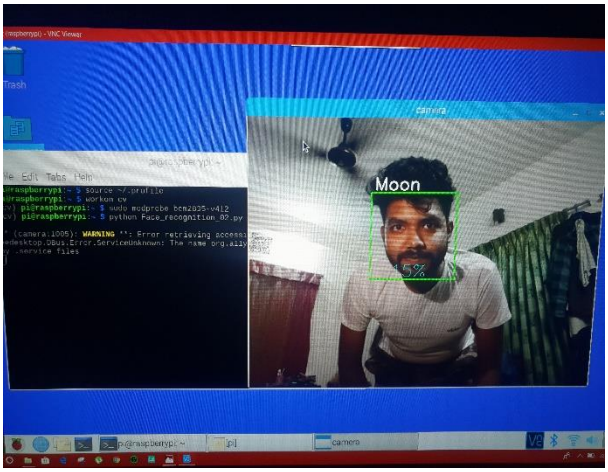


Figure: 5.2(a) Verifying known person

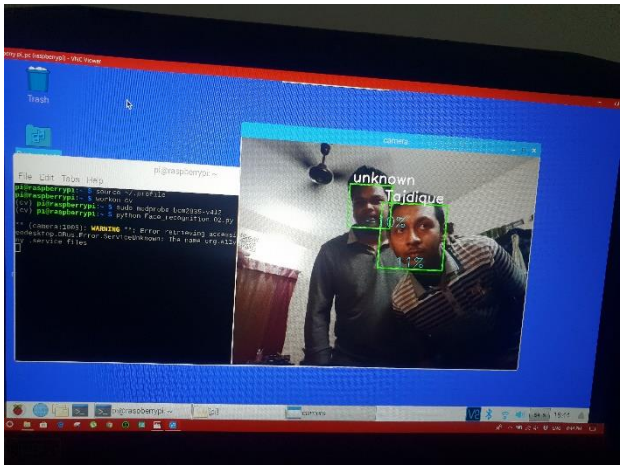


Figure: 5.2(b) Verifying known and unknown person

Afore-cited yields demonstrate the aftereffects image processing via the Open-CV environment. Two different experimented outcomes have given above. Too much or less ambient light in the environment might affect result, otherwise, it gave good precision as long as it had been affirmed to the assignment.

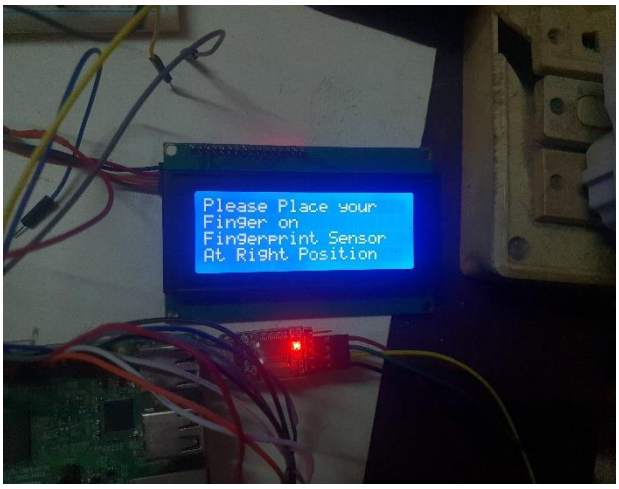


Figure: 5.3(a) Command for fingerprint

Figure: 5.3(b) Waiting for fingerprint

Above pictures demonstrate the impact of finger-check coordinating. At the point when people put his pointer on the sensor that point it's come into the demonstration.

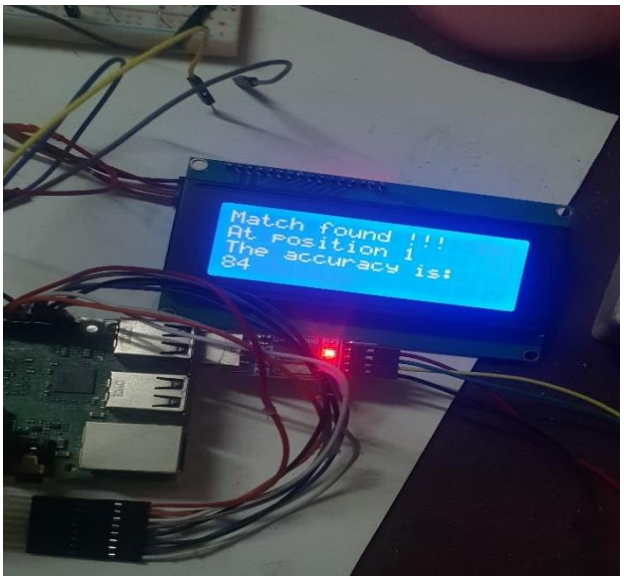


Figure: 5.3(c) Finger print match found

Figure: 5.4(a) Passcode id

While true it demonstrates the result, otherwise, access denied on the display. After verifying the face and fingermark step there will be a command for entering a passcode. In figure 5.4(a) shows the passcode ID.

Figure: 5.4(b) Access granted for passcode matching

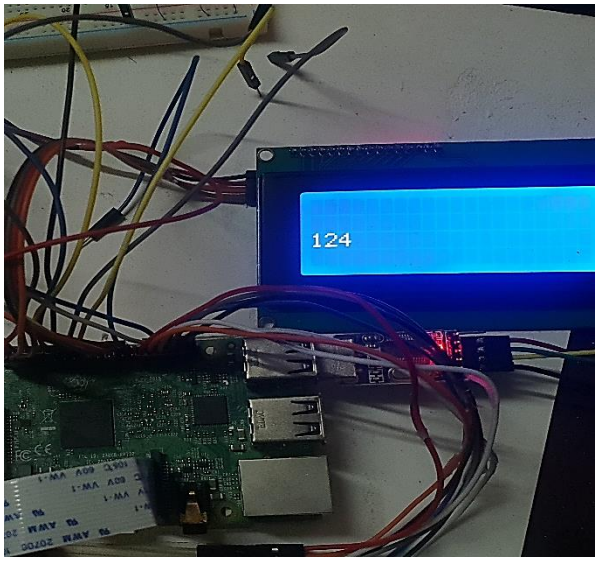


Figure: 5.4(c) Wrong passcode on the display

Figure 5.4(b) demonstrates the outcomes of passcode matching, for verifying the results of the wrong password a random number was pressed on the keypad. The system disqualifies the wrong passcode displaying access denied in the LCD. The output of the wrong passcode illustrated in the figure: 5.4(d).

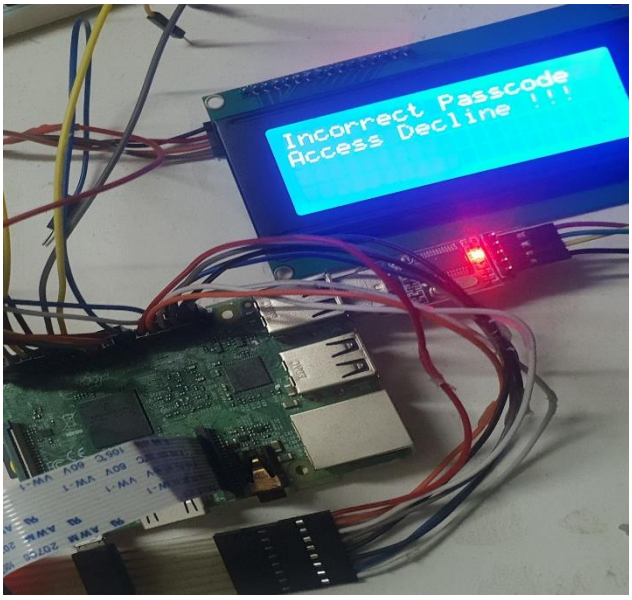


Figure: 5.4(d) Incorrect password for wrong passcode

Figure: 5.5 Command for placing RFID card

When placing your RFID card command displayed on the LCD, individuals punched their card on the sensor, the message shown RFID matched as shown in the figure:5.5. Then the person got access to the door.

5.3. Summary

This framework is utilized with raspberry pi, finger mark sensor, keypad, and RFID sensor with the end goal to get multiple verified steps. The objective of this task is to secure confidential premises or room from any interloper. The outcomes appeared in the above segment comments on the objective that every progression is especially potential to anchor the system. However, it is tough to sidestep every one of the means. As referenced before the absence of simulation tools and library the simulation was undone in this undertaking. This chapter has mainly covered the description of a block diagram of circuit design and the experimented results of real time analysis.

Chapter 6

CONCLUSION

6.1. Summary of Findings

The principal target of our task is to shield the vault from any sort of unusual circumstance. The fundamental part of our task is Raspberry Pi. The framework breaks down all the given data in Raspberry Pi. An open-cv condition is utilized for breaking down the information. Python code is utilized for coding. A camera module is utilized for taking the live pictures and send it to the Raspberry Pi. Keypad for taking the secret key and a unique finger impression sensor for taking the unique mark from the client. An RFID card is utilized for the last advance check. An alert is utilized if any of the data is invalid. Amid the execution, we have confronted distinctive sort of troubles. Right off the bat, the python code was not working appropriately. At that point, we did the code over and over. After that, we could do as our objective was set.

6.2. Project Finance

The appropriate point for each project is that for completing that project, each material is selected for the best fit rectification on very low cost and high market availability.

Table 6.1: Project budget

Equipment	Quantity	Price (TK.)	Total price (TK.)
Raspberry Pi	1	3800	3800
Camera module	1	1600	1600
Finger print scanner	1	1800	1800
4 x 4 number pad	1	20	20
RFID card reader	1	300	300
12V door lock	1	350	350
4- channel relay	1	250	250
20 x 4 LCD display with module	1	390	390
Wire	100	1	100
12V 1100 mAH battery	1	1200	1200
		Total	9810

6.3. The novelty of the work

The main objective of the project is to ensure the security of the vault. The security system can ensure four steps of security. If any person tries to enter the vault that person should have to pass the four-layer security. The authority can observe the situation live. If any unauthorized person tries to enter the vault it will alert to the authority.

In the market different kind of companies are offering only two-step security. RFID and finger print security are offered by those company. We can offer the best security to the vault and also very user friendly and the cost will be less compared to that company's system. We have used the python code which ensures the most security.

6.4. Final Impact of This Project

The main impact of the project is to ensure the best security to the vault where the confidential documents are kept. This system provides different layers of security. If any of the layers fails then another layer will make it quite impossible to enter the vault. Face recognition, password, finger print, and RFID card scanner are used. There is also a scope to watch the live video which is transmitted through the wireless system.

6.4.1. Survey on Environmental Impact

We have conducted a survey on our project through google form. We have asked a different question regarding our project and record their opinions.

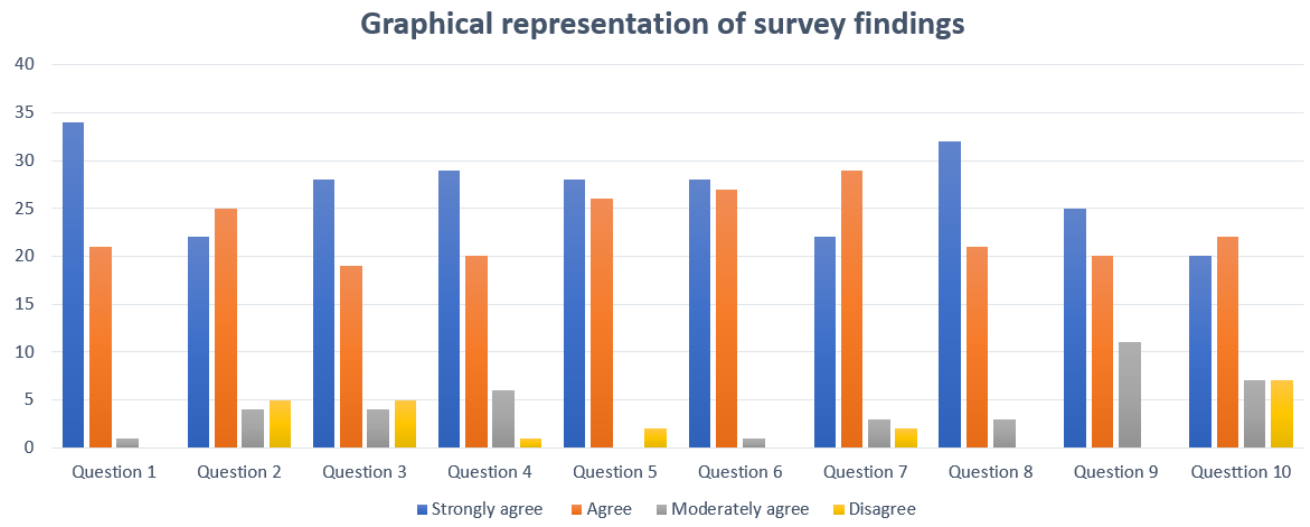


Fig 6.2: Graphical representation of survey findings

We have asked 56 peoples regarding our project. Among 56 people 26 people think such kind of security system can be designed using Raspberry Pi and 20 people think it can be designed by Arduino. One of the advantages of our project is cost effectiveness. We also asked about the preferable cost of such kind of system. 20 people strongly agree and 22 people agree about the approximate costing of the system. We also asked about the reliability of face recognition. 28 people strongly agree and 22 people agree about the reliability of the face recognition. 29 people strongly agree and 20 people agree on the password which can be an extra feature.

6.4.2. Project Sustainability and Future Scopes

Presently multi day's security is a major worry of any association. Each association has various types of secret archives. which the association would prefer not to impart to other association. In a bank vault of a bank cash, records and costly ornaments are kept. In this way, the security is the enormous concern. Our undertaking is appropriate for that vault or room. Where unapproved individual can't get passage. Since there are 4 layers of security. A man needs to pass every one of the security steps. Failure of any layer of the security step, individual won't get entry to the vault. The authority will get additionally notice through live footage if any unauthorized individual attempt to enter the vault and our venture is cost-effective.

6.4.3. Recommendations on Future Developments

We have made some development after the implementation of our project. There are several scopes to develop the project and the security of the system will be increased.

6.4.3.1. 3-D face recognition

A recently rising pattern in facial acknowledgment programming utilizes a 3D show, which professes to give more exactness. Catching a constant 3D picture of a man's facial surface, 3D facial acknowledgment utilizes particular highlights of the face - where inflexible tissue and bone is most clear, for example, the bends of the eye attachment, nose, and button - to distinguish the subject. These zones are on the whole remarkable and don't change over time. If the picture is 3D and the database contains 3D pictures, at that point coordinating will occur with no progressions being made to the picture. In any case, there is a test right now confronting databases that are still in 2D pictures. 3D gives a life, moving variable subject being contrasted with a level, stable picture. The new innovation is tending to this challenge. potential coordinate. In check, a picture is coordinated to just a single picture in the database (1:1). [40]

6.4.3.2. Voice recognition

Voice or speaker acknowledgment is the capacity of a machine or program to get and translate transcription or to comprehend and complete talked directions. Voice acknowledgment has picked up unmistakable quality and use with the ascent of artificial intelligence and clever partners, for example, Amazon's Alexa, Apple's Siri and Microsoft's Cortana. [41]

6.4.3.3. Iris scanner

Iris checking biometrics measure the one of a kind examples in the hued hover of your eye to confirm and validate your character. Contactless, quick and prestigious for its precision, biometric iris acknowledgment can work at long separations, with a few arrangements that use the methodology requiring just a look from a client. [42]

6.5. Limitations of the Work

We know every project have some limitation. There is some limitation of our project.

I. The system can only record the entry time of a person but do not record the exit time.
II. There is no sensing element.

6.6. Ethical concerns

Our task depends on Raspberry Pi. Camera module assumes a critical job of our framework. The camera module is the essential hardware for taking the pictures and send the picture into the framework and break down the picture authorized or unauthorized which is the principal layer of security. The face location is the primary worry of our system. The authority will store the picture of the approved individual in the system. The system will identify the picture utilizing a camera module which makes the framework more reliable and feasible.

6.7. Conclusion

Our main focus was to establish such a security system that can protect the vault from any heist situation. At first, we were concentrated on face detection. For detecting the face, we were created an open-cv environment in Raspberry Pi by using Python language. After finishing the face detection, we were implemented the password and fingerprint which was actually done by creating another open-cv

environment. After finishing our main task, we were thought two steps further and decided to implement RFID card reading. After implementing the RFID card, we were experimented our system on the different palace and checked our system working properly or not. Our security system makes different from another system for four-steps security. Which have to pass individually. Security was our main concern. So, our system can give maximum possible security for any kind of vault.

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Appendix A

Survey Questionnaire

1. Finger print adds an extra layer in security system

- Strongly agree
- Agree
- Moderately agree
- Disagree

2. Face recognition is a reliable, strong and secured method

- Strongly agree
- Agree
- Moderately agree
- Disagree

3. Face recognition is preferred for highly secured zone

- Strongly agree
- Agree
- Moderately agree
- Disagree

4. Pin or password system must be used along with other advanced security systems

- Strongly agree
- Agree
- Moderately agree
- Disagree

5. Extra power supply can be used as a backup in case of power failure or interruption

- Strongly agree
- Agree
- Moderately agree
- Disagree

6. Wireless communication would be a prominent feature for the system

- Strongly agree
- Agree
- Moderately agree
- Disagree

7. Ethernet cable can help faster data transmission compared to wifi or Bluetooth

- Strongly agree
- Agree
- Moderately agree
- Disagree

8. There is a high possibility that the communication developed using ethernet cable can be disturbed or interrupted by unauthorized person

- Strongly agree
- Agree
- Moderately agree
- Disagree

9. Emergency button can be an additional feature

- Strongly agree
- Agree
- Moderately agree
- Disagree

10. Alarm system can be used to alert the authority and guard

- Strongly agree
- Agree
- Moderately agree
- Disagree

11. Warning the unauthorized person by voice command can be an extra feature

- Strongly agree

- Agree
- Moderately agree
- Disagree

12. Night vision camera can be used to monitor the secured zone even in darkness

- Strongly agree
- Agree
- Moderately agree
- Disagree

13. Stored video footage can help the authority to investigate in case of any sort of unwanted situations

- Strongly agree
- Agree
- Moderately agree
- Disagree

14. Automatic power on-off electronic devices like light or camera module by sensing human can decrease power consumption

- Strongly agree
- Agree
- Moderately agree
- Disagree

15. Security system can be designed by using

- Rasberry pi
- Arduino
- MATLAB

16. Less than Tk. 15,000 will be preferable for the security system

- Strongly agree
- Agree
- Moderately agree
- Disagree

Appendix B

Datasheet of the ICs used

- **Datasheet of Raspberry Pi model 3B**

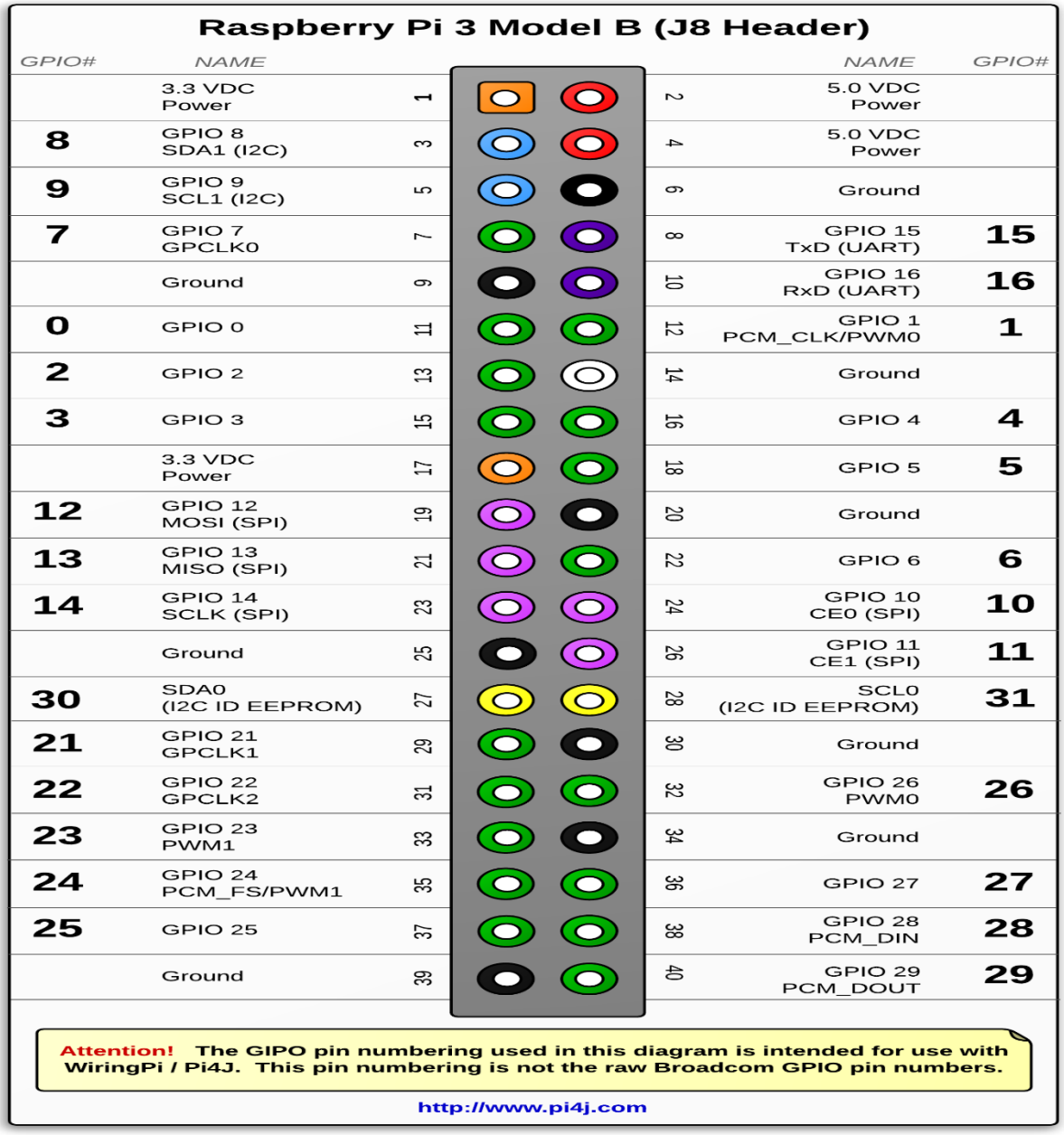

Figure: Pin Layout of Raspberry Pi Model 3 B

Datasheet of 4-Channel Relay

- Relay Maximum output: DC 30V/10A, AC 250V/10A
- 4 Channel Relay Module with Opto-coupler. LOW Level Trigger expansion board, which is compatible with Arduino control board.
- Standard interface that can be controlled directly by microcontroller (8051, AVR, *PIC, DSP, ARM, ARM, MSP430, TTL logic).
- Relay of high-quality low noise relays SPDT. A common terminal, a normally open, one normally closed terminal.
- Opto-Coupler isolation, for high voltage safety and prevent ground loop with microcontroller.

Datasheet of R305 Finger print sensor

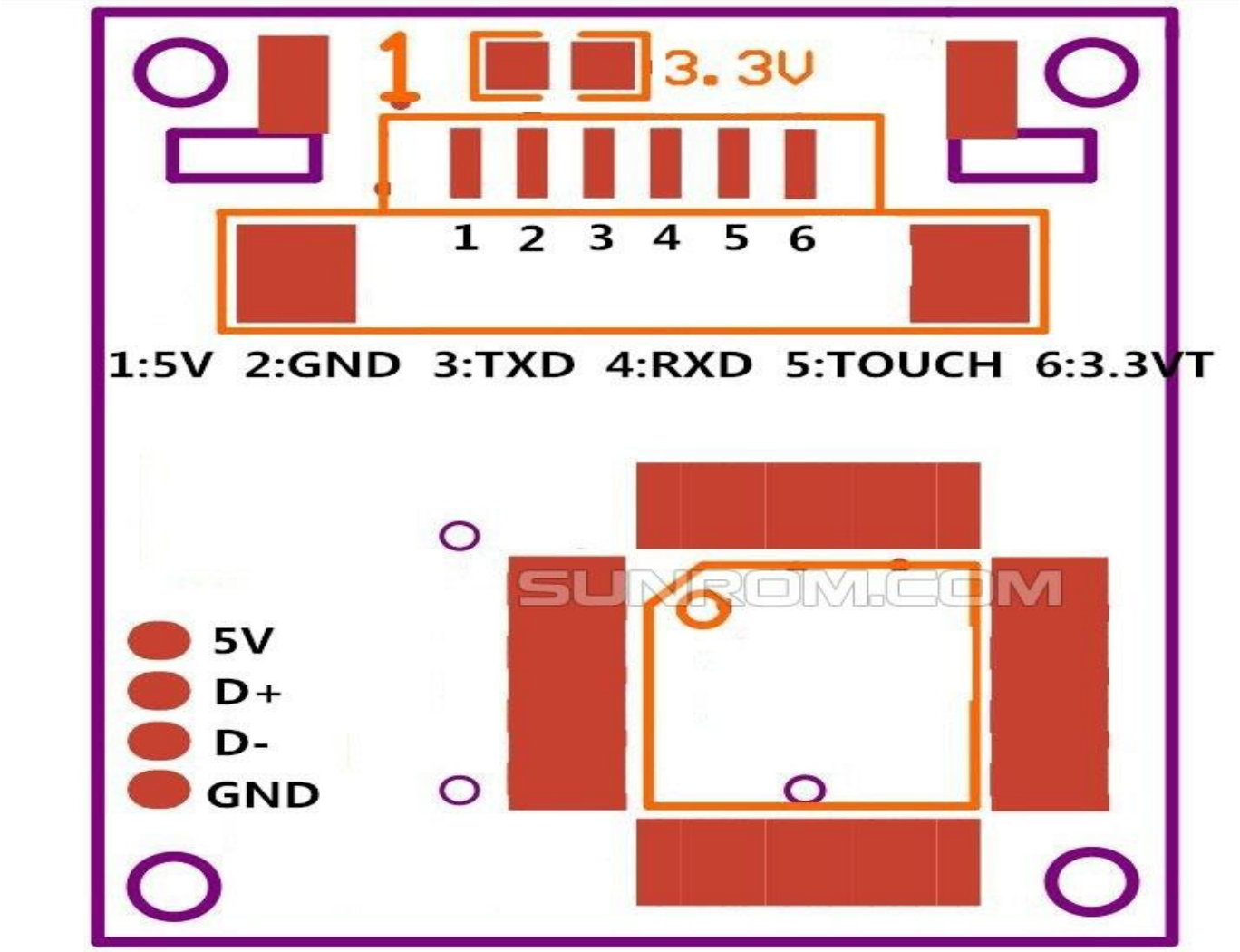

Figure: Pin layout of R305 finger print sensor

Pin configuration of R305 finger print sensor

Pin#	Pin Name	Details
1	5V	Regulated 5V DC
2	GND	Common Ground
3	TXD	Data output - Connect to MCU RX
4	RXD	Data Input - Connect to MCU TX
5	TOUCH	Active Low output when there is touch on sensor by finger
6	3.3V	Use this wire to give 3.3V to sensor instead of 5V