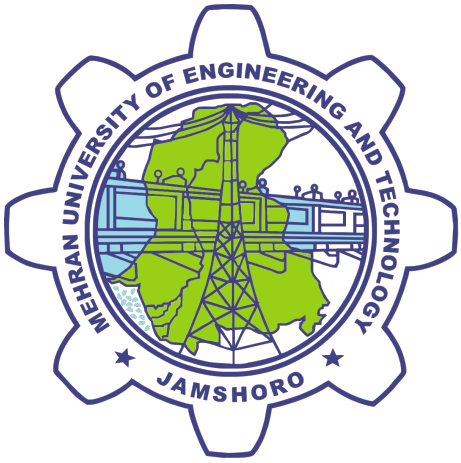
SMART SURVEILLANCE SYSTEM



A thesis submitted by

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Submitted in the partial fulfillment of the need for the degree of Bachelor of Engineering in Computer System

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CERTIFICATE

The following students have submitted thesis, entitled, "**Smart Surveillance System**" under the directions of the *Dr Moazzam Jawaid* (supervisor) and approved by all the members of the thesis committee, has been presented to and accepted by the Chairman, Department of Computer System Engineering, in partial fulfillment of the need for the degree of Bachelor of Engineering in Computer System.

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Last but not least we would like to thank our parents for their constant support in our studies which allowed us to be at this level today.

ABSTRACT

Human face detection in any criminal activity has been a difficult task in the field of image-processing and pattern recognition. But Security and verification is an vital part of any organization. Hence, our proposed system is of a surveillance security camera with help of Raspberry-Pi and IOT. So The (Closed-circuit television)CCTV is used for surveillance and security methods. In Real-time/Live, Human face recognition can be acted in two phases such as,Face recognition and Face detection. This system carries out Haar- Cascade calculation/algorithm , to recognize human countenances from given Data-Base, which is coordinated in Open-CV by Python programming. Haar contain based course classifier frame-work uses just 200 features out of 6000 elements/features to generate/produce an acknowledgment rate of 85-95 percent.So This framework will screen through Twilio application when movement recognized and checks/compared for the appearances in the captured picture with the recognition of face acknowledgment, alerts by message in the event that the face identified isn't stored in the database.If soo, the Solenoid lock which is associated with Raspberry Pi camera will be opened. With the assistance of Open-CV, test results on images of individuals/alone under several impediments and illumination and few level of revolutions and directions, in both preparing and test set reveals that the proposed calculation is successful and accomplishes cutting edge execution.

Besides, Internet of things (IOT) based application can be deployed distantly to watch the action and get notices/alert when motion is distinguished ,Therefore, benefits to make this application ideal for checking homes in abscenes.

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CHAPTER 1

INTRODUCTION

1.1 OVER VIEW

The word Survelliance is the combination of two words first is “sur” that means ”from above” and second is ”veiller” that means ”to watch. Surveillance is one of the vital aspects in various areas such as military fields ,banking sectors, and personal security etc. Due to sudden rise in robbery and theft illegal activities/actions, surveillance systems are proved to be a best source of security. Because of truly expanding innovation, individuals/people are depending on advanced edge innovations for their security issues. Security frameworks, for example, CCTV have shown to be enormously well known for security purposes because of their expense proficient nature and simple support. Observation is exceptionally useful for law implementation to investigate/prevent crimes, for perceiving and checking dangers. Additionally, security frameworks have consistently been assuming an indispensable part in managing the theft cases. These CCTV frameworks will in general monitors exercises constantly.

This outcomes in high force utilization and memory wastage. In addition, it doesn’t give alert/notice on any dubious exercises detected.There are frameworks accessible other than CCTV like IR lasers, RFID, Retina and unique mark scanner frameworks as it were with the downside that they are cost wasteful with high execution and support costs. Consequently, such frameworks are not a favored way for security purposes for limited

scope applications. Proposed framework covers this load of downsides .

by its productivity, compactness. This observation framework is minimal cost/expense and convenient to understand as well.

By using CCTV concept we create a project that is SSS. This SSS basically works a security purpose in our home by stopping the entrance of intruder or unknown person This SSS is mainly connected with Solenoid lock at home main door ,which is a based for automatically locked and unlock door system. This SSsystem is consist of both software and it's technology,The hardware needs are raspberry-pi 4, with raspberry pi camera,power cable(HDMI,USB-C),Micro-SD card, keyboard and mouse, solenoid lock and relay . The software need Raspbian-OS for raspberry pi and Python programming language, Open-CV, Raspberry-PI imager, SD-Card bootable. Raspberry-Pi camera and memory card is being connected to the raspberry pi camera. In the SD card, the Raspbian Operating-System(OS) is boot. the Raspberry-pi module perform function only on the Raspbian-OS and Linux. Raspbian is a free operating system(OS) based on Debian optimized for the Raspberry-Pi hardware. An operating-system(OS) is the set of basic instructions and utilities that ready your Raspberry Pi for running and yields GUI. However, Raspbian yields more than a pure OS, it contains more than 35K packages; bundled of built-in software in a efficient format/way for convenient installation on your Raspberry-Pi. For interaction Putty configuration , VNC viewer and other software's are required to install Raspbian-OS. Putty configuration is SSH and Telnet client. and this is open-source .

Plug the bootable SD Card into the Pi along with also the keyboard and mouse via USB port into the Pi, then connect LCD screen (TV) with HDMI into Pi. U can also Plug additionally into the Pi i.e. (USB Wi-Fi, hard-drive and Ethernet cable etc.). This is where you must need a USB Hub. For Screen, Plug the power source into the main socket , and in last plug the USB-C for the power source to Pi.

After Such connection The Pi will be boot up and show messages on the display screen. As this system implement in house , the person can monitor the home activities remotely from anywhere. If a unknown person comes at gate our built-in surveillance system can

detect its face and check from our imported/created database if visitor's face is in the database then simply door will unlock if not then the alert message will generate on the mobile phone where this live surveillance system is being running. So that we can easily maintain our security system remotely.

1.2 PROBLEM STATEMENT

This rapidly evolving in Artificial intelligence, Many researchers and developers have contribute, to develop different algorithms and techniques to detect the humans. So to detect a human in real time is a very crucial task now in this modern world. Because from long time, there are many issues and problems are rapidly increased. Few problems are discussed in this section are:

- To identify the thief/robber and illegal act in any areas such as public, private sectors, bank, police station and houses etc.
- to Recognize the unknown person for their act, purpose.
- Recently there are many incidents occurs some of these are robbery , snatching child abduction ,target killing which is one of the most spreading crime in our country .to recognize the involved or criminal person is very hectic activity or very main problem. and their action we can resolve this issue.

Now a days there are large number of illegal activities cases are rapidly increased .our problem is that how to detect the illegal and unauthorized or intruder. The CCTV cameras are able to detect all those person and capable to saving the whole scenario in the form of live streaming but the processing time is much higher and unable to detect the particular part such as only focused on faces of persons. Hence the detection not accurately correct or possible by just using built-in CCTV. This project is developed to enhance the face recognition system by using Haar-Cascade classifier to attain higher accuracy rate. Haar-Cascade classifier is used for face detection since it can identify the image at the qualified fast, the algorithms and techniques have been used for the

identification which reached high recognition accuracy rate.'

1.3 AIMS AND OBJECTIVES

This Face recognition is a basically bio-metric software application, developed to recognize individuals with tracking and detecting. This techniques/idea can be implemented practically in several number of peoples/crowded place like airports,Bus stops, railway-stations, education side and malls for security. The real motive of our project/system is

- To identify the person, Surveillance camera with face recognition system which has been provided.
- recognize the faces of visitors.
- to enhance the recognition rate.
- This recognition system has the ability to understand the danger/problems and ultimately stop any upcoming illegal activity from happening.

There are enormous apps system for this Face recognition in rest of world. It has also be find in applications like Facebook(FB), Instagram and in several social media platforms. It will also suggest/provide the user to tag that person which has been detected in images. But if we watch out the criminal activities ,the main problem occurs is that initially the culprit faces can't be found for any suspicious activity that can be murder, robbery , snatching etc. Although, the case-related department or the investigator found the criminal faces , even then ,the main problem occurs is they can't find the culprit very easily . means in this growing population how they manually detecting the criminal face. So for that our aim is that we created a project

- for home/house robbery safety , which BASICALLY work as

The custom made surveillance camera will be implement at the enter/exit door. So, as new comer / visitor came close to door to enter in the house he/she must go through the camera .The next step is, our custom made surveillance camera which will be working

as live video feeding ,will detect automatically visitor face and in back-end and will match face with our created database, if so he/ she belongs to our known list/our close person's list then simply door will unlock and if not then a alert message will generate at house owner's mobile or that person's mobile whom we assign the number of that suspicious man/woman/intruder. So that is our aim and object to at-least secure our houses from entering unknown person in home either intruder, thief or a guest.

1.4 SCOPE OF PROJECT

This project's scope is widely be used in any face detection activities. But we add Door lock system via face detection then it can be used in any houses/ small organizations, where we need to identify new comers/ intruders manually. Secondly scope of our project, is to design and develop a face detection in real time based on Haar-Cascade classifier which gives a better accuracy . It can efficiently reduce or increase the class variability and improved the confidence level of prediction . That model can easily able to detect faces of authorized and unauthorized/unknown persons accurately. Haar cascade classifier make the classification easier. The further scope is to extract human faces. It will extract the desire image from the stored/created datasets. so that it will easily identify the faces and able to fetch information of particular person from database. Another scope of our project is , not to monitor whole time to CCTV for intruder , we can watch live streaming but although we are not watching live streaming or for from live streaming, than our project will alert u via sms for the known or unknown visitor at home. In this way we will able to detect any visitor entry in real time.

1.5 THESIS LAYOUT

Our thesis is spilted into Five-Chapters, each of which has a separate purpose until the analysis is completed. Chapter 1 is the project's overview. It explained the explanations for the study and the declaration of issues. It also defined the nature, goals and objectives of the study. Chapter 2 offers a description of the explanatory literature which examines,

describes and summarises research work specific to the experiments. Chapter 3 describes the project methodology. Chapter 4 shows the results and discusses the project implementation. In Last, conclusions and future improvements has been done in Chapter 5 .

CHAPTER 2

LITERATURE REVIEW

In this chapter , we will discuss about the previous work done, related to our project. Those some Previous work, applications and techniques are defined below;

2.1 REAL-TIME SMART SURVEILLANCE SYSTEM USING RASPBERRY-PI

This article [1] suggests that the Personal surveillance and safety system is an indispensable point in the field of examination and PC Vision. The CCTV is utilized for security and observation reason. The wrongdoing recognition is conceivable with observation yet on the off chance that the face acknowledgment is coordinated with reconnaissance the presentation of existing observation and security framework can be improved. The brilliant observation framework utilizing face acknowledgment can be utilized for a verity of use, for example, participation framework for understudies and workers at private and government workplaces, research-labs, ATM and so on In this designed paper, one application hostel attendance system of smart surveillance is demonstrate.

In this time, to maintain attendance is very complicated and vital task . Every firm/organization has it's own attendance-System in hard form like paper, pen and register-based attendance.Some have Bio-metric attendance System like Radio Frequency Identification (RFID), finger-Print scanner system. These ways are time-consuming and require stu-

dents to stand in a waiting queue/line. Every system has yet to follow two processes i.e. enrollment and verification. The enrollment is a single time process in which unique features of a student/person are stored in the data-base. During process of verification, the input features are to be compared with stored data/features in the data-base. These features can be palm,eye,iris, gait, palm,face or fingerprint.

In RFID based participation System , It needs clients to convey RFID-Tags. There working will be start by examining the RFID-tag and the client needs to put cards on a per user to mark them present. There is an issue additionally, it might raise the issue of misrepresentation on the grounds that an obscure/unapproved individuals can accompany approved RFID and imprint participation. It is still, extremely tedious.
Refer to the Fig. 2.1.

Figure 2.1: Hardware Setup

2.2 SMART SURVEILLANCE SYSTEM USING RASPBERRY-PI AND FACE RECOGNITION

This research-paper [2] tells about the Smart-Survellance Sytem using Raspberry-Pi and Image Processing. This designed system will work as smart security module for

monitoring. Current surveillance-systems solely stored the activities/working based on motion, but this proposed system present the purpose of face recognition so as to decrease the errors, detected due to motion detection . this Pi-camera module will used to capture pictures as the motion is felt by the PIR Sensor. in the last this developed system will monitor, if any motion detected and search for the faces captured in the frame with the help of face recognition notice, if that detected face is not been stored in our created data-base.

This framework will fit in as shrewd security module for checking. Conventional observation frameworks exclusively put away the exercises based on movement, yet this proposed framework completes the requirements of face acknowledgment to decrease/reduce the mistake caused b/c of movement identification . this Pi-camera module will used to catch images as the movement is recognized by the PIR Sensor. in the last This created framework will screen, when any movement recognized and searches for the appearances in the frame/pics caught and with the assistance of face acknowledgment alarms, if that recognized/detected face is not stored in created data-base. Designed system basically wrapped all these flaws by its efficiency and portability. This surveillance-system is user friendly and very low-cost too.

Block Diagram is in Fig. 2.2.

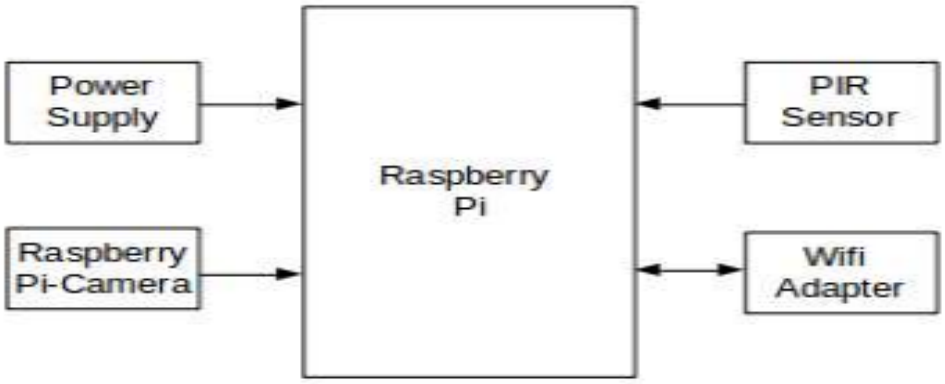


Figure 2.2: PIR sensor Block-Diagram

2.3 USING HAAR-CASCADE CLASSIFIER FOR FACE RECOGNITION OF CRIMINAL IDENTIFICATION

In the year 2020 ,the author Subranmanium [3] suggests that ,Security and Authentication is a basic piece of any firm. In Real/live time, Human face acknowledgment can be acted in two phases, for example, Face detection and Face recognition. This paper carries out "Haar-Cascade algorithm" to distinguish human faces which is coordinated in Open CV by Python programming and "Local-binary-pattern(LBP) algorithm" to perceive faces. Grouping with other existing calculations.

This classifier creates a high acknowledgment rate even with different expressions, efficient feature choice and low combination of false positive elements. Haar feature based cascade classifier framework uses just 200 components out of 6000 elements to yield an acknowledgment pace of 85-95 percent.

Proposed Block Diagram ,is : in Fig. 2.3.

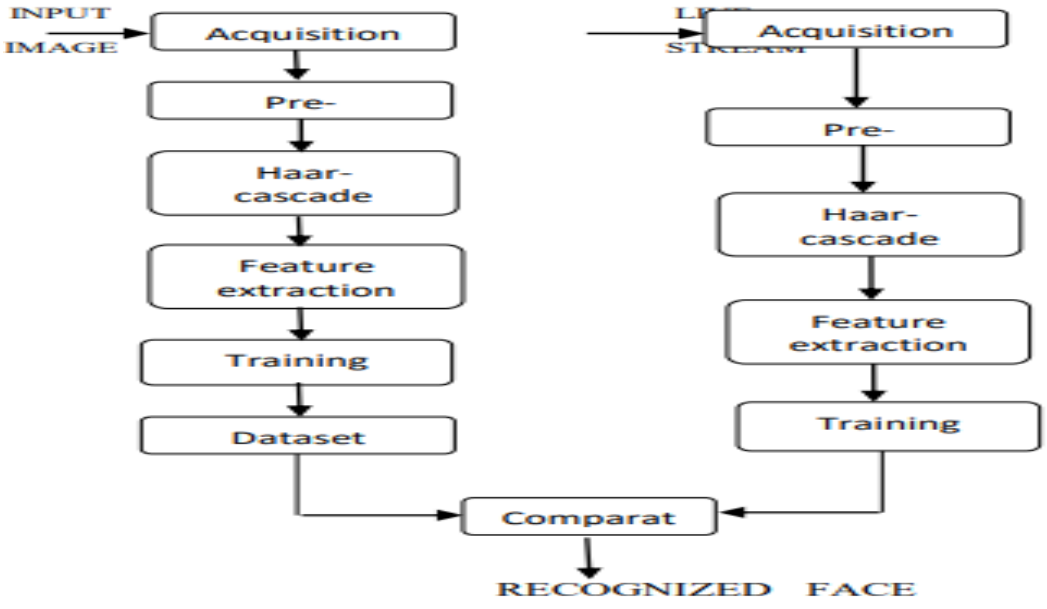


Figure 2.3: Proposed Block Diagram

2.4 SMART SURVEILLANCE MONITORING SYSTEM USING RASPBERRY PI AND PIR-SENSOR

This research papers [4] tells us that ,The security is a situation wherein stuffs, individual things are given specific identifiers and the capacity to move information over an organization without helping human-to-human or human-to-PC cooperation. The webcam has advanced from the intermingling of remote innovations and the Internet. The security system is the correspondence of anything with another thing, the correspondence basically moving of use able info, for instance, a sensor in a space to screen and maintain the temperature. To depict a security ready structure using low taking care of force chips using Internet of things(IOT) which helps with checking and get alarms when development is recognized and sends photos likewise, accounts to a cloud server. Furthermore, Internet of things(IOT) based application can be used remotely to see the development and get sees when development is recognized. The images and accounts are sent clearly to a cloud-server when the cloud isn't open then the data is taken care of locally on the Raspberry-Pi and sent when the association resumes. Thu-sly, benefits to make these application is ideal for noticing homes in nonappearances.

Proposed Block Diagram is in Fig. 2.4.

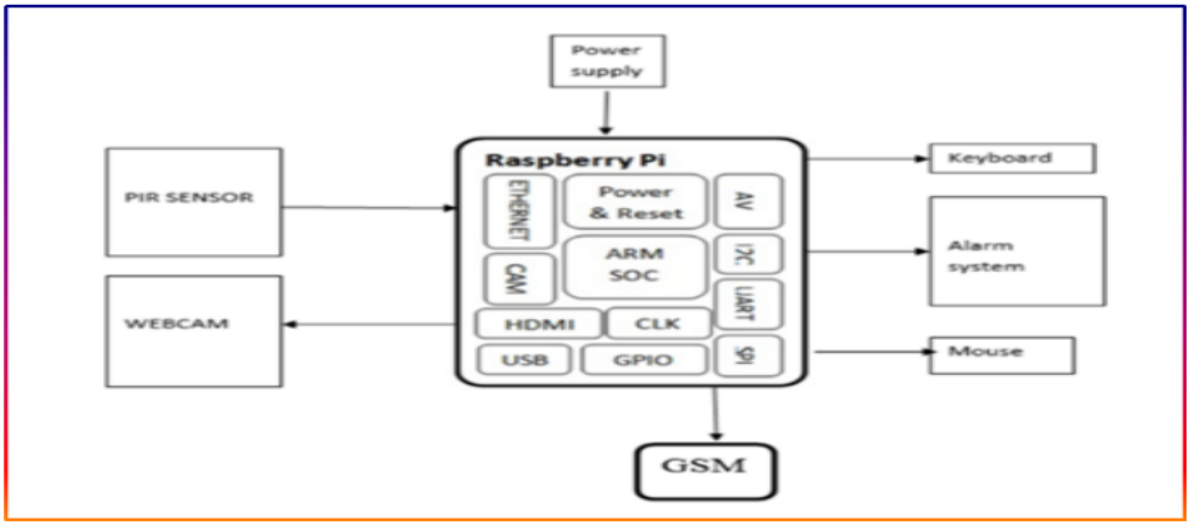


Figure 2.4: Proposed Block Diagram

2.5 SURVEILLANCE CAMERA USING IOT AND RASPBERRY-PI

Mr.Bandi Narasimha Rao and their colleagues proposed a system [5] in which they express that Security stays as one of the most significant parts of keen urban areas. As of now, due to the expanded populace and urbanization there is an enormous interest for savvy security framework. Yet, existing CCTV and IP cameras are wasteful interms of picture quality and these frameworks need enormous measure of extra room. Thus, this paper proposed a reconnaissance camera by utilizing Raspberry-Pi and IoT. It will utilize raspicam-camera for catching the pictures. The proposed reconnaissance framework requires less extra room as it records the video and catches the pictures just when the movement is recognized in the checked region. Movement discovery should be possible by utilizing PIR sensor. The execution of the proposed reconnaissance camera is straightforward, where the caught information is encoded at the transmitter side and unscrambled at the recipient side. Thus, the proposed framework gives a got information transmission. The live taking care of is conveyed by utilizing Raspicam Far off App. The proposed model can be handily arranged, where it permits us to test the picture channels of the camera. Subsequently, the proposed reconnaissance camera utilizing raspberry pi and IoT Prototype of Surveillance camera is in Fig. 2.5.

Figure 2.5: Proposed Block Diagram

CHAPTER 3

DESIGN AND METHODOLOGY

3.1 SYSTEM DESIGN

3.1.1 Hardware Description

3.1.1.1 Raspberry-Pi 4

is IT is a mini computer,contains Storage , I/O ports, Ethernet port along with some others functionalities through which , it helps to make custom hardware,like GPIO , PI-camera etc. This is created on June 2019 and is normally used in Robotics, IoT and Embedded Projects... It is very updated and has a high qualities from previous modules in terms of speed ,efficiency and performance. This hardware is such a small or average in size, robust, and can be best to fit into difficult-to-reach areas. Also contains GPIO pins and can be employed for many crucial computer operations i.e. surfing the portal, writing instructions and document and many more.

Raspberry Pi 4 features, Gigabit Ethernet, along with Bluetooth and on-board wireless networking. Also has a fast and efficient 1.5GHz quad-core processor, considered as brain of this module. So it has every features required to process I/O and store information. Also have Two mini HDMI ports on it's board , see in fig 3.1. These ports are used for transmitting audio and video signal in other modules/devices. It also come with three USB ports, out of which, one is a USB-C port used for it's own power . rest are USB 2.0 and 3.0 ports. U can also connect peripheral devices, like webcams, and keyboards for additional functionalities in these USB ports.

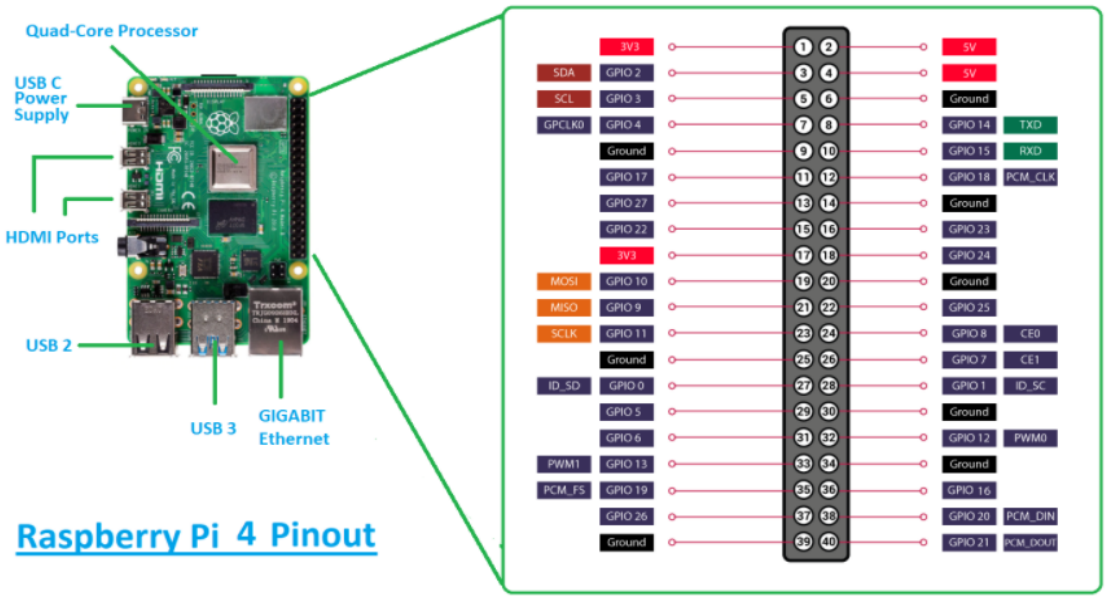


Figure 3.1: Raspberry-Pi 4 PinOut

3.1.1.2 Raspberry pI Camera

The Pi camera Module is official product from the Raspberry-Pi Foundation/firm. Initially 5-MP model was released in year 2013. It has visible light and infrared versions. Basically it is used to made custom based surveillance camera, not like other built-in surveillance camera ,it has just live streaming ability but along this we can apply different algorithms , Computer Vision to play with images and videos. WE make our surveillance security more better with this raspberry-pi camera module.

Connection of Camera with Raspberry Pi !!! The flex cable portion inserts into the port/connector, labelled as "CAMERA" on the Raspberry-Pi, which is located between the HDMI and ethernet ports . The cable must be inserted with the silver jack facing the HDMI port. To open it, pull the tabs on the top of the port upward side, after that towards the Ethernet-port.BE careful while inserting this flex cable because it is very sensitive ,also make sure, it may not bend at an acute angle. This module's hardware is 3.2

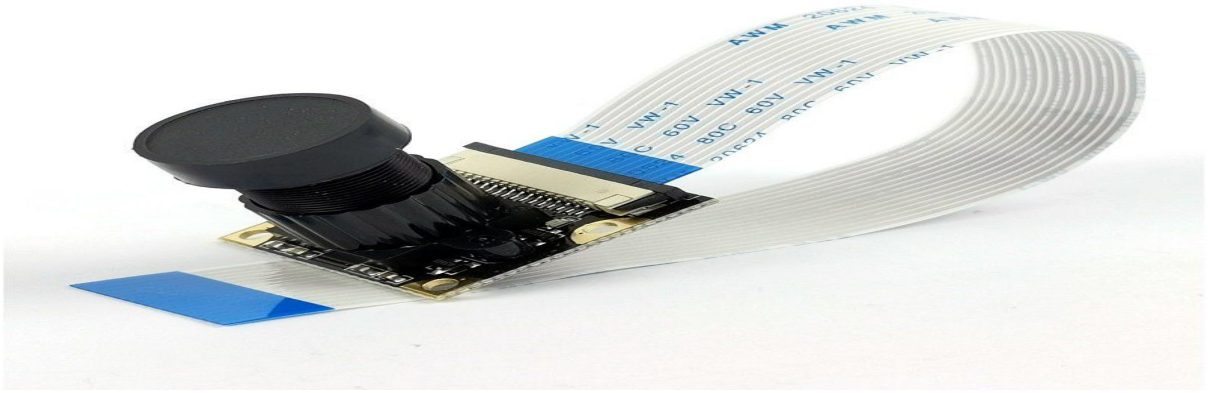


Figure 3.2: Raspberry Pi Camera

3.1.1.3 Solenoid Lock

12V Solenoid lock has a slug with a skewed cut and a decent mounting portion. It is an essentially electronic lock, used for a safe or entryway/door. The point when 9-12 VDC is applied, the slug pulls in so it doesn't stand out and the door can be unlocked. It doesn't utilize any force in this state. It is exceptionally simple to introduce for programmed entryway lock frameworks like electric entryway lock with the mounting board. This solenoid specifically is quite amazing , see in 3.3.

Figure 3.3: Solenoid Lock

3.1.1.4 Relay

This module is an electrical switch operated by an electromagnet.By a separate low-power signal from a micro controller , this electromagnet is activated . Time of activation, the electromagnet pulls to either open or close an electrical circuit.

When electrical current is go through a coil, it yields a magnetic field that in turn enables the armature. This momentum of the movable contacts enable/disable the connection with the fixed contact.

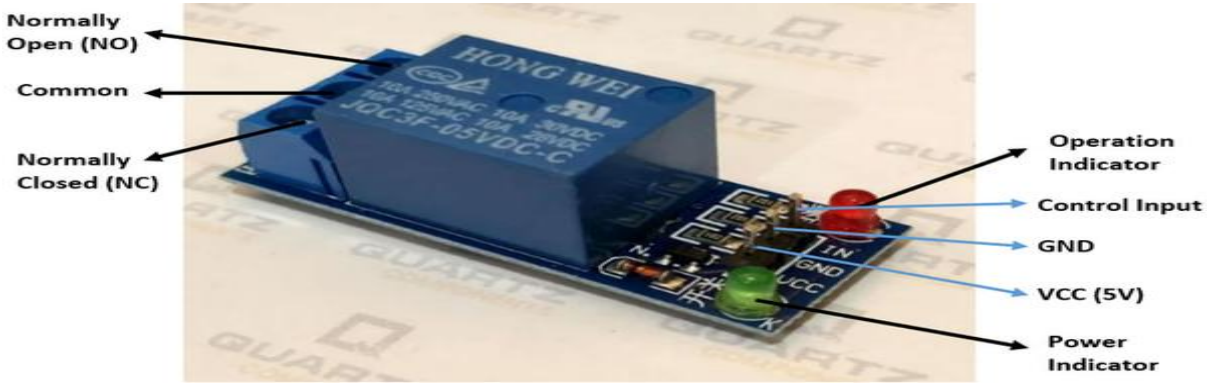


Figure 3.4: Power Relay module

3.1.1.5 Display Monitor

touchscreen Monitor for Raspberry Pi enables clients to make across the board, incorporated activities like tablets, infotainment frameworks and embedded projects.

For Custom based project via raspberry , Display screen must be used . It is interaction between raspberry Pi and Developer. We can easily embedded via coding by using display into any hardware, like as raspberry pi camera etc.

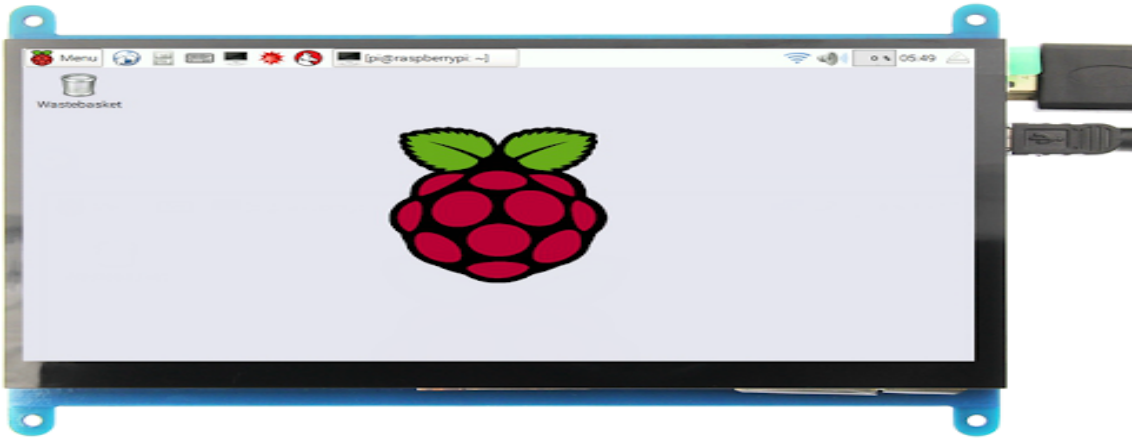


Figure 3.5: 7-Inch Screen Display

3.1.2 Software Description

3.1.2.1 Raspbian Pi OS

This Operating System(OS) is designed by Raspberry PI foundation . Used in Raspberry PI . It provides GUI so that any custom based coding can be implemented. Initially it must be boot into SD-Card or USB after that , the SD-Card or USB will be inserted into Raspberry PI. Then It Provides Graphical User Interface.

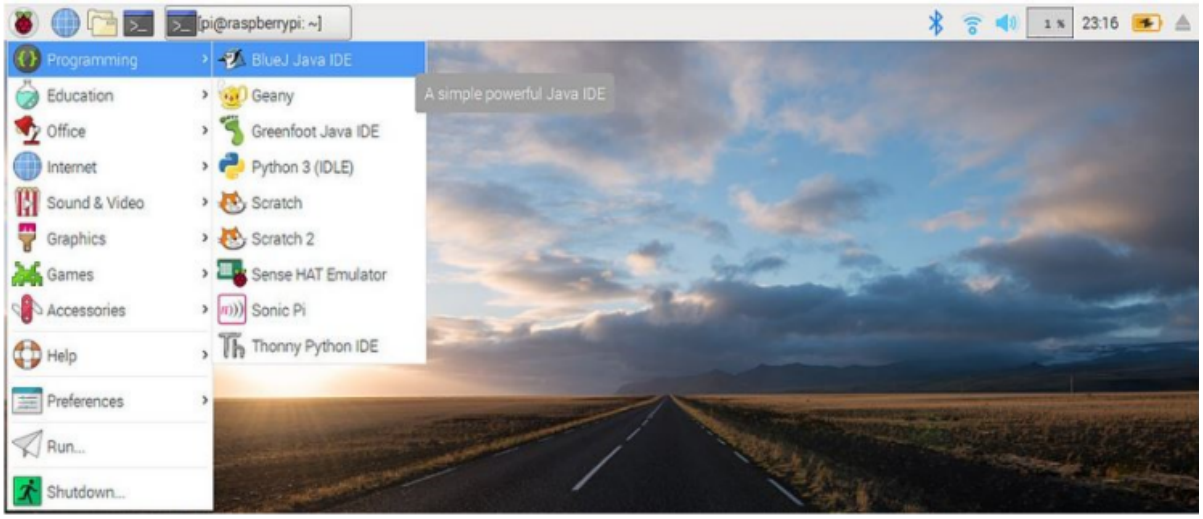


Figure 3.6: Raspbian OS

3.1.2.2 Python Language

Python is a famous ,high Level and Object Oriented programming language. It was Developed by Guido van Rossum, and released it in 1991.

Can Be used For:

- Web-Development (Server Side),
- Desktop Application,
- Statistics/Mathematics,
- System-scripting.
- Data- Science
- AI

Functions Python can do?

- It is used on a server to create web-applications.
- It is used to create workflows.
- It is used to manage big-data and solve difficult Statistics/Mathematics.

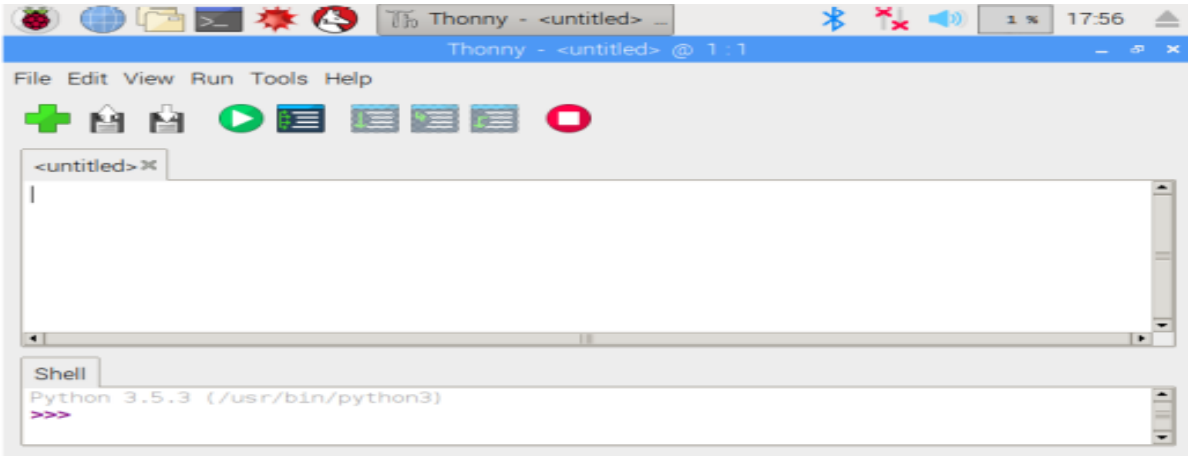


Figure 3.7: Python IDE

3.1.2.3 Haar-Cascade Algorithm

It is a machine-learning object detection algorithm . It is machine learning-based approach where a cascade function learned from several of positive. This algorithm is splited into four stages : Haar-Features selection, creating integral images ,ad boost training and cascade classifier .Features can be nose, lips eyes ,eyebrows etc. By use of help of this model we worked on face detection .The functionality of this algorithm is work sequentially step by step .initially , it chooses the characteristics of our black and white portion of our face, for instance. , so we required to search the su of pixels under white and black rectangles. To tackle with this, it goes to the next step, which is integral pictures. It simplifies the estimation of the total of pixels, how high the number of pixels might be, but their several characteristics are meaningless so that the best attribute is measured. In ad boost preparation, the judgment total used to break the right image classified and the image incorrectly classified or less-classified will be used to measure the weighted sum of the week classifier and iteration will be carried out on the image until the effective classifier is as a result. After that, it moves through the classifier's next step cascade. Instead of adding all the features on a window, split the features into different classifier stages and add one by one. (Normally, the first some stages will include very fewer features). If a window fails the first step, discard it. If its passes, we do not accept remaining features on it .

3.1.2.4 raspiCam app

This raspiCam Remote is a free app for Android published in the Screen , Capture list of apps, part of Graphic Apps etc.

Mike Redrobe is The company that develops RaspiCam Remote . The latest version released by its developer is 1.17.

This can be used for remotely monitor the surveillance camera of any orginization/ firm etc. Easy to use and maintain. Also it is robust.

3.1.2.5 Twillio app

this is basically an application of a messaging company having ability to assign and instead of a URL it creates a Twilio Application to a mobile number. Time of Login Twilio.com you will watch a new tab in your account dashboard called “Apps”, where you can easily manage and create your applications. Applications make it convenient to alter voice , SMS URLs and other settings across many mobile numbers in a single place. It will provide users to log in , then user’s dashboard will be created. user’s number is very crucial, then we purchase a USA number by some payment then through that allocated number, user can easily perform the sending and receiving messages to registered or any other numbers. It will be very helpful in project while alerting any owner via SMS / Calls.So this Applications are vital for encapsulating configuration info that user need to spread across several phone numbers.

3.2 PROJECT METHODOLOGY

3.2.1 Working Principle

We have designed a very compact surveillance system which can be easily integrated with any residential or commercial properties . Our main components are raspberry pi ,pi camera ,relay and a solenoid lock which has to be attached with the front door.

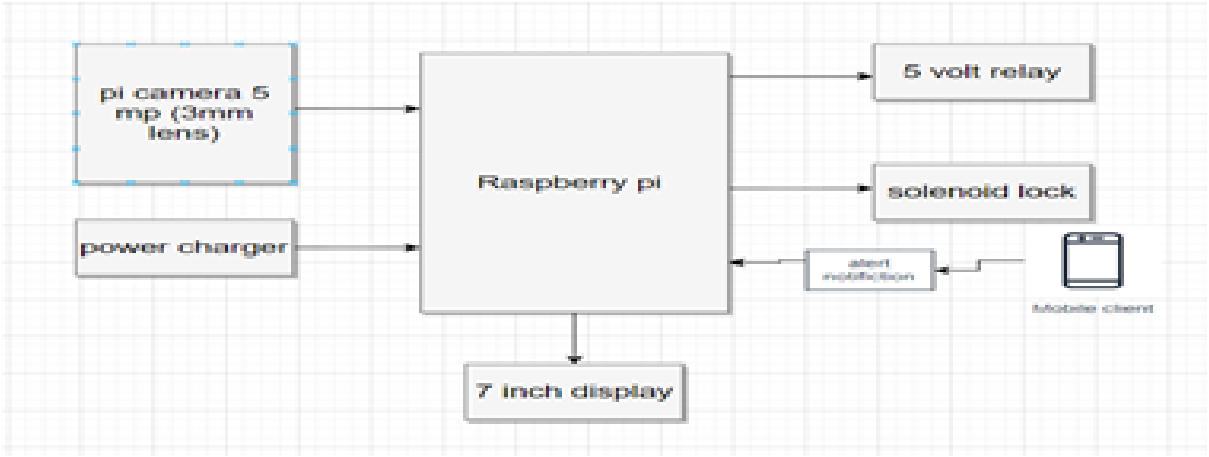


Figure 3.8: Our System Block Diagram

According to our proposed design the pi camera attached to raspberry pi starts the live

stream and starts capturing the frames .if any faces detected by the camera ,and if its is recognized as known person then the signal generated by GPIO pin of pi is send to solenoid lock and lock will get open .the solenoid lock is powered by 12 volts hence pi vcc only provide 5 volts and 5 volt relay is also used here to power the solenoid lock .the relay is powered by a 12 volt adapter.

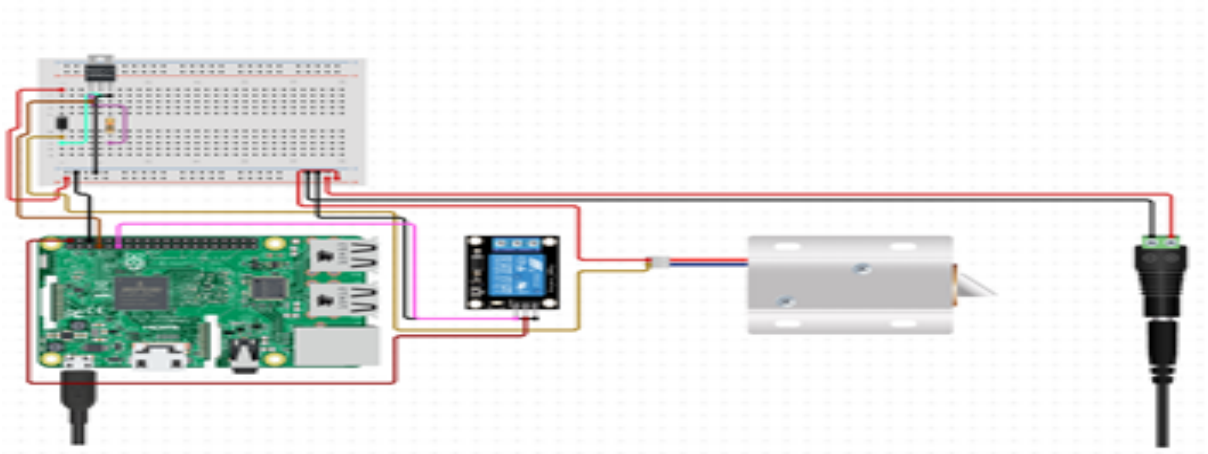


Figure 3.9: Our System Circuit Diagram

The Flow chart of our Project is :

3.2.2 Implementation

3.2.2.1 Hardware assembly and working

Our main component of the surveillance system is 2GB raspberry pi microprocessor which is used to operate and handle all the functionalities of our project .it runs on raspbian operating system which is stored in sd-card attached to pi .the pi is attached to the 5 mp (3mm lens) night vision pi camera which will be used to capture the live stream and detect faces .the camera is attached to the camera slot of raspberry pi .we are using solenoid lock which is a 5volt lock integrated with our pi using relay .The solenoid lock needs 7-12V to operate but GPIO pins of PI only give the output of 3.3 V. To tackle this, we will required to use relay and external power source to manage the lock. VCC and GND pins of the relay device can be connected to 5V and GND of Pi. After that signal/individual pin of the relay module should be connected to the GPIO 26 of Pi. Other

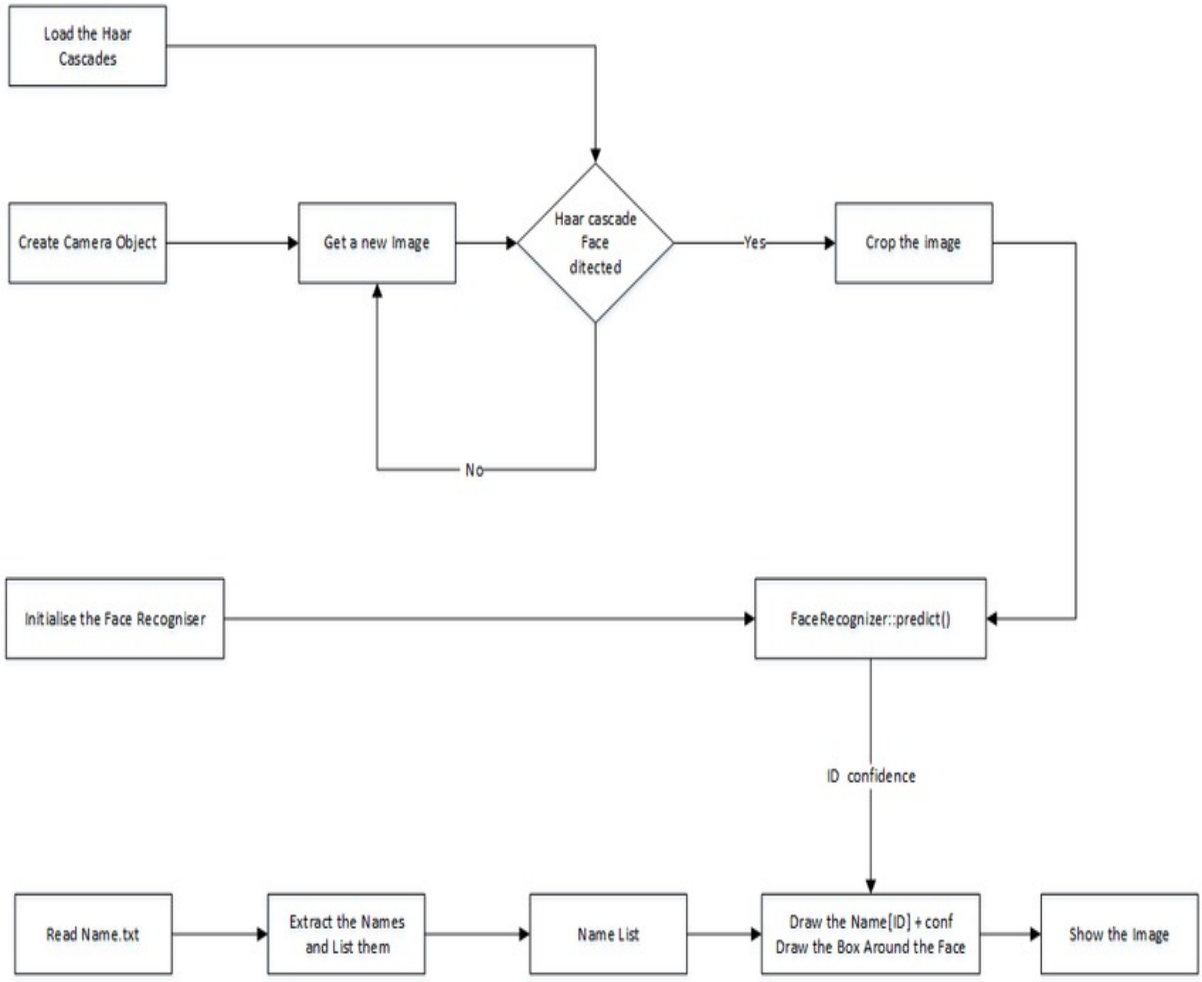


Figure 3.10: Our System Flow Chart

side of the relay module, connect the negative form DC power source to the negative of the solenoid lock. Also Bind the positive from the DC power source to the common of the relay module and then connect normally open from the relay module to positive of the solenoid lock.

3.2.2.2 Software Implementation

This part composed of the algorithm for face detection and recognition .the flask script to put live stream on web server And the script for sending alert notification through Twilio API .

Data Gathering for Face Detection The initial step is to collect the information that will be used to train our classifier. We'll develop a Python script that uses an

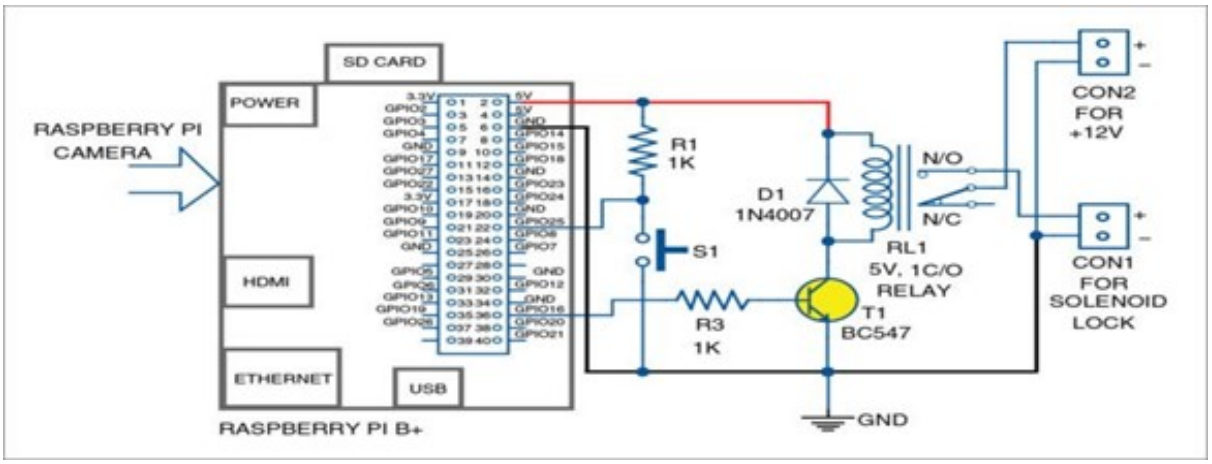


Figure 3.11: Hardware assembling

Open0CV pre-trained classifier to capture 30 faces of each participant. Many pre-trained classifiers for the face, eyes, grin, and other facial features are already included in Open-CV. Faces will be detected by the classifier we'll deploy haar cascade frontal face.

Code Walk through Now let's write the code. initially, Import the important package and some functions for alert notification that we have created in check new python script that will be discussed later ..

```
3  import cv2
4  from picamera.array import PiRGBArray
5  from picamera import PiCamera
6  import numpy as np
7  import os
8  import sys
9  from PIL import Image
10 import pickle
11
12 from checknew import hello
13 from checknow import new
14
```

Figure 3.12: Libraries Import

The camera object is then initialized, allowing us to interact with the Pi-Camera. We used a resolution of (640, 480) and a frame rate of 30 frames per second.

From an encoded RGB capture, PiRGBArray() returns a 3-dimensional RGB array arranged (rows, columns, colours). The advantage of PiRGBArray is that it can read frames from the Pi camera as NumPy arrays, making it compatible with Open-CV. It

eliminates the need to convert from JPEG to Open-CV format, which would slow down our workflow. There are two arguments:

- The Camera Object
- The Resolution

Also ,Load a cascade file for detecting faces.

```
14
15 camera = PiCamera()
16 camera.resolution = (640, 480)
17 camera.framerate = 30
18 rawCapture = PiRGBArray(camera, size=(640, 480))
19
20 faceCascade = cv2.CascadeClassifier("haarcascade_frontalface_default.xml")
```

Figure 3.13: Initializing camera and PiRGBArray

After that, we ask for the user's name. So the directory of same name already exists, the code will exit with the message "Name already exists." It will create a directory with this name if one does not already exist, and images will be saved under this name.

```
22 name = input("What's his/her Name? ")
23 dirName = "./images/" + name
24 print(dirName)
25 if not os.path.exists(dirName):
26     os.makedirs(dirName)
27     print("Directory Created")
28 else:
29     print("Name already exists")
30     sys.exit()
```

Figure 3.14: Input newComer Info

The capture continuous method is then used to begin reading frames from the Raspberry Pi camera device. Three arguments are passed to the capture continuous function:

- rawCapture

- The format in which user aim to read every frame. Because, Open-CV expects that the image must be in BGR rather than RGB, So user specify BGR as the format.
- The use video port boolean, when set to true, indicates that a stream is being treated as video.

As we have the frame, we can go through the raw NumPy array via the array attribute. After accessing, we change this frame to gray scale. Then, to recognise faces in the frame, we use our classifier function. The gray-scale image is the first argument we pass. The parameter defining how much the image size is decreased at each frame scale is the second argument. The third argument is a parameter that tells the number of neighbours of every single candidate rectangle should have in order to be retained. False positives are reduced when the number is bigger.

The above code returns the face area's rectangle coordinates. We extracted the face from the image using these coordinates and saved it in the directory we created at the start. After that, we displayed the cropped face and used the original frame to make a rectangle. 30 photographs will be collected by the code.

```
count = 1
for frame in camera.capture_continuous(rawCapture, format="bgr", use_video_port=True):
    if count > 30:
        break
    frame = frame.array
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
    faces = faceCascade.detectMultiScale(gray, scaleFactor = 1.5, minNeighbors = 5)
    for (x, y, w, h) in faces:
        roiGray = gray[y:y+h, x:x+w]
        fileName = dirName + "/" + name + str(count) + ".jpg"
        cv2.imwrite(fileName, roiGray)
        cv2.imshow("face", roiGray)
        cv2.rectangle(frame, (x, y), (x+w, y+h), (0, 255, 0), 2)
        count += 1
```

The original frame is then displayed in the output window. A keyboard binding function is cv2.waitkey(). Any keyboard event is delayed for a given millisecond. It just needs one argument, which is the milliseconds of time. The application will continue if the key is pushed within that time frame. If you set the value to 0, it will wait indefinitely for a

key. The Reason to clear the stream now is to get preparation for the upcoming frame by calling truncate(0) between captures.

```
47      cv2.imshow('frame', frame)
48      key = cv2.waitKey(1)
49      rawCapture.truncate(0)
50
```

Training the Recognizer: Now we must train the recognizer relevant to the info we gathered in the prior step. We will use the LBPH (LOCAL BINARY PAT-TERNS HISTOGRAMS) face recognizer, included on the Open-CV package. We load it in the following line:

Also, We acquire the current working directory's path and move to the directory containing the image folders.

```
59
60 faceCascade = cv2.CascadeClassifier("haarcascade_frontalface_default.xml")
61 recognizer = cv2.face.LBPHFaceRecognizer_create()
62
63 baseDir = os.path.dirname(os.path.abspath(__file__))
64 imageDir = os.path.join(baseDir, "images")
```

Figure 3.15: LOCAL BINARY PATTERNS HISTOGRAMS Function

Then move into each pic directory and look for the frame. Then convert into the NumPy array, as we find that image is present. After that, we perform the face detection again to make sure we have the right images and then we prepare the training data.

```
xTrain = []

for root, dirs, files in os.walk(imageDir):
    print(root, dirs, files)
    for file in files:
        print(file)
        if file.endswith("png") or file.endswith("jpg"):
            path = os.path.join(root, file)
            label = os.path.basename(root)
            print(label)

            if not label in labelIds:
                labelIds[label] = currentId
                print(labelIds)
                currentId += 1

            id_ = labelIds[label]
            pilImage = Image.open(path).convert("L")
            imageArray = np.array(pilImage, "uint8")
            faces = faceCascade.detectMultiScale(imageArray, scaleFactor=1.1, minNeighbors=5)

            for (x, y, w, h) in faces:
                roi = imageArray[y:y+h, x:x+w]
                xTrain.append(roi)
                yLabels.append(id_)
```

Store the dictionary which contains the directory names and label IDs. Now train the data and save the file. This code creates a trainer.yml and labels files that can be used in the recognition code. **Using the Recognizer for Facial Recognition:**

```
94
95  with open("labels", "wb") as f:
96      pickle.dump(labelIds, f)
97      f.close()
98
99  recognizer.train(xTrain, np.array(yLabels))
100 recognizer.save("trainer.yml")
101 print(labelIds)
```

Figure 3.16: Train the data

Face recognition may now be done with the recognizer we built up in the previous section. It will provide us assurance and help us identify labels (rate of confidence in recognition). The relay will switch on if the faces match. We begin by loading the dictionary from the pickle file.

The classifier for detecting faces and the recognizer for predicting faces, as well as the trained data, are then loaded.

```
104
105 with open('labels', 'rb') as f:
106     dicti = pickle.load(f)
107     f.close()
108
109 faceCascade = cv2.CascadeClassifier("haarcascade_frontalface_default.xml")
110 recognizer = cv2.face.LBPHFaceRecognizer_create()
111 recognizer.read("trainer.yml")
112
```

Figure 3.17: Use of Recognizer for Facial Recognition

We examine the frame, convert it to grayscale, then search the image for faces. If there are any faces in the image, we'll extract the face region and use the recognizer to identify it. Our label ID and confidence will be provided by the recognizer. We see in the dictionary for the name assigned to this label-ID.

```
112
113 gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
114     faces = faceCascade.detectMultiScale(gray, scaleFactor = 1.5, minNeighbors = 5)
115     for (x, y, w, h) in faces:
116         roiGray = gray[y:y+h, x:x+w]
117         roiColor = frame[y:y+h, x:x+w]
118
119         id_, conf = recognizer.predict(roiGray)
120
121 for name, value in dict.items():
122             if value == id_:
123                 print(name)
124
```

Then we determine whether we have sufficient confidence to open the door lock and the message will be send to the owner with known person name . The door will open if the confidence level is less than 70. It will remain closed if this does not happen. Create a rectangle in the original image and write this name on top of the rectangle.

```
125
126 if conf <= 70:
127             GPIO.output(relay_pin, 1)
128             cv2.rectangle(frame, (x, y), (x+w, y+h), (0, 255, 0), 2)
129             cv2.putText(frame, name + str(conf), (x, y), font, 2, (0, 0 ,255), 2,cv2.LINE_AA)
130
131         else:
132             GPIO.output(relay_pin, 0)
133             new()
134
135             cv2.rectangle(frame, (x, y), (x+w, y+h), (0, 255, 0), 2)
136 cv2.putText(frame, name, (x, y), font, 2, (0, 0 ,255), 2,cv2.LINE_AA)
```

Figure 3.18: Solenoid Lock Coding

Flask script for live-stream First we are going to import the necessary libraries and packages .the camera file where we have written our face recognition and gpio control script. Then we set flask app authentication by setting up username and password to get

```
from flask import Flask, render_template, Response, request
from camera import VideoCamera
import time
import os
import sys
```

Figure 3.19: import Libraries For Flask

the live-stream on browser .

Then we render our HTML page where we can see our camera live-stream . Here we get the camera frame and then we set the boundaries for the frame .then we set the local host and port number 5000 where our flask app will run .

```
app = Flask(__name__)
app.config['BASIC_AUTH_USERNAME'] = 'aj'
app.config['BASIC_AUTH_PASSWORD'] = 'ja'
app.config['BASIC_AUTH_FORCE'] = True
#app = Flask(__name__, template_folder='/var/www/html/templates')
```

```
@app.route('/', methods=['GET', 'POST'])
def move():
    result = ""
    if request.method == 'POST':

        return render_template('index.html', res_str=result)

    return render_template('index.html')
```

Figure 3.20: Flask App Authentication

```
def gen(camera):
    while True:
        frame = camera.get_frame()
        yield (b'--frame\r\n'
               b'Content-Type: image/jpeg\r\n\r\n' + frame + b'\r\n\r\n')

@app.route('/video_feed')
def video_feed():
    return Response(gen(VideoCamera()),
                    mimetype='multipart/x-mixed-replace; boundary=frame')

if __name__ == '__main__':

    app.run(host='0.0.0.0', debug=True, threaded=True)
```

Twilio script for alert message and Setting up Twilio account

Figure 3.21: Twilio Sing Up Page

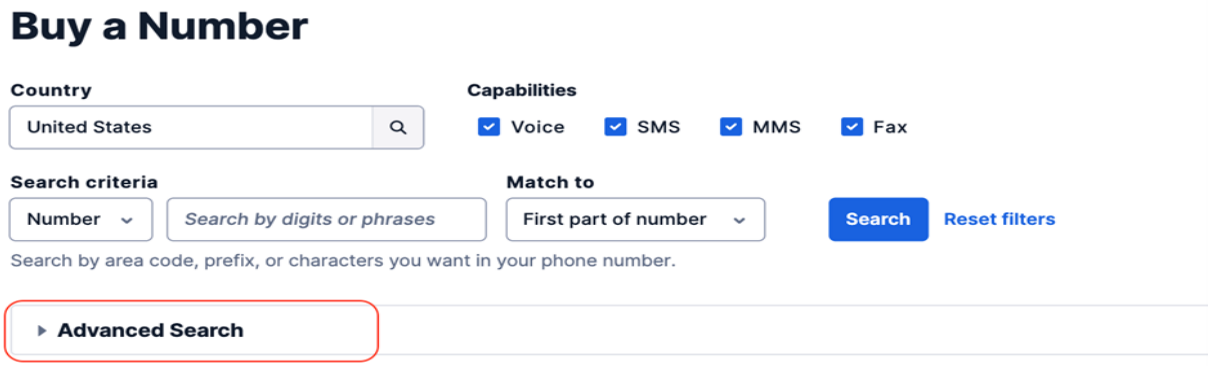
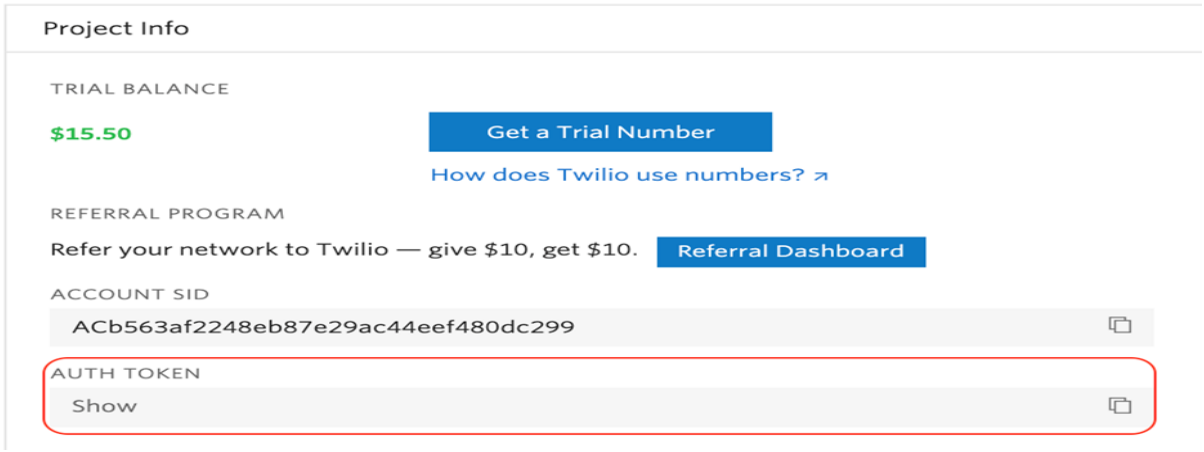


Figure 3.22: Buy Number via Twilio



Python script for Twilio:

first install python on raspberry pi using command sudo- apt -get install twilio. then import the twilio library. First we have to define the account sid and authentication token that we got while setting up twilio account on their website then we have to pass the sid and token to the client fucntion .then we have to define the sender and reciever number and the message that we have to send . We need to put this all code in a function so that we can import that function in the face recognition python scirpt .

Remote accessing live stream Our survillieance system si smart so to make it possible we also have the functionality of accessing the live stream over other netwrok so that owner can view the live stream remotely. We have used port forwarding method and we have took help of third party application ngrok . This application is a cross platform application that makes ease us to expose a web server running on your local machine to

```
from twilio.rest import Client

account_sid ="AC[redacted]ed15a4fac8bba511011" # Put your Twilio account SID here
auth_token ="4eb[redacted]c139104515720dc" # Put your auth token here

client = Client(account_sid, auth_token)

message = client.api.account.messages.create(
to="+923[redacted]614", # Put your cellphone number here
from_="+12[redacted]49209", # Put your Twilio number here
body="some unknown person is at your gate")
```

Figure 3.23: Twilio App libraries and Use

the internet. We have used the port 5000 on which our live stream is running locally and then passed then http port to ngrok .ngrok forwarded the port over the network and make it public on internet .ngrok provide you the link which allows you to watch the live stream remotely .

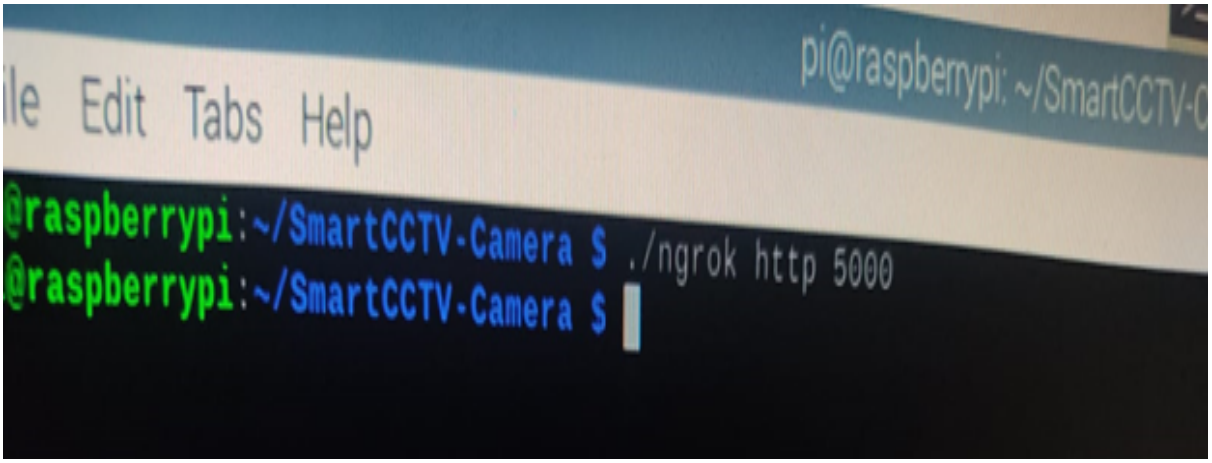


Figure 3.24: Remote Accessing Live Streaming

CHAPTER 4

RESULTS AND DISCUSSION

We tested our system on various sample and in different conditions like in daylight and in night to check our classifier accuracy .in each sample we checked for detection of multiple no of faces and counted correct detection.

samples	No of faces in images	Correct detection	False detection
1	1	1	0
2	2	2	0
3	2	2	0
4	3	2	1
5	3	2	1
6	4	4	0
7	5	4	1
8	5	5	0
9	6	5	1
10	7	7	2

Figure 4.1: Table of Face Detection's Result

The table shows the results of 10 samples and with each sample we have multiple faces and of correct detection and no of false detection.altogether we have around 38 faces and our classifier correctly detected 33 faces.using accuracy formula : Face detection accuracy = (no of correct face detection /total no of faces in the samples)*100 Our accuracy is = (33/38)*100 = 87 percent

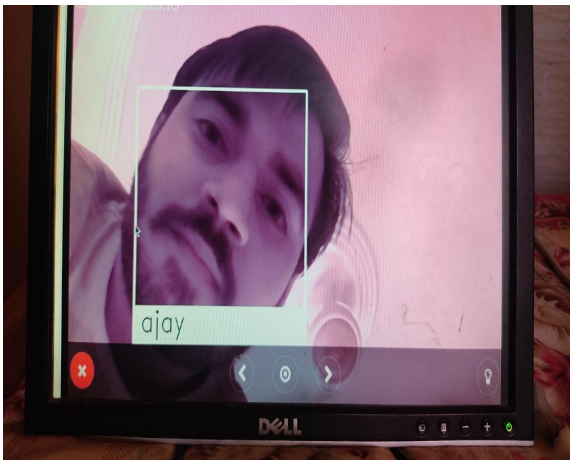


Figure 4.2: Day Time Recognition

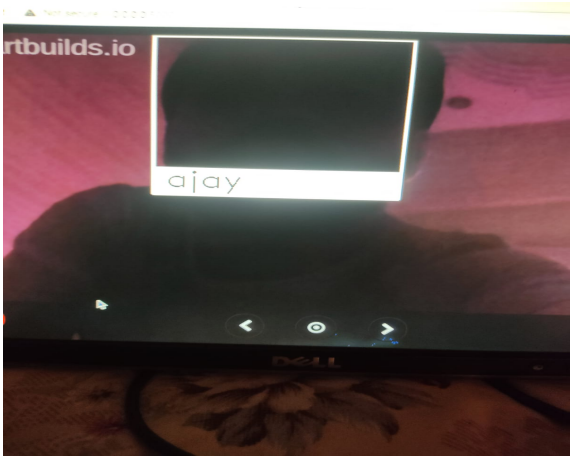


Figure 4.3: Dark Time Face Recognition

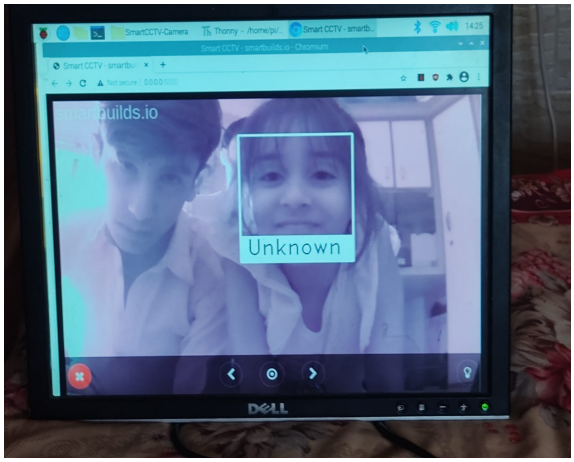


Figure 4.4: Multiple Face Recognition

Our camera is detecting recognizing the face in both daylight and also in darkness with acceptable accuracy .the latency is minimum when live stream is running locally but there is 5 -7 seconds latency while watching it remotely.

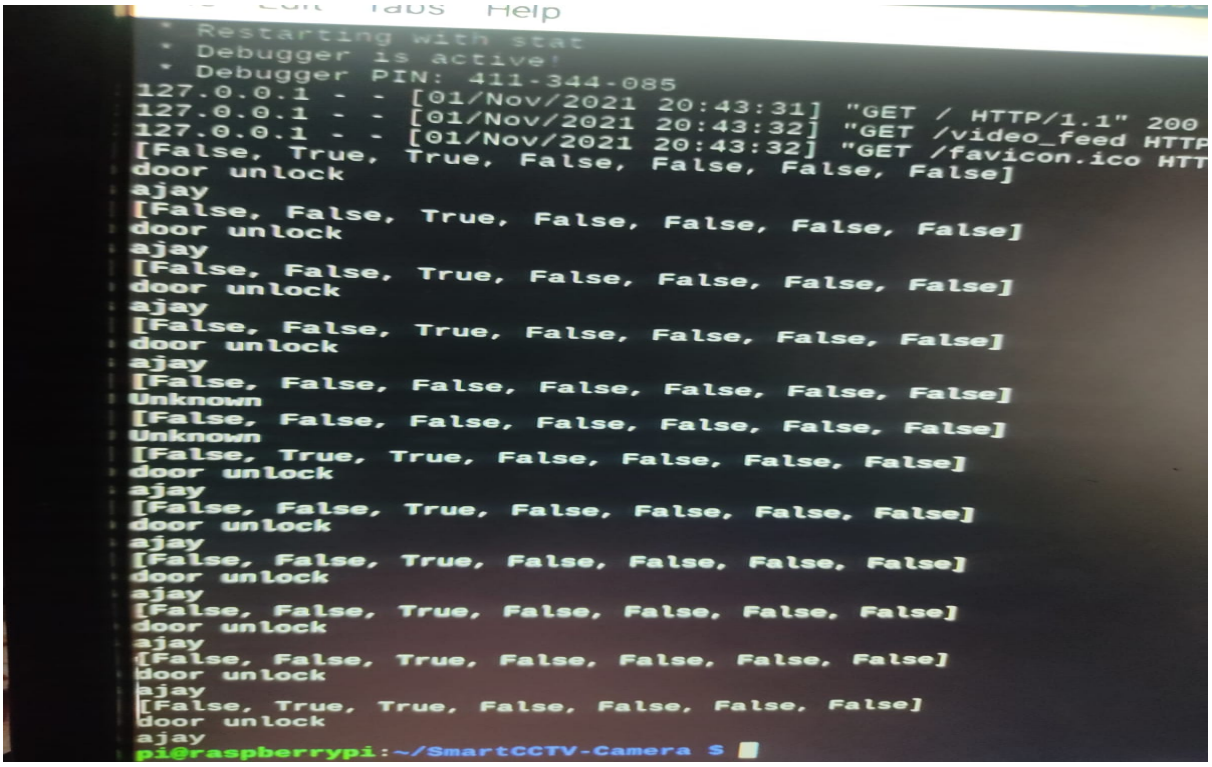


Figure 4.5: Backend Detection CMD Results

After These Face Recognition's , With the help of Twilio service , As the known or unknown person detect by our surveillance system the Twilio Send alert message to our given owner number. see in 4.6

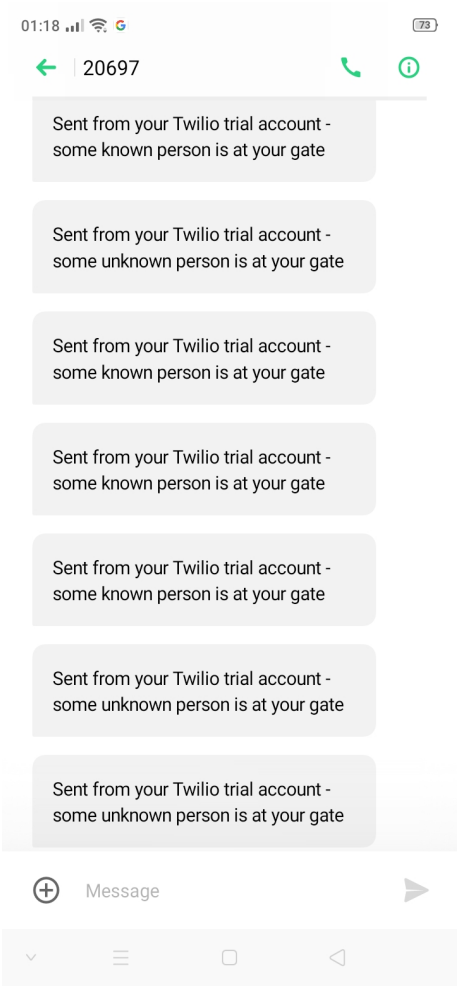
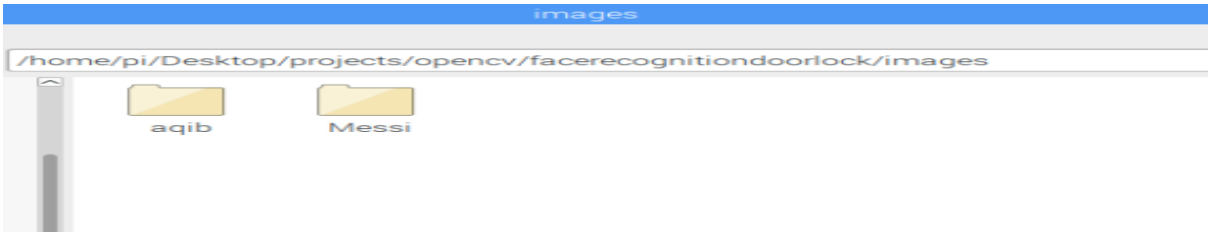


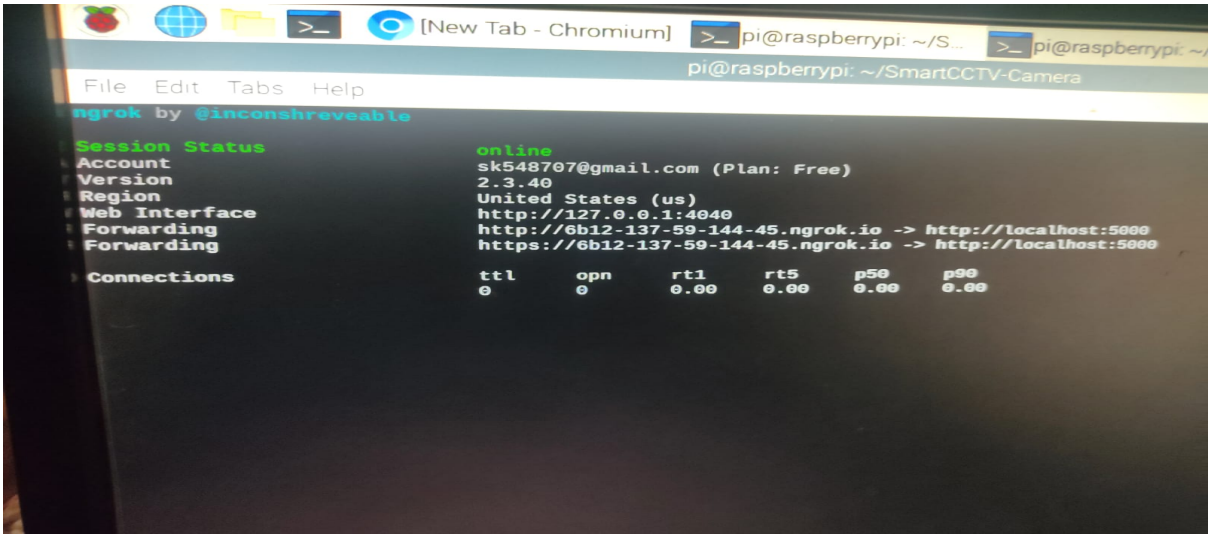
Figure 4.6: Twilio Alert Messages

As soon the flask web server starts running it starts detecting and recognizing faces .as the 4.2 output shows that ajay has been detected and recognized with the message door unlock .Along with this 4.3 is successfully detect face in dark time and 4.4 shows the detection of faces in multiple peoples faces.

As in 3.14 , We can Also Store Faces of New Comer by Taking Input a small Info as shown in Below Figure.



The ngrok web application has also forwarded our local host address over the network .the new url that has been assigned is http://6b12-137-59-14445.ngrok.io .now any one with this URL can watch the live stream of our camera on any network in the world .



CHAPTER 5

CONCLUSION AND FUTURE RECOMMENDATIONS

5.1 CONCLUSION

The primary aim and objective of our designed project is to control and monitor a surveillance camera with best security features. To acquire this idea, we developed hardware and software modules. Further more in final , our custom based surveillance camera which is implemented at door will secure our homes , the main motive or conclusion of this project is that it warn home owner from intruder without his presence.

Our designed system is most particularly for intruder/unknown person identification in the absence of owner, The designed system will get implemented using Raspberry PI,Open-CV,Haar-Cascade along with solenoid lock. The recognition rate attained by this process is 85 percentage . we also get to know that ,every place/city/organization should have surveillance. Only be done by creating awareness about the importance of security in the city.

Hence, our designed smart surveillance camera capable of storing images, live streaming in a secure and efficient manner. So, this smart Surveillance system provides us an efficient method to look/ monitor illegal/suspicious activities.

5.2 FUTURE WORK

Surveillance is a vast and diversified security System and with rapid advancement in security, we can further enhance the performance and usability of this surveillance. Some

of the enhancement are discussed below but are not limited to:

- can be used in crowd places or lane for criminal detection and alert the forces.
- must avoid the detection of captured images
- can be used for face spoofing
- applied same techniques for another security reason/ face detection.

Above are few future enhancement that can adapted with numerous other latest technology.

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