Project on

Face Recognition Based Smart Door System

Submitted for the partial fulfilment of the award of

Degree

In

Computer Science and Engineering

By

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CERTIFICATE OF APPROVAL

Certified that the project report entitled "**Face Recognition Based Smart Door System" is** a bonafide work carried out jointly by **Dhrubark Sarmah** (**D/18/CS/106**) and **Saurabhjyoti Deuri** (**D/18/CS/103**)**.** The project report embodies the original work done by them towards partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology in Computer Science and Engineering** at **North Eastern Regional Institute of Science and Technology, Arunachal Pradesh**. It is understood by this approval that the undersigned do not endorse or approve any statement made, opinion expressed or conclusion drawn therein, but approve the project report only for the purpose for which it has been submitted.

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DECLARATION

We hereby declare that the project entitled **"Face Recognition Based Smart Door System"**, is submitted to the North Eastern Regional Institute of Science and Technology, Nirjuli; is a record of an original work done by us, ***Dhrubark Sarmah*** and ***Saurabhjyoti Deuri*** under the abled guidance of our respected teacher and guide, ***Dr. Monjul Saikia***. This report is submitted in partial fulfilment for the award of degree of Bachelors of Technology in Computer Science and Engineering. The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

This significance of the project work is about the Facial Recognition and its applications in different areas of genuine real world using Raspberry Pie, OpenCV programming and different significant libraries. Because of upgraded development and modern, making life easier. People search for ways of doing things effectively and which saves time and energy. So hence, the automated doors are one of many models that a person concocts. Programmed entrance/leave entryway control is broadly utilized out in the open places, for example, shopping centers, transportation stations, air terminals, and theaters store to take out the need of physically opening and shutting activities. Shrewd Door framework gives advance robotization to proprietors. The savvy entryway project is an inventive access control framework, in light of item location. The proposed framework can initially recognize an article with the assistance of camera sensor and on the off chance that the item is in wanted range, the camera will catch the face and afterward contrast the picture recently caught and the data set.

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Chapter 1: INTRODUCTION

1.1 About the work

Opening and shutting of entryways is dependably a monotonous work, particularly in places like shopping centres, air terminals, lodgings, emergency clinics and theatres where an individual is constantly expected to open the entryway for guests. For individuals in wheelchairs(handicapped people), opening the door is undeniably challenging.

In distribution centres and different offices where individuals habitually have their hands full, adding to somewhere safe and secure and effectiveness by making it more straightforward for individuals to get around.

1.1.1 System Existed

To operate the entryway naturally with the utilization of a savvy Facial Recognition System, the conventional way is to physically open and close the entryway which is by all accounts extremely dreary to be relevant in our bustling everyday life.

1.1.2 Disadvantages

Human effort is required to manually open and close a door in the usual manner. It is a time-consuming and exhausting task.

1.2 Motivation

Shrewd entryway framework gives advance mechanization to proprietors. We have seen programmed entryway openers in shopping centres, theatres and business structures. These frameworks are utilized to open the entryway when an individual approaches the entry of the entryway and close it after went into the entryway. The project proposes an autonomous door opening and closing system that detects any authorized person movement near the door.

1.3 Objective and Contribution

The principal objective of this task is to make a practical and working Face acknowledgment based Smart Door System utilizing Raspberry Pie (4B). The point of our venture is to give a high security framework utilizing Face Recognition innovation on Raspberry Pi, this will build the security of our undertaking. We have seen programmed entryway opening frameworks in shopping centres, theatres, air terminals, stockrooms, clinics and business structures. In this sort of spots or other numerous different spots

opening and shutting of entryways physically is consistently a monotonous work. Where an individual is constantly expected operate the entryway.

For individuals with disabilities who cannot walk and other impaired people, since ordinary entryways can be exceptionally difficult to work with. This could be difficult to use a regular entryway while situated in a wheelchair and as such a shrewd framework comes in exceptionally convenient.

The proposed work is as per the following:

1) Set up the Raspberry Pie climate with the framework that we will chip away at.

2) Installation of the multitude of required libraries on the framework.

3) Linking of camera module to catch Face picture (live).

4) Make an information base containing approved individual.

5) Capture current face, save it and contrast and information base pictures.

6) Interface hand-off as a result module.

Chapter 2: Preliminaries and Background

2.1Literature Survey

2.1.1 Embedded System

As an innovation, implanted framework is exceptionally helpful, on the grounds that in today time every one of the undertakings are currently implanted. “An implanted framework is a PC that has a dedicated capacity within a larger mechanical or electrical framework, and is frequently used for continuous processing. It is frequently implanted as part of a larger device that includes equipment and mechanical pieces.” [17] As such implanted framework is characterized as "An approach to working, coordinating or performing one or many errands as per a proper arrangement of rules, program or plan."

In our undertaking as well, implanted framework is utilized as the innovation. The equipment a piece of framework comprises a hand-off module, a solenoid entryway lock, Raspberry Pi(4B) matched with the Raspberrian OS. Brilliant entryway framework is a proper utilization of inserted innovation.

Different instances of installed framework are as per the following:

Time shows framework (a watch)

Programmed fabric washing framework (clothes washer)

“Rather of being a generically helpful PC for a variety of tasks, inserted frameworks are designed to perform a specific task. Some have ongoing execution requirements, such as

security and convenience; others may have low or no exhibition requirements, allowing the framework equipment to be enhanced to reduce costs." [9]

Current inserted frameworks are much of the time in view of microcontrollers (for example Computer processors with coordinated memory or fringe interfaces) and devoted to explicit errands, Embedded frameworks range from convenient gadgets, for example, advanced watches and MP3 players, to huge fixed establishments like traffic signals, production line regulators, and generally complex frameworks like half and half vehicles, MRI. "With a single microcontroller chip, complexity is low; with several units and peripherals, complexity is extremely high." Implanted frameworks are broad in buyer, modern, business and route administrations. Telecom frameworks utilize various installed frameworks from phone switches for the organization to cell phones toward the end-client. PC organizing utilizes committed switches and organization scaffolds to course information.

Major Components of embedded System Processors:

It is the embedded system's central processing unit, commonly known as the brain. The hardware is responsible for running the software and controlling the operations of all the other circuits.

Storage Device:

It is utilized to introduce the product (Raspbian OS). In our very project we have utilized a 64GB SD card as memory source. It likewise gives capacity to information, for example, program factors, transitional outcomes and some other information produced all through the activity.

2.1.2: Referred Methods

In our very project we have alluded to such a generally existing technique which essentially fills in as follows. Subsequent to setting up the climate in the framework, with the assistance of different programming we make a data set, which essentially stores the face information of the relative multitude of approved people. So on the off chance that an article comes before the camera (PiCamera) it identifies the item and perceives whether. It is a human, it then catches the picture of the individual it identifies and afterward contrasts it and the information base put away and performs essential activities on the equipment.

2.1.3: Related Works

Implanted frameworks range from no UI by any means, in frameworks devoted exclusively to one errand, to complex graphical user interfaces which looks like the present day personnel's computers work area. Basic inserted gadgets use buttons, LEDs, realistic or character LCDs with a straightforward menu framework. Implanted systems are often found in machines which are intended to run continuously for a long duration time without any errors and to occasionally recover if a blunder occurs. As a result, the product is developed and tested more carefully than that for personnel computers, and inconsistent mechanical parts, such as circle drives, switches, or fasteners, are avoided.

2.1.4: Recognition algorithm

Haar cascade:

The Haar Cascade algorithm is the strategy where a sectionalisation is bored from a lot of positive and negative photographs. This sectionalisation pursues an AI system in which a fountain activity is taught from the photographs to find things in extra photographs. Face identification and looks in a picture are likewise effectively recognized. The activity is done by setting values greater than zero and lesser than zero pictures to the classifier. Then the attributes are somewhat long from the image. Every trademark is a singular worth, which is procured by taking away amount of pixels in white square shape from summation of pixels in dark rectangle. In which it distinguishes the essences of various person in various conditions. The Haar-like component of variable dimensions can be determined in consistent time in view of basic pictures.

The above strategy can be defined in four stages:

1. Searching for Haar Features
2. Generating Integral Images
3. Utilizing Adaboost
4. Utilizing Cascading Classifiers

Calculating Haar Value:

Pixel value = (Sum of dark pixels/Number of dark pixels)-
(Sum of light pixels/Number of light pixels)

Accuracy Calculation:

$$\alpha = \frac{\beta+\gamma}{\beta+\gamma+\delta+\theta} \qquad \text{eq. 1}$$

Where α = Accuracy

β = True Positive

γ = True Negative

δ = False Positive

θ = False Negative

Obtained Accuracy rate for the Haar cascade is 96.24%.

Chapter 3: Proposed Work

3.1: Working

It, most importantly, is guaranteed that that the association are done precisely and appropriately then it is made sure that the framework is associated with a satisfactory power supply (2000mAh Li-Ion) so it gets sufficient ability to appropriately run. At the point when the framework is dynamic an article (say human) moves toward neighbouring the framework distinguishes it and attempts to catch the face and afterward run face acknowledgment calculations on it. Before full arrangement of the framework it is prepared well with adequate measure of datasets so the framework become precise and immaculate. After the calculation is applied on the caught picture by the USB camera it then speaks with the related information base to confirm the character of the individual. In the event that a match is found it shows the name of the individual on the screen and afterward invites the individual by opening the entryway.

This sort of mechanized brilliant entryway frameworks saves a great deal of time and is safer when contrasted with unique finger impression palm print entryway lock frameworks and has a wide assortment applications on genuine world.

Face Detection is the utilization of picture handling methods to decide whether the picture is/has a human face or not. It is practically equivalent to protest recognition, however the particular and reliable elements of the human face make face discovery a more educated task feasible by hand-tuned highlight descriptors and traditional picture handling strategies. Face identification is the forerunner to confront acknowledgment. Face identification in a scene with numerous individuals or items presents difficulties in confinement of the jumping box for the face.

Essential thought is to search normal personals face characteristics in a picture. Normal characteristic face highlights have:

- 2 eyes with black masses.
- An in the middle of between the two eyes.
- A level surface over the eyes (temple).
- A couple of lips beneath the nose extending on a level plane.

There are many such highlights, recognising a person’s face is a reasonably intricate calculation and a tedious process.

Normally used Face Detection and Recognition Techniques:

"The Viola-Jones calculation for face identification utilizing Haar Feature-based overflow classifier is a famous picture handling method. Histogram of Gradient (HOG)-based highlight descriptors are broadly utilized in the Haar overflow technique. OpenCV, the biggest open-source PC vision library, has an inbuilt execution of the Haar Cascade-based face recognition calculation with a pre-prepared classifier for human face characterization." [3]

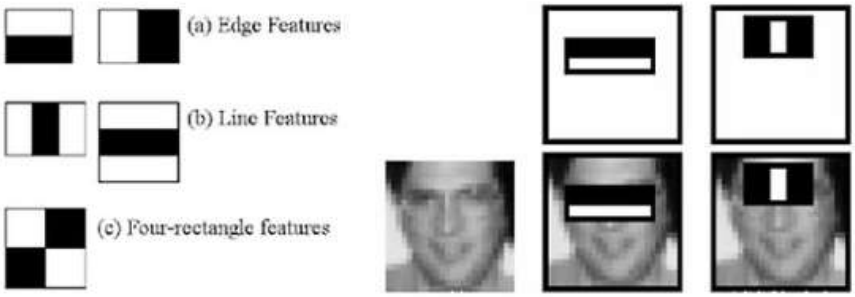


Fig: Common feature detectors and their corresponding on the human face

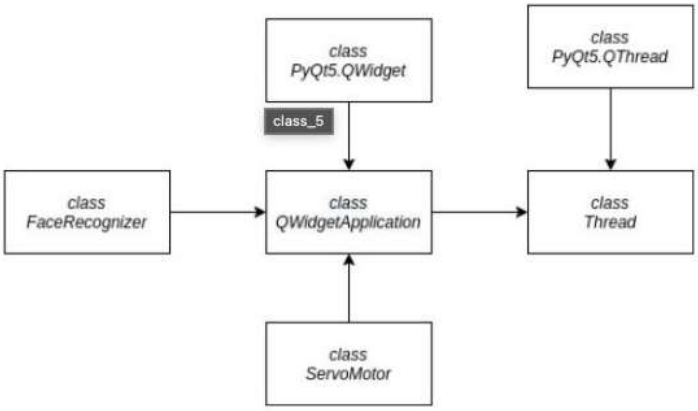


Fig: Class Architecture for the Face Recognition.

Important libraries used in the project are:

1. dlib –It is a deep learning and machine learning efficient library. It is written in C++ but supports python's bindings.
2. face_recognition –It is a face recognition library in Python.
3. RPi.GPIO –General Purpose Input Output pins are controlled with the help f this library.
4. OpenCV –It is library which uses Computer used to read image and update annotation on it

3.2: FLOW CHART

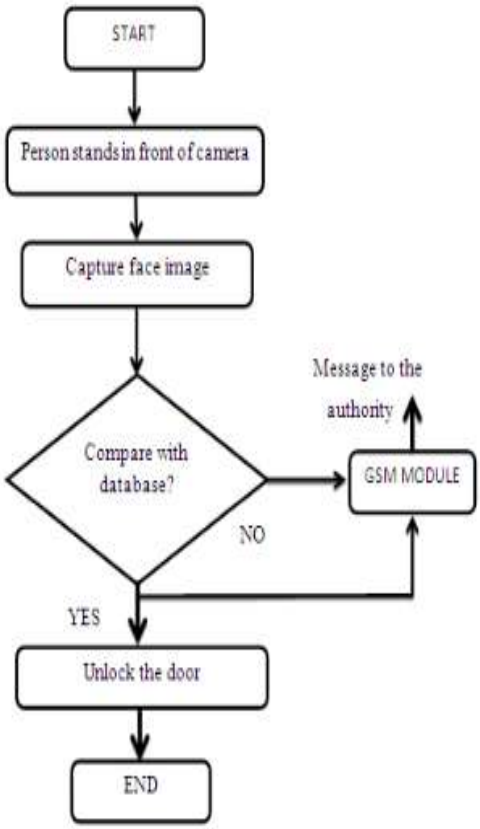


Fig: Flowchart of Image capturing and database comparison.

3.3: BLOCK DIAGRAM

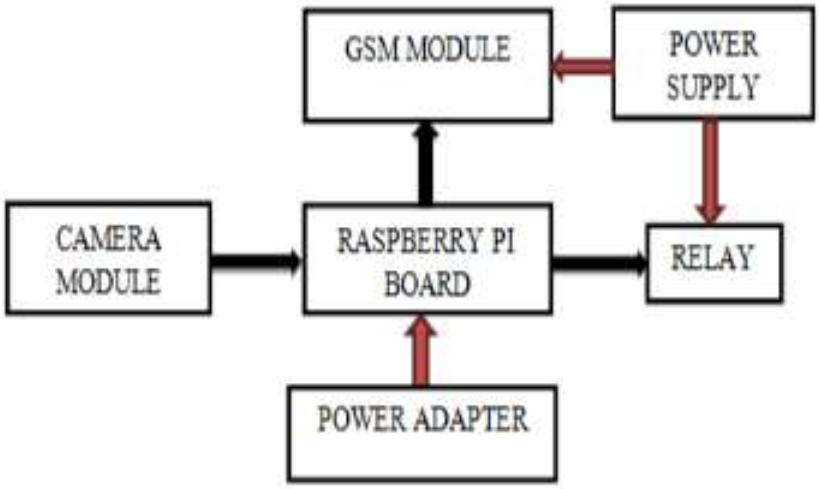


Fig: Block diagram of "Raspberry pi based face recognition system for door unlocking".

3.4: HARDWARE REQUIREMENTS

3.4.1 Raspberry Pie 4 (model B)

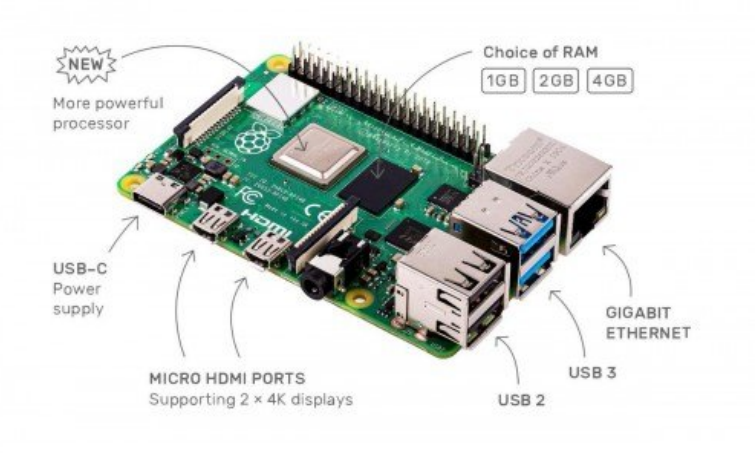


Fig: Raspberry Pi 4b

A Raspberry Pi is a little computer with a lot of power, which can be plugged into external hardware like monitor, keyboards, etc to give full functionality of a computer. It can perform all the computation, run programming languages, run games, videos, basically everything a normal computer can do just in a compact form. It can communicate and control external peripherals through the various GPIO (General Purpose Input Output) pins.

3.4.2Memory Card (SD micro 32 GB)

A memory card is electronic data storage device which can store flash data normally. It is used for storing information in digital form. These are portable memory bands. It can be used o the go and has a lifespan of more than 5 years. They have significantly been evolved with fast transmission speed and huge memory band capacity in rangers of 512 GBs.

Fig: SD Card

3.4.3 12volt DC Power Adapter

A power source of 2000mAh to juice up the system so that it supplies enough power that is required by the system to work flawlessly.

Fig: 12 V DC Adapter

3.4.5 The Relay Module

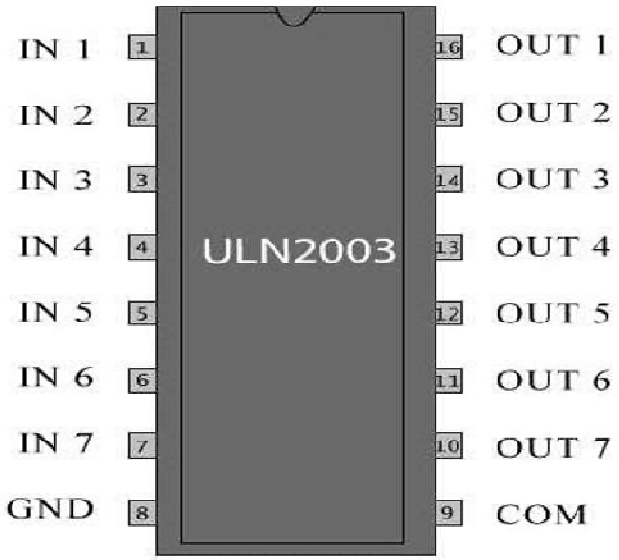


Fig: Relay Module ULN2003

A Relay module is an electronic element which is used to combine electrical entities.(say AC voltage and DC voltage). We use a Relay module in various applications like when we want to switch on a electric fan or a bulb with a microcontroller because the microcontroller always operate on the low voltage which is DC voltage which is about 5Volt DC voltage but on the other hand the electric fan or a bulb will operate on the AC voltage. A relay module combines DC voltage and AC voltage. The ground pin of the relay module is connected to the ground terminal of the Raspberry Pi board VCC should be connected with the 5volt Raspberry Pi board. The pins marked as IN stands for input pins. It also has LEDs to indicate the status of the module and during the application time the LED turns ON to indicate that the hardware is alright and functioning properly. There is also a component at the Relay module known as the Auto coupler which basically separates the AC and the DC voltages.

The ULN2003 is known for its high-current, high-voltage limit. The drivers can be resembled for much higher momentum yield. Much further, stacking one chip on top of another, both electrically and actually, has been finished. For the most part it can likewise be utilized for interacting with a stepper engine, where the engine requires high evaluations which can't be given by other connecting gadgets.

Feature

• 500 mA rated collector current (single output)

• 50 V output (a variant with 100 V output is also available)

• Includes output flyback diodes

• TTL and 5-V CMOS logic compatible inputs

Application

The ULN2003A is commonly used in relay, lamp, and LED display driver circuits, stepper motors, logic buffers, and line drivers.

3.4.6 PiCamera

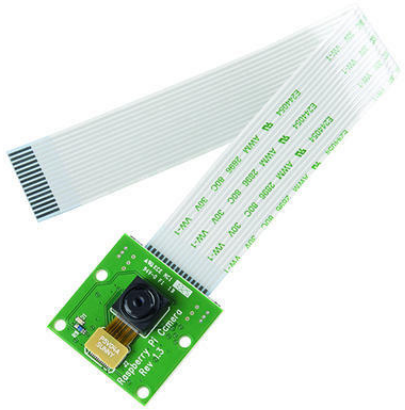


Fig: PiCamera (5MP)

A PiCam is one of the fundamental instruments for the task. At the point when an individual or article moves toward neighbouring, the framework sees, catches a computerized picture of it and afterward recognizes it as an enrolled substance or not, on the off chance that the article is distinguished effectively the entryway lock is opened else it will stay close. The picture ID occurs through an innovation called OpenCV.

Preceding full sending of the framework the calculation is prepared well with different datasets.

3.4.7 Jump Wires

Fig: Jump Wire

A jump wire is basically a connecting wire which has pins attached at both ends. The pins help both the terminals to connect with soldering them. It makes making the circuit asy and less scrambled with wires. It makes changing the circuit easy whenever it needs modification. It is used in breadboards and other tools for prototyping.

3.4.8 Solenoid Door Lock

Fig: Solenoid door lock

A solenoid is basically an electromagnet, which is looped around by copper wire with a armature at the centre. An electromagnetic force is needed to order the solenoid to retract and extend, allowing the device to lock and unlock. When it gets a required voltage is acquired (normally around 9-12V), the solenoid lock retracts and hence the lock stays in open mode.

They are found in many shapes and sizes, small ones being used in doors, locks, etc to big ones being used in the industrial applications.

3.5: SOFTWARE REQUIREMENTS

3.5.1 OpenCV:

OpenCV is a cross platform library which can be used for Computer Vision in real time. It is a open-source library for Artificial intelligence, Vision PC, handling pictures. It can be used for detection, recognition, classification of both human and non-human characteristics. It can e used with various other libraries like numpy, pythonis to attain different visual goals. It uses vector Space to identify pictures, designs, patterns and perform various procedures on them.

3.5.2 Computer Vision

Computer Vision is a cycle using which we are able to store, control and extract information from pictures and recordings. For most part Utilization of Artificial Intelligence Computer Vision acts as a beginning point. PC Vision is assuming a significant part in self-driving vehicles, mechanical technology as well as in photograph revision applications.

3.5.3 Python (OpenCV implementation)

Python is an undeniable level, most famous and most used programming language. Python is used my millions of users just because of its very helpful community and the functionality of supporting a vast pre defined and user defined standard libraries. The functionality of modules reduces code word subsequently as we don't have to write huge codes repeatedly and simply use these modules. Python is the most preferred

language for Machine Learning, Artificial Intelligence and analysis as it is really powerful yet simple enough to understand and that is also a major reason of its fame among the beginners. Some information about Python are:

1.It is the most used and known programming language currently in the world.

2.It supports both Object Oriented and Procedural programming.

3.Normal user can understand the codes as the codes are really simple and understandable.

4.All big companies over the world prefer it as their main working language.

5.The biggest advantages of python is the vast standard libraries which allows us to perform various machine learning, artificial intelligence, GUI based applications, test format ,etc.

Chapter 4: EXPERIMENTS AND RESULTS

4.1: Model of the project:

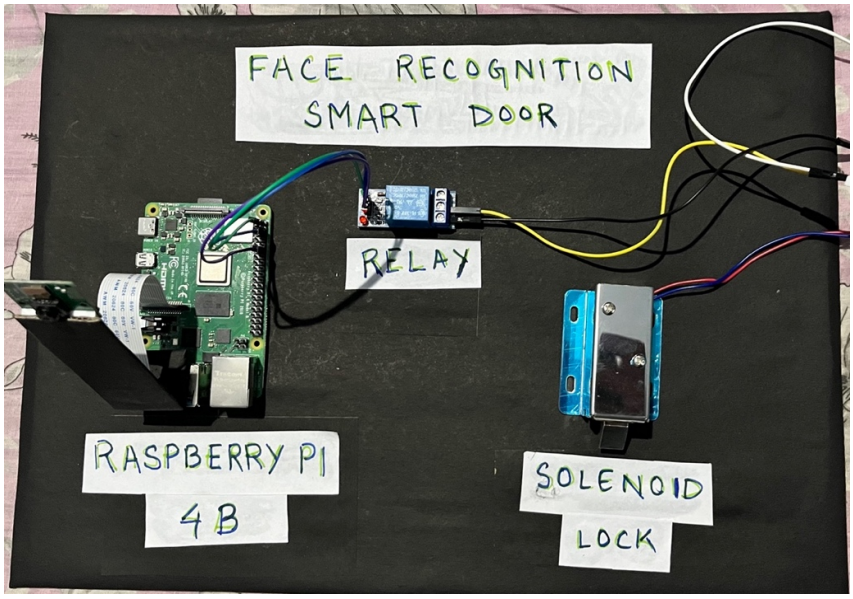


Fig: Final model of the Project

Fig: Compact model of the Project

4.2: Implementation:

The code has 4 important segments, one co-dependent on the other.

1: Capturing image and making dataset.

facial_req.py | headshots_picam.py

```python
import cv2
from picamera import PiCamera
from picamera.array import PiRGBArray

name = 'new nane' #name of new entry

cam = PiCamera()
cam.resolution = (512, 304)
cam.framerate = 10
rawCapture = PiRGBArray(cam, size=(512, 304))

img_counter = 0

while True:
    for frame in cam.capture_continuous(rawCapture, format="bgr", use_video_port=True):
        image = frame.array
        cv2.imshow("Press Space to take a photo", image)
        rawCapture.truncate(0)

        k = cv2.waitKey(1)
        rawCapture.truncate(0)
        if k%256 == 27: # ESC pressed
            break
        elif k%256 == 32:
            # SPACE pressed
            img_name = "dataset/"+ name +"/image_{}.jpg".format(img_counter)
            cv2.imwrite(img_name, image)
            print("{} written!".format(img_name))
            img_counter += 1

    if k%256 == 27:
        print("Escape hit, closing...")
        break

cv2.destroyAllWindows()
```

Fig: Registering new user.

2. Training the model with the available dataset

facial_req.py | headshots_picam.py | train_model.py

```python
#! /usr/bin/python

# import the necessary packages
from imutils import paths
import face_recognition
#import argparse
import pickle
import cv2
import os

# our images are located in the dataset folder
print("[INFO] start processing faces...")
imagePaths = list(paths.list_images("dataset"))

# initialize the list of known encodings and known names
knownEncodings = []
knownNames = []
```

```
# loop over the image paths
for (i, imagePath) in enumerate(imagePaths):
    # extract the person name from the image path
    print("[INFO] processing image {}/{}".format(i + 1,
        len(imagePaths)))
    name = imagePath.split(os.path.sep)[-2]

    # load the input image and convert it from RGB (OpenCV ordering)
    # to dlib ordering (RGB)
    image = cv2.imread(imagePath)
    rgb = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)

    # detect the (x, y)-coordinates of the bounding boxes
    # corresponding to each face in the input image
    boxes = face_recognition.face_locations(rgb,
        model="hog")

    # compute the facial embedding for the face
    encodings = face_recognition.face_encodings(rgb, boxes)

    # loop over the encodings
    for encoding in encodings:
        # add each encoding + name to our set of known names and
        # encodings
        knownEncodings.append(encoding)
        knownNames.append(name)

# dump the facial encodings + names to disk
print("[INFO] serializing encodings...")
data = {"encodings": knownEncodings, "names": knownNames}
f = open("encodings.pickle", "wb")
f.write(pickle.dumps(data))
f.close()
```

Fig: Training the model

3. Controlling solenoid through relay.

```
#Import all neccessary features to code.
import RPi.GPIO as GPIO
from time import sleep

#If code is stopped during active it will stay active
#This may produce a warning if restarted, this
#line prevents that.
GPIO.setwarnings(False)
#This means we will refer to the GPIO
#by the number after GPIO.
GPIO.setmode(GPIO.BCM)
#This sets up the GPIO 18 pin as an output pin
GPIO.setup(18, GPIO.OUT)

while (True):

    #This Turns Relay Off. Brings Voltage to Max GPIO can output ~3.3V
    GPIO.output(18, 1)
    #Wait 1 Seconds
    sleep(1)
    #Turns Relay On. Brings Voltage to Min GPIO can output ~0V.
    GPIO.output(18, 0)
    #Wait 1 Seconds
    sleep(1)
```

Fig: Solenoid lock control

4: Recognizing the registered user and opening the lock through relay

facial_req.py ✖ headshots_picam.py ✖ train_model.py ✖

```
#! /usr/bin/python

# import the necessary packages
from imutils.video import VideoStream
from imutils.video import FPS
import face_recognition
import imutils
import pickle
import time
import cv2
import RPi.GPIO as GPIO
from time import sleep

relay = 18
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(18, GPIO.OUT)



#Initialize 'currentname' to trigger only when a new person is identified.
currentname = "unknown"
#Determine faces from encodings.pickle file model created from train_model.py
encodingsP = "encodings.pickle"

# load the known faces and embeddings along with OpenCV's Haar
# cascade for face detection
print("[INFO] loading encodings + face detector...")
data = pickle.loads(open(encodingsP, "rb").read())

#stream the current live captures
vs = VideoStream(usePiCamera=True).start()
time.sleep(0.1)
```

facial_req.py ✖ headshots_picam.py ✖ train_model.py ✖

```
# start the FPS counter
fps = FPS().start()

# loop over frames from the video file stream
while True:
    # grab the frame from the threaded video stream and resize it
    frame = vs.read()
    frame = imutils.resize(frame, width=500)
    # Detect the fce boxes
    boxes = face_recognition.face_locations(frame)
    # compute the facial embeddings for each face bounding box
    encodings = face_recognition.face_encodings(frame, boxes)
    names = []
    GPIO.output(18, 1)

    # loop over the facial embeddings
    for encoding in encodings:
        # attempt to match each face in the input image to our known
        # encodings
        matches = face_recognition.compare_faces(data["encodings"],
            encoding)
        name = "Unknown" #if face is not recognized, then print Unknown


        # check to see if we have found a match
        if True in matches:
            print("Unlocking")
            #if found encoding set relay to open the lock
            GPIO.output(18,0)
            #time.sleep(5)
            # find the indexes of all matched faces then initialize a
            # dictionary to count the total number of times each face
            # was matched
            matchedIdxs = [i for (i, b) in enumerate(matches) if b]
            counts = {}
```

facial_req.py ✖ headshots_picam.py ✖ train_model.py ✖

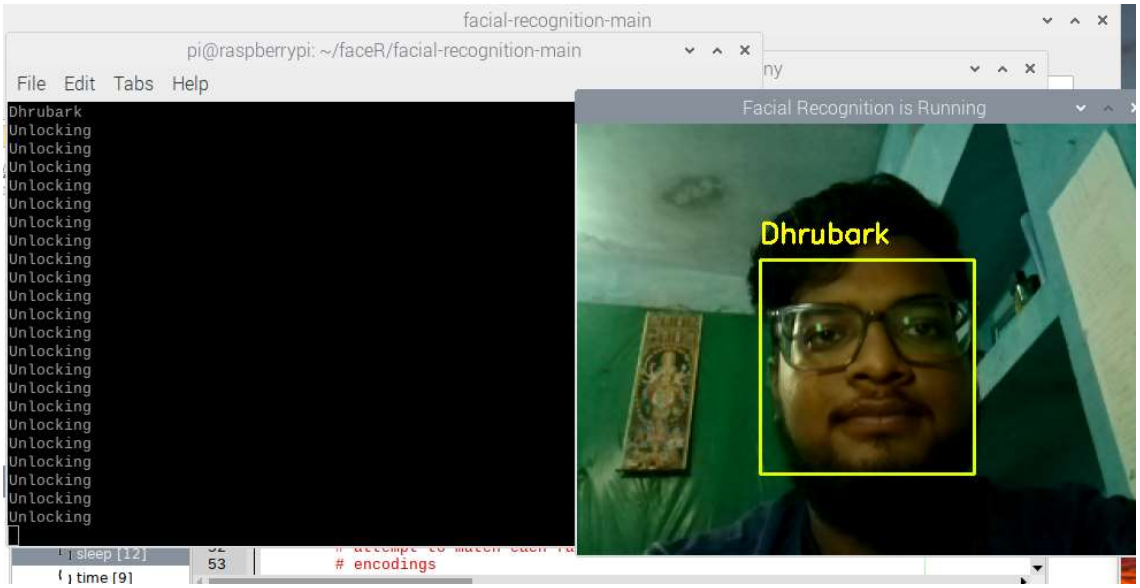
```
            # loop over the matched indexes and maintain a count for
            # each recognized face face
            for i in matchedIdxs:
                name = data["names"][i]
                counts[name] = counts.get(name, 0) + 1

            # determine the recognized face with the largest number
            # of votes (note: in the event of an unlikely tie Python
            # will select first entry in the dictionary)
            name = max(counts, key=counts.get)

            #If someone in your dataset is identified, print their name on the screen
            if currentname != name:
                currentname = name
                print(currentname)

        # update the list of names
        names.append(name)

    # loop over the recognized faces
    for ((top, right, bottom, left), name) in zip(boxes, names):
        # draw the predicted face name on the image - color is in BGR
        cv2.rectangle(frame, (left, top), (right, bottom),
            (0, 255, 225), 2)
        y = top - 15 if top - 15 > 15 else top + 15
        cv2.putText(frame, name, (left, y), cv2.FONT_HERSHEY_SIMPLEX,
            .8, (0, 255, 255), 2)
```

Fig: Execution

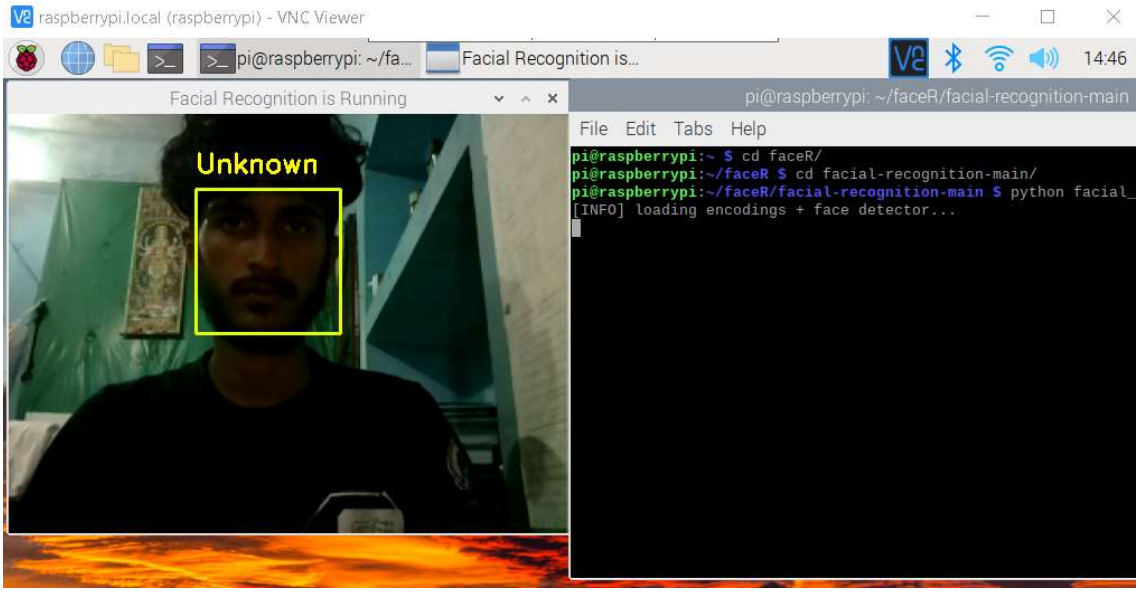
4.3 Result:

The system successfully identifies a registered personal, and opens the solenoid lock.

And on failure the lock remains close.



Success: Upon recognising a registered user the Door gets unlocked and the name of the person is showed on the screen.



Failure: Upon not recognizing the user, the lock stays closed and “Unknown” is shown in screen.

Chapter 5: CONCLUSION AND FUTURE SCOPE

We were able to recognize a registered user using OpenCv and python in raspberry pi OS (operating system). The model works almost perfectly under different lighting and camera conditions. Also, the algorithm needs ample training sets to identify an object with precision.

5.1 Future Scopes

The whole system can be replaced by a instance in the cloud, while will drastically save cost of the system. Migrating the system into the cloud would give a sub sequential advantage over costly traditional system.

For an improved, powerful framework to be carried out and accomplished, the accompanying idea needs additional working.

A high quality sensor is prescribed for accomplish improve execution, upgrade precision also accomplish better usefulness.

The Raspberry pi board used is really costly and it is required for each separate unit. We can lower the cost subsequently by transferring the computation done by the board to an instance in the cloud. The instance will be able to upscale and downscale accordingly. This will in turn save us a lot of money as computation could be performed in the cloud for a bunch of units in a single instance in the cloud.

5.2 Limitation of the project

The direct sunlight affects the camera sensor where in the sensor is unable to take pictures. Additionally, different factors like a chimney, wind from a system, heat from heaters also effect the functionality of the picamera. Under dark condition, picamera is unable to capture frames.

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