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Secure Door Entry Using Face Recognition And Thermal Screening

Prince Mohammad Bin Fahd University
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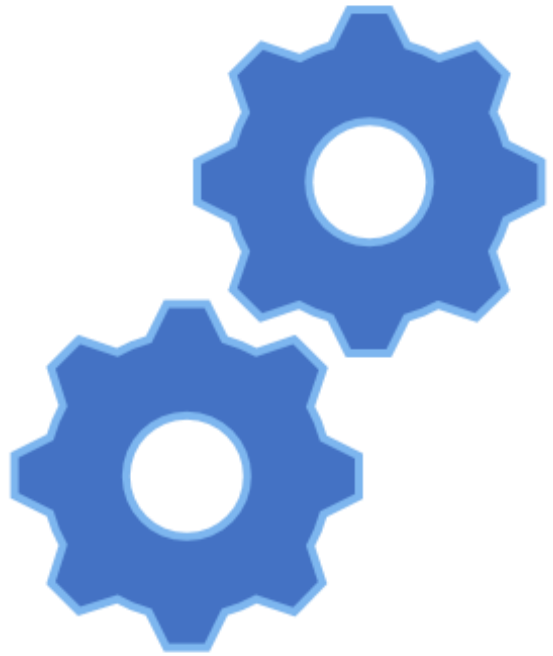
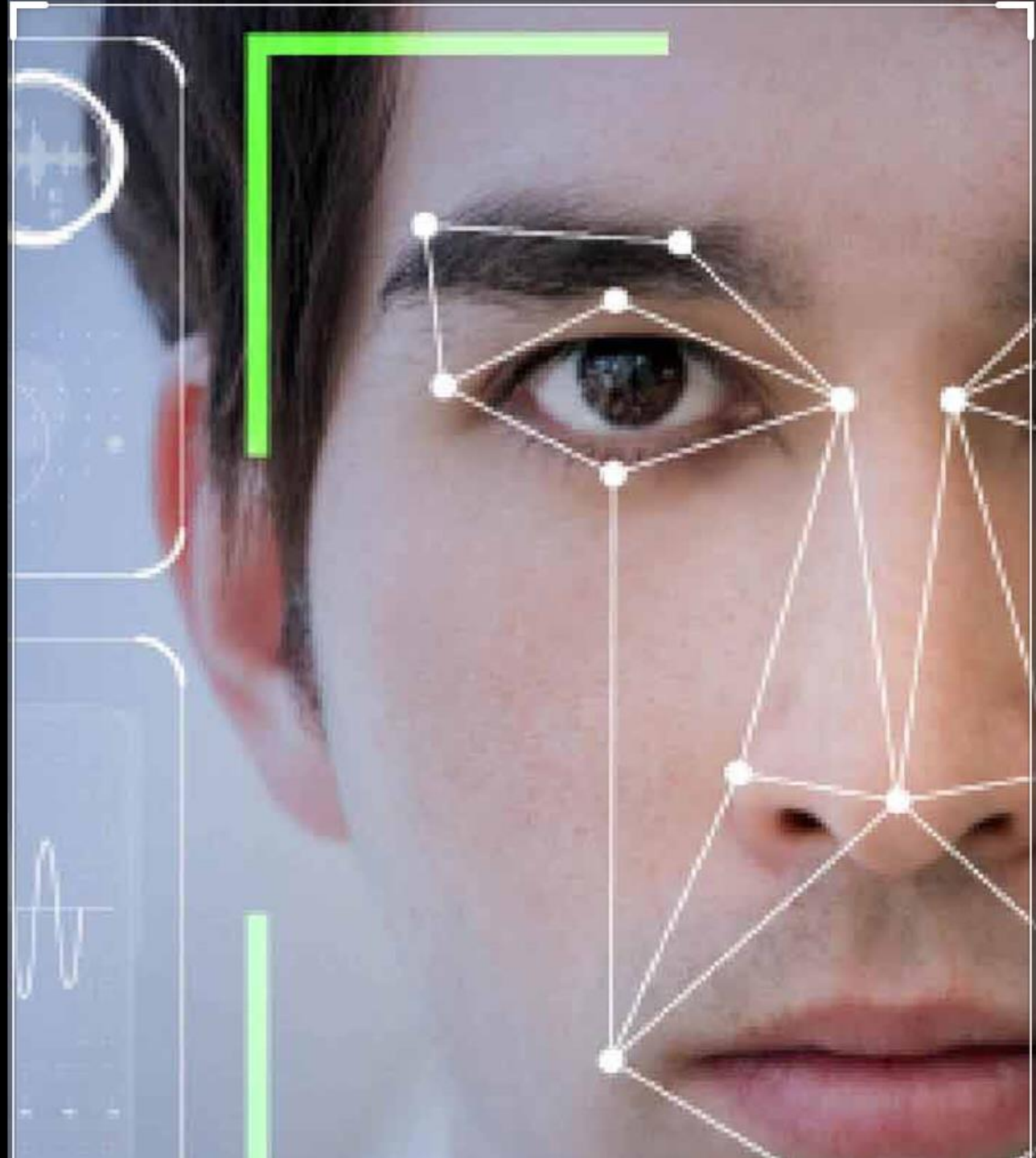
Outline

- Project Definition .
- Project Objectives.
- Project Specifications .
- Project Constraints and Engineering Standards
- Project Architecture .
- Planning .
- Background &Previous Project .
- Design: subsystem and components Selection
- Testing.
- Project Management & Team Work.
- Impact Of Project.
- New Skills Acquired And Applied.
- Completed and Remaining work.
- Budget estimate
- References.



Project Definition

Designing a smart device that allows or disallowed people to get access through the door based on their face and body temperature.



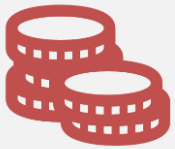
Project Objectives

- To Protect human beings.
- To Minimize infection of“ COVID 19” Corona virus.
- To Organize people entrance through the door.
- To Do temperature quick check up.
- To be able to use this smart device at every assembly places.

Project Specifications

- To Allow entry of the person based on his/her recognized face and body temperature .
- To Recognize the face, capture the video and process it .
- To Measure the body temperature using IR sensor.
- To Display the face matching percentage

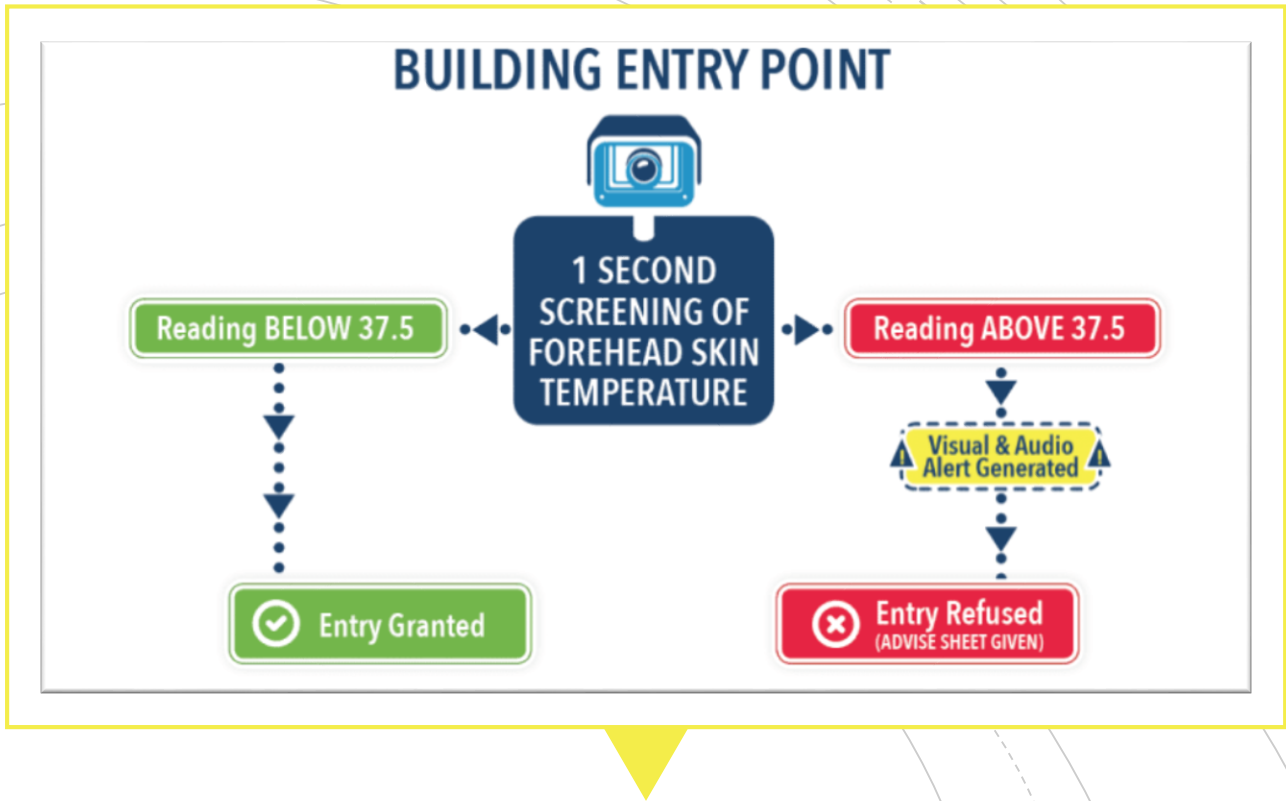
Design Constraints &Engineering Standard



Economic.

Safety.

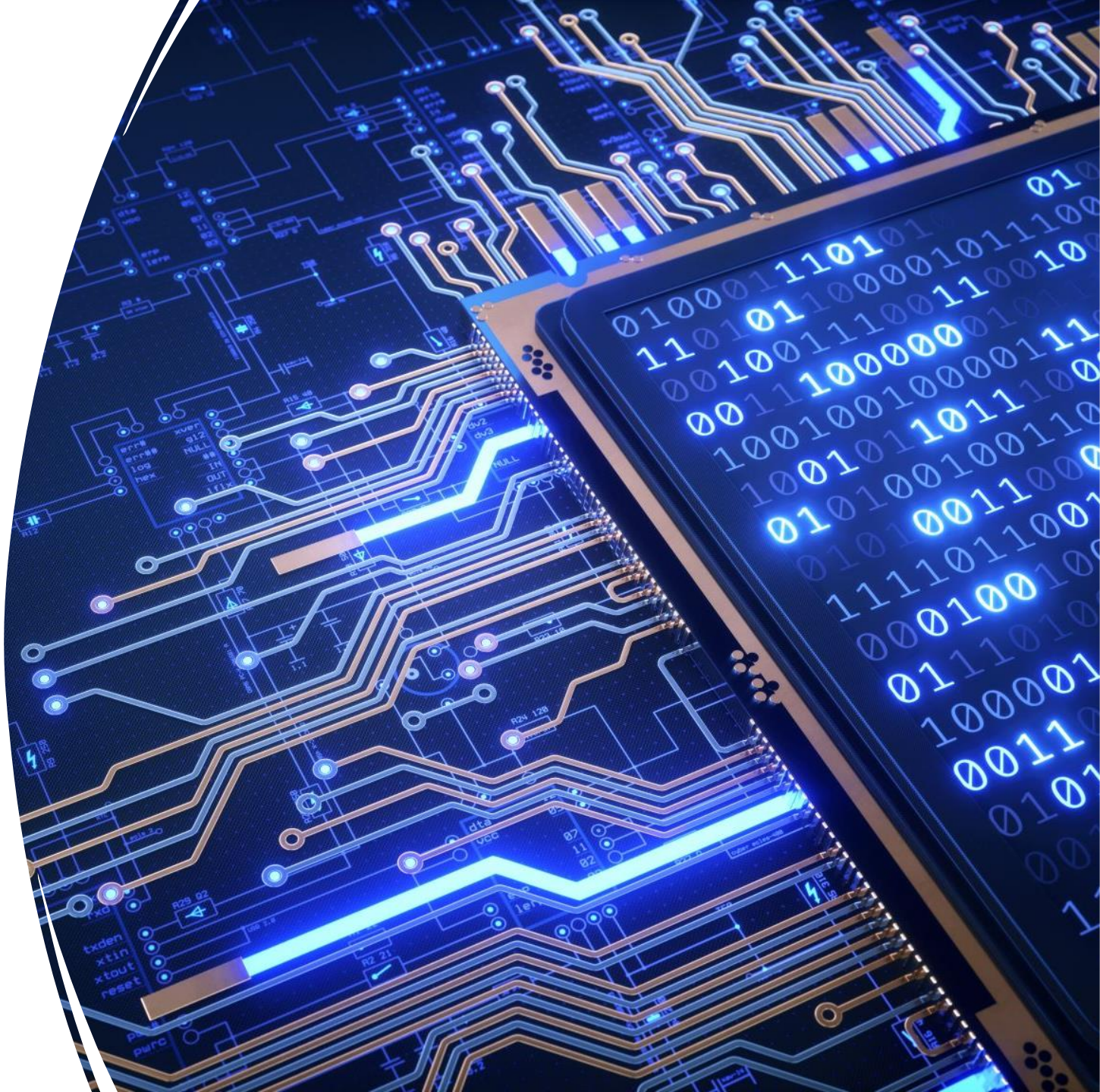
Social,Culture.



Project Architecture

Planning

- We ordered most of the components from the online market.
- We were able to borrow some components from the university
- We were able to test and measure the components at PMU labs.



Previous Project Summary

Project	1	2	3	4	Our project
Temperature sensor	Yes	Yes	Yes	Yes	Yes
Way of measuring temperature	Through forehead	Through human body	Through forehead	Through human body	Through human body
Camera	Yes	N\A	Yes	Yes	Yes
Screen Monitor	Yes	Yes	Yes	Yes	Yes

Design

- Computer vision based image processing for face recognition, thermal screening using temperature sensor, door locking system implementation.

.

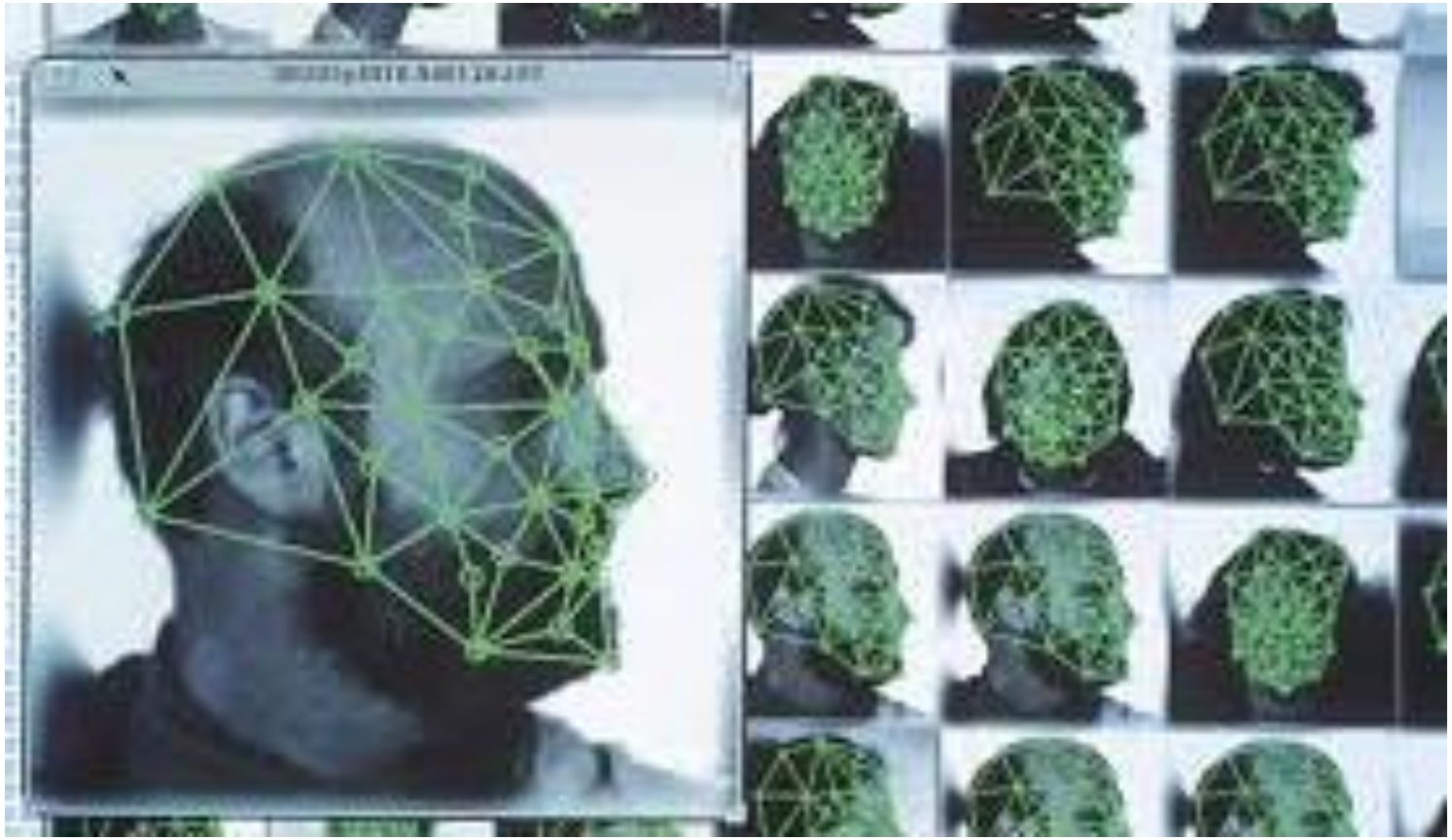
❖ To study face detection and recognition algorithm applicable in real-time processing.

❖ To prepare the processor OS.

❖ To simulate the face recognition algorithm.

❖ Implement the face recognition algorithm in the processor.

Face Recognition



- **Face recognition systems can operate basically in two modes:**

❖ Verification a facial image.

❖ Identification or facial recognition.

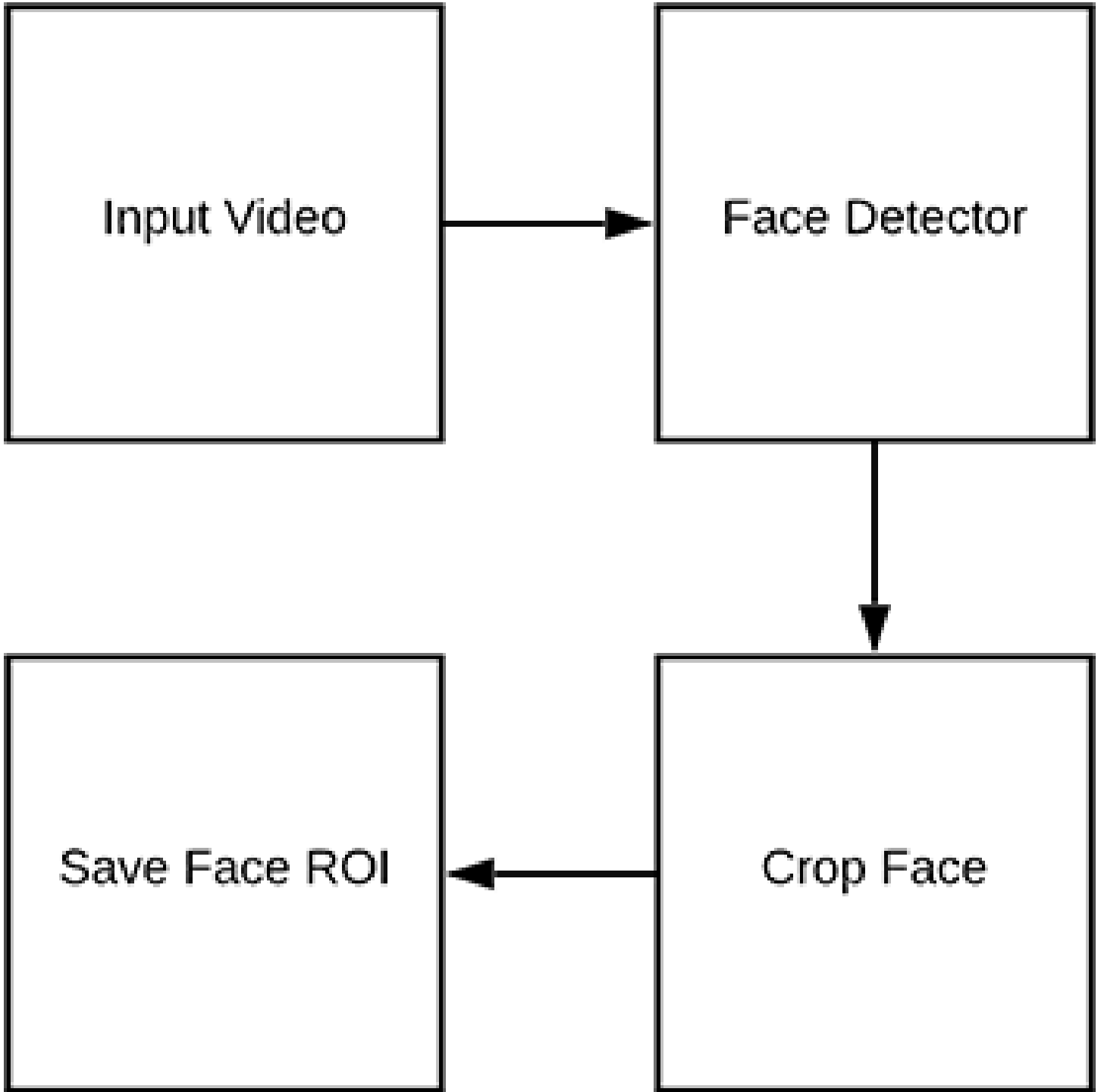
Difference between Face detection and Face recognition

Face Detection: Is finding the location and size of faces.

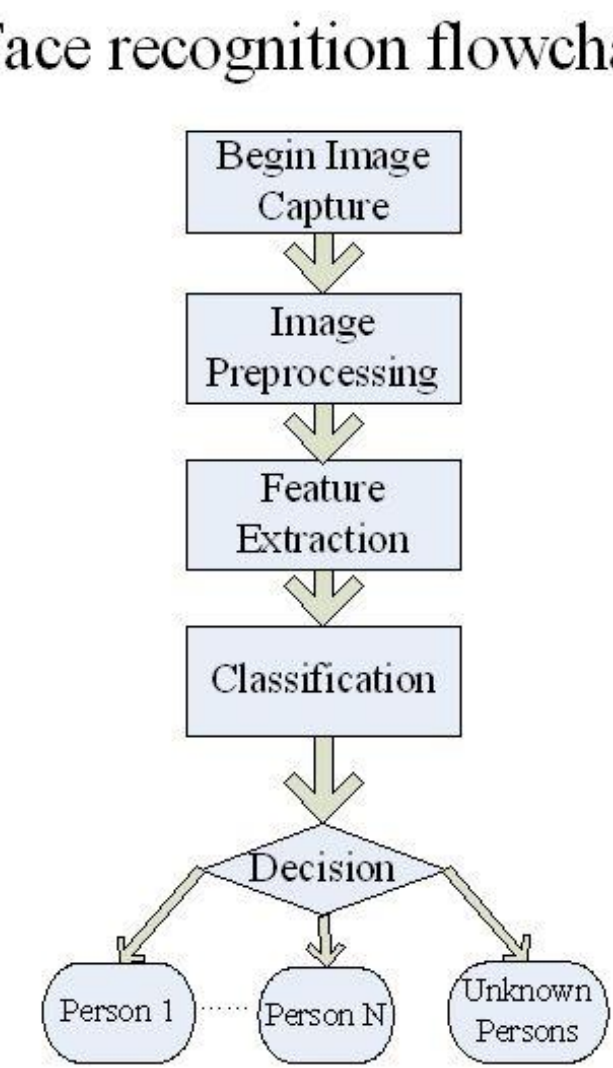
Face Recognition: is resized and corpped the image then converted to gray scale.

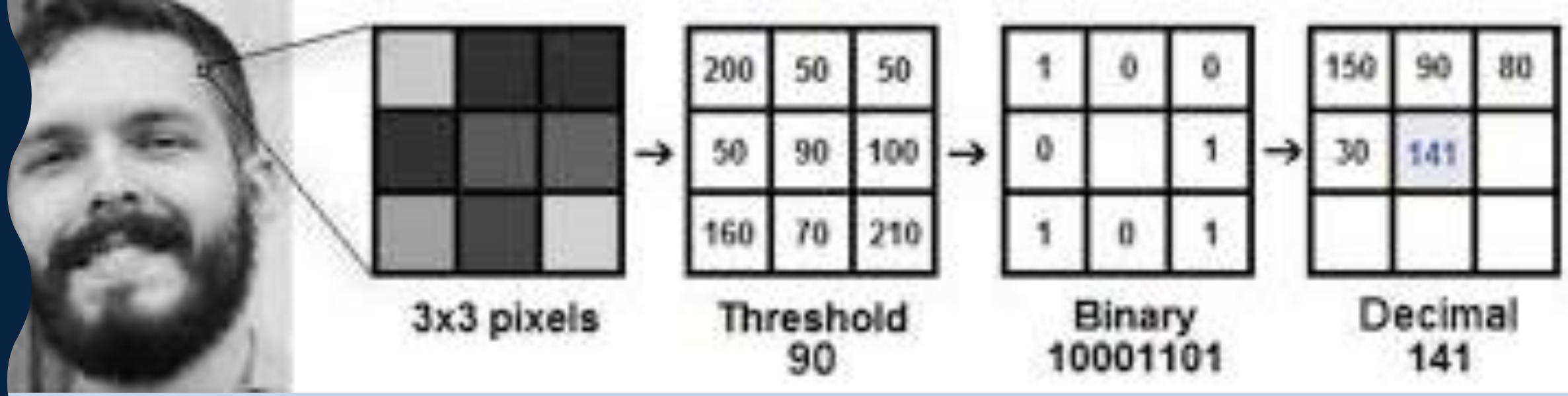
Local Binary Pattern detarepo si :(PBL) yb egami na fo slexip eht slebal hcihw hcae fo doohrobhgien eht gnidlohserht yranib a sa tluser eht sredisnoc dna lexip rebmun

Datasets Flow Chart



A Face Recognition Flowchart





Local Binary pattern Histogram

Testing

We wrote programs in python and we test(extract) the result:

- Face Detection program
- Create Data file.
- Initiate and run Face recognition program.
- Test Raspberry PI.

```python
import cv2
import sys

faceCascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')

video_capture = cv2.VideoCapture(0)

img_counter = 0

while True:
    # Capture frame-by-frame
    ret, frame = video_capture.read()

    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
    k = cv2.waitKey(1)
    faces = faceCascade.detectMultiScale(
        gray,
        scaleFactor=1.5,
        minNeighbors=5,
        minSize=(30, 30),
        flags=cv2.CASCADE_SCALE_IMAGE
    )

    # Draw a rectangle around the faces
    for (x, y, w, h) in faces:
        cv2.rectangle(frame, (x, y), (x+w, y+h), (0, 255, 0), 2)

    # Display the resulting frame
    cv2.imshow('FaceDetection', frame)

    if k%256 == 27: #ESC Pressed
        break
    elif k%256 == 32:
        # SPACE pressed
        img_name = "facedetect_webcam_{}.png".format(img
        cv2.imwrite(img_name, frame)
        print("{} written!".format(img_name))
```

Codes for programs

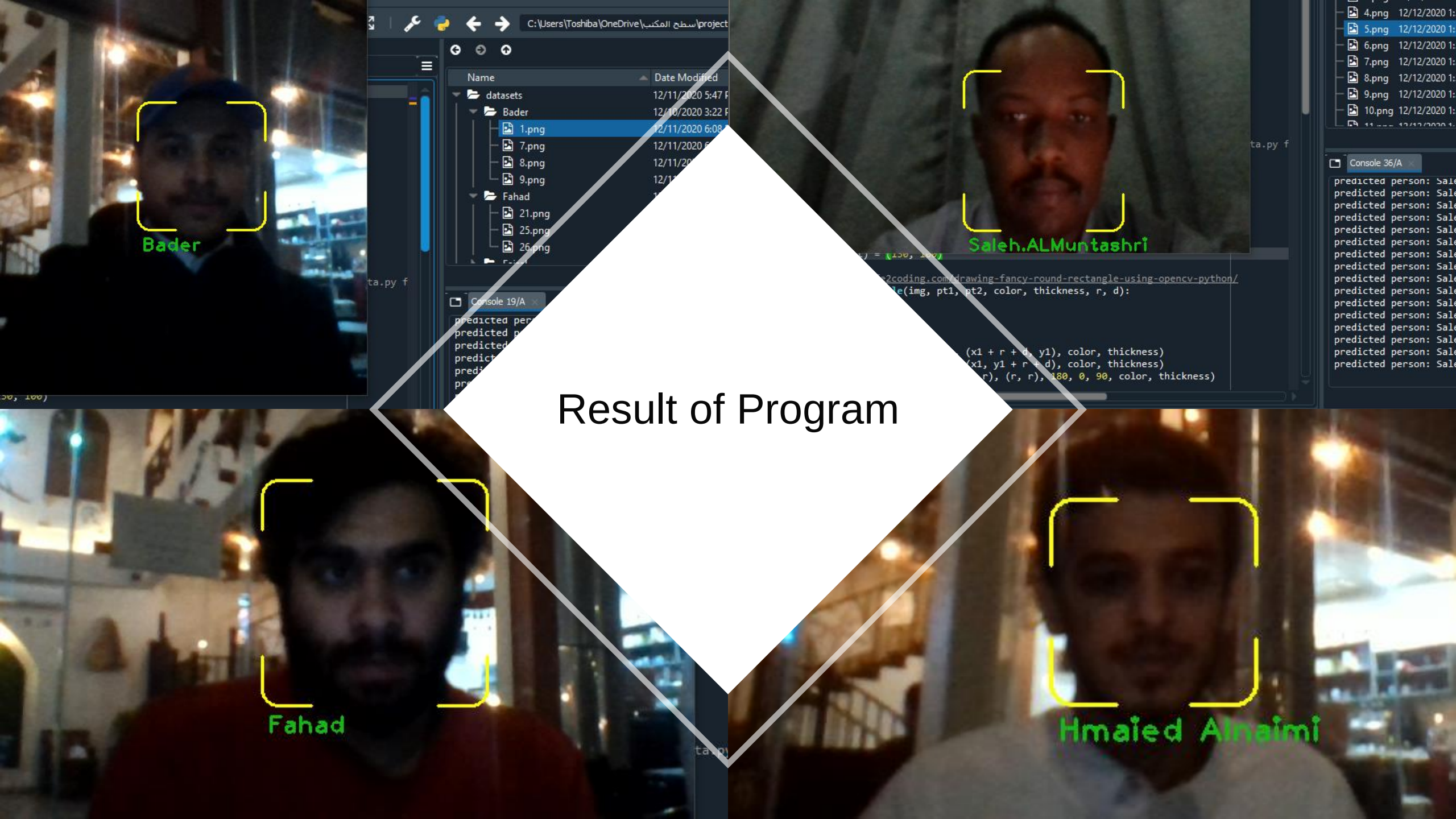
Face Detection code

```python
size = 4
import cv2, sys, numpy, os

# change the paths below to the location where these files are on your machine
# haar_file path
haar_file = 'haarcascade_frontalface_default.xml'
# path to the main faces directory which contains all the sub_datasets
datasets = 'datasets'


print('Training classifier...')
# Create a list of images and a list of corresponding names along with a unique id
(images, labels, names, id) = ([], [], {}, 0)
for (subdirs, dirs, files) in os.walk(datasets):
    for subdir in dirs:
    # the person's name is the name of the sub_dataset created using the create_data.py f
        names[id] = subdir
        subjectpath = os.path.join(datasets, subdir)
        for filename in os.listdir(subjectpath):
            path = subjectpath + '/' + filename
            label = id
            images.append(cv2.imread(path, 0))
            labels.append(int(label))
        id += 1
(width, height) = (130, 100)

# https://www.life2coding.com/drawing-fancy-round-rectangle-using-opencv-python/
def rounded_rectangle(img, pt1, pt2, color, thickness, r, d):
    x1,y1 = pt1
    x2,y2 = pt2

    # Top left
    cv2.line(img, (x1 + r, y1), (x1 + r + d, y1), color, thickness)
    cv2.line(img, (x1, y1 + r), (x1, y1 + r + d), color, thickness)
    cv2.ellipse(img, (x1 + r, y1 + r), (r, r), 180, 0, 90, color, thickness)
```

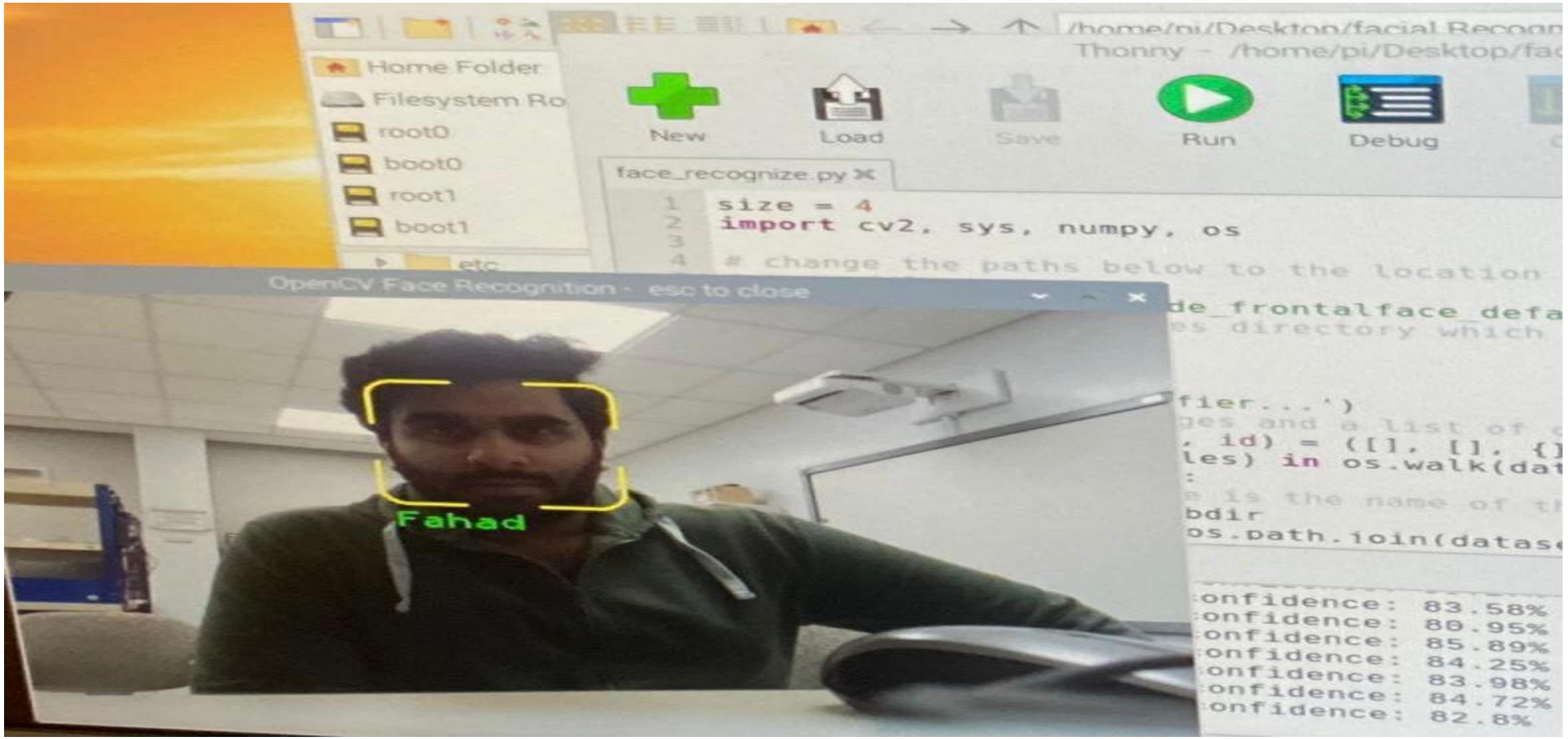
- Face Recognition codes:

```
5   @author: Toshiba
6   """
7
8   # -*- coding: utf-8 -*-
9   """
10  Created on Mon Nov 30 12:00:29 2020
11
12  @author: hmewada
13  """
14  # Creating database
15  # It captures images and stores them in datasets
16  # folder under the folder name of sub_data
17  import cv2, sys, numpy, os
18  haar_file = 'haarcascade_frontalface_default.xml'
19
20  # All the faces data will be
21  #  present this folder
22  datasets = 'datasets/'
23
24
25  # These are sub data sets of folder,
26  # for my faces I've used my name you can
27  # change the label here
28  sub_data = 'Faisal'
29
30  path = os.path.join(datasets, sub_data)
31  if not os.path.isdir(path):
32      os.mkdir(path)
33
34  # defining the size of images
35  (width, height) = (130, 100)
36
37  #'0' is used for my webcam,
38  # if you've any other camera
39  #  attached use '1' like this
40  face_cascade = cv2.CascadeClassifier(haar_file)
41  webcam = cv2.VideoCapture(0)
```

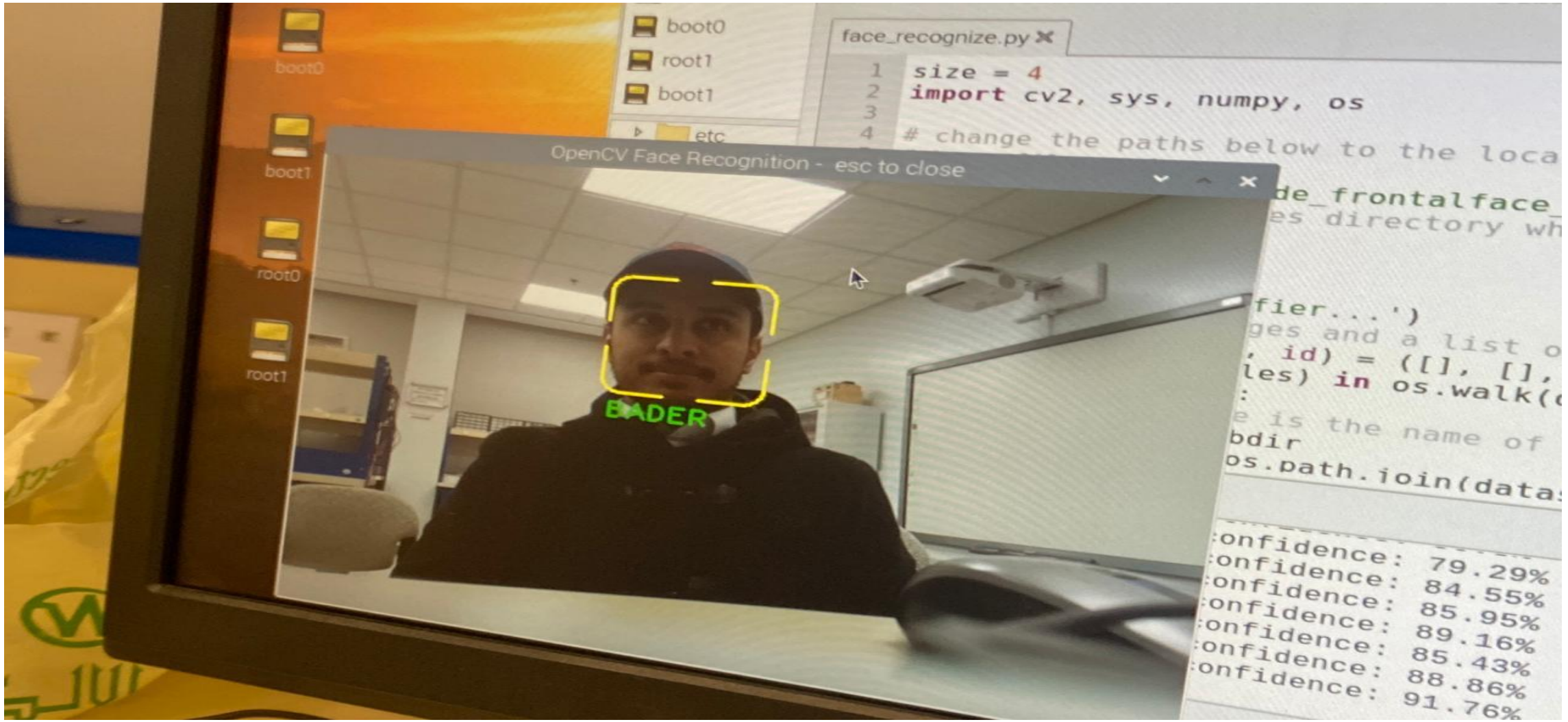
❖Datasets:

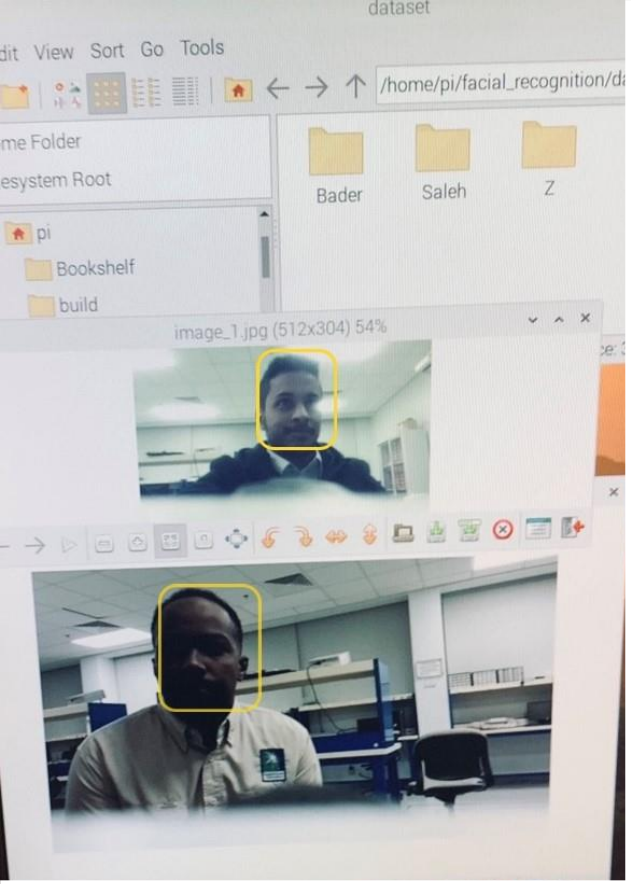

Bader
Saleh.ALMuntashri
Fahad
Hmaied Alnaimi
Result of Program

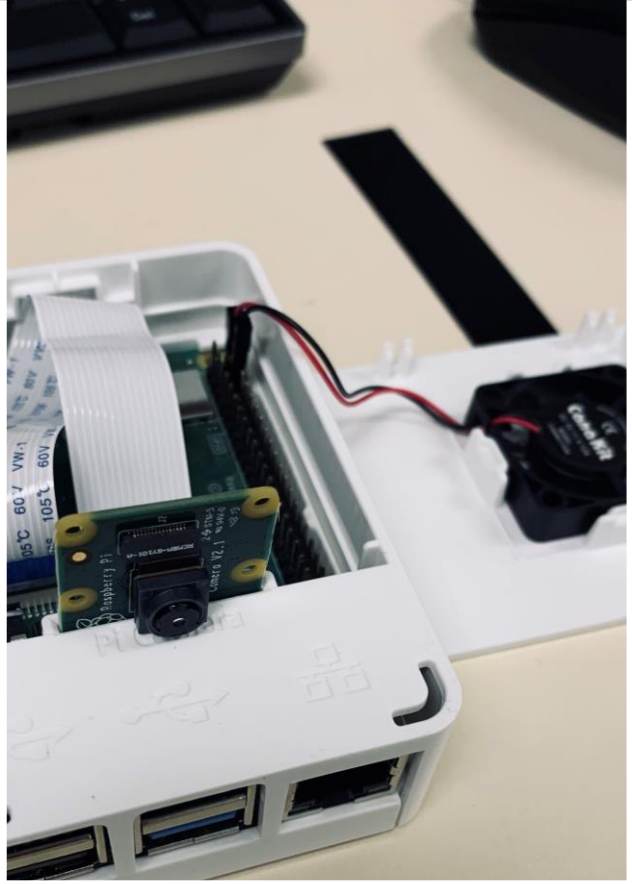
Face Matching Percentage

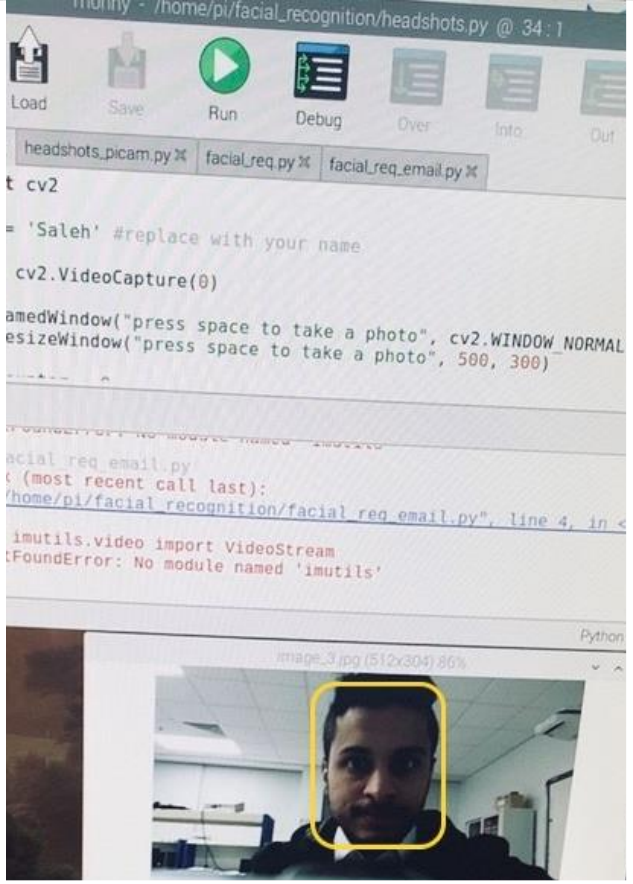


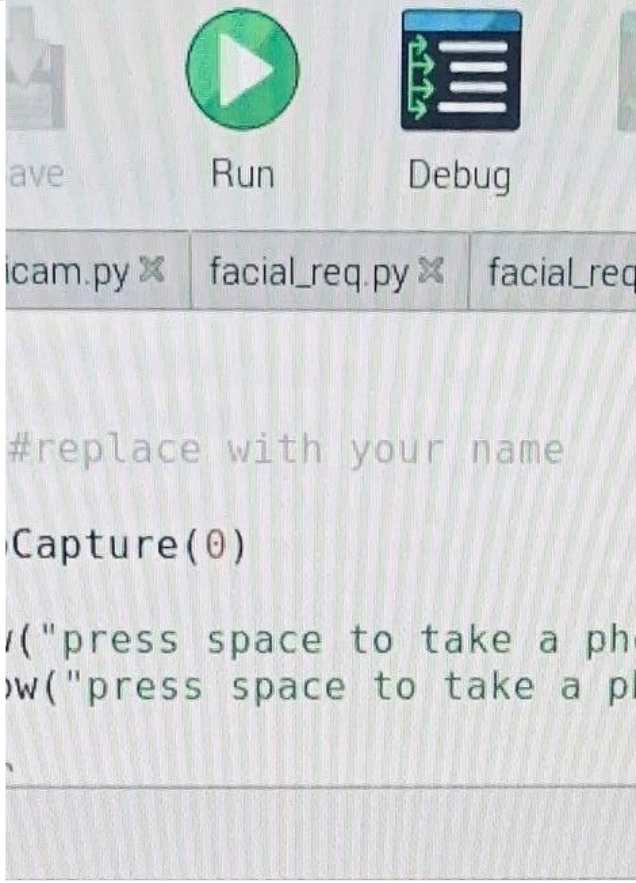
Face Matching Percentage







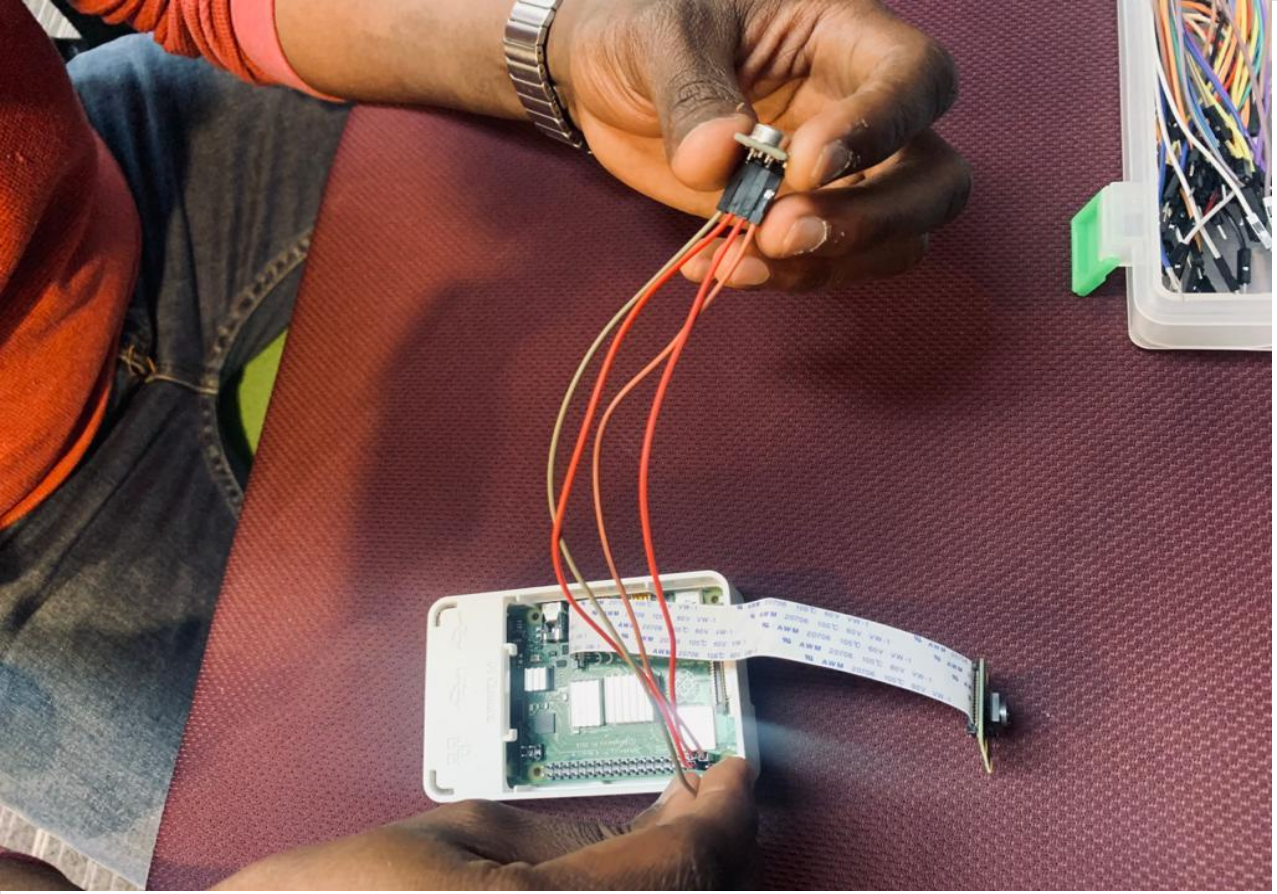




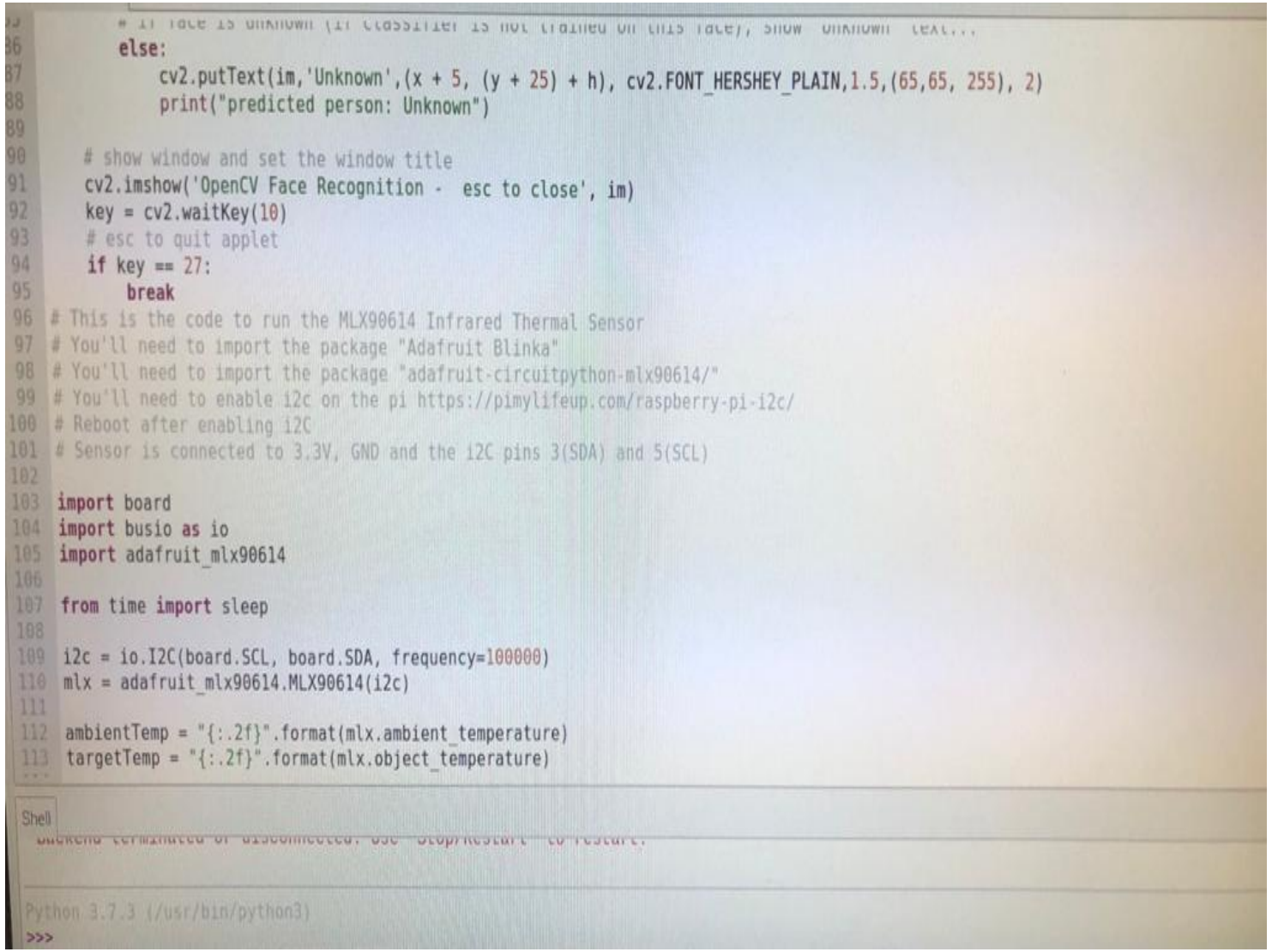
Raspberry PI Testing &Excute Data

Thermal Screening

Measuring the body temperature



IR SENSOR



```
        else:
            cv2.putText(im,'Unknown',(x + 5, (y + 25) + h), cv2.FONT_HERSHEY_PLAIN,1.5,(65,65, 255), 2)
            print("predicted person: Unknown")

    # show window and set the window title
    cv2.imshow('OpenCV Face Recognition -  esc to close', im)
    key = cv2.waitKey(10)
    # esc to quit applet
    if key == 27:
        break
# This is the code to run the MLX90614 Infrared Thermal Sensor
# You'll need to import the package "Adafruit Blinka"
# You'll need to import the package "adafruit-circuitpython-mlx90614/"
# You'll need to enable i2c on the pi https://pimylifeup.com/raspberry-pi-i2c/
# Reboot after enabling i2C
# Sensor is connected to 3.3V, GND and the i2C pins 3(SDA) and 5(SCL)

import board
import busio as io
import adafruit_mlx90614

from time import sleep

i2c = io.I2C(board.SCL, board.SDA, frequency=100000)
mlx = adafruit_mlx90614.MLX90614(i2c)

ambientTemp = "{:.2f}".format(mlx.ambient_temperature)
targetTemp = "{:.2f}".format(mlx.object_temperature)
```

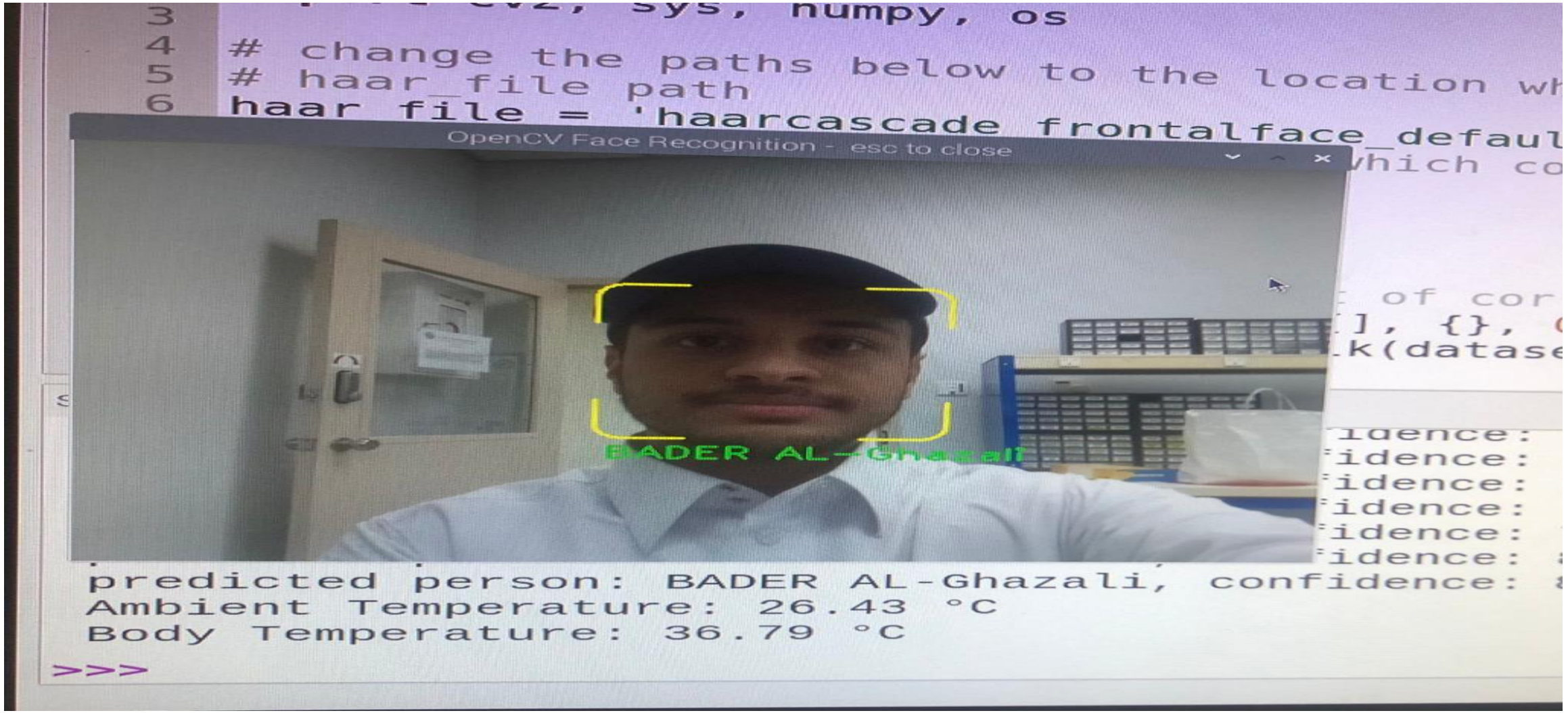
Shell

Python 3.7.3 (/usr/bin/python3)

>>>

Combined code (face recognition & body temperature)

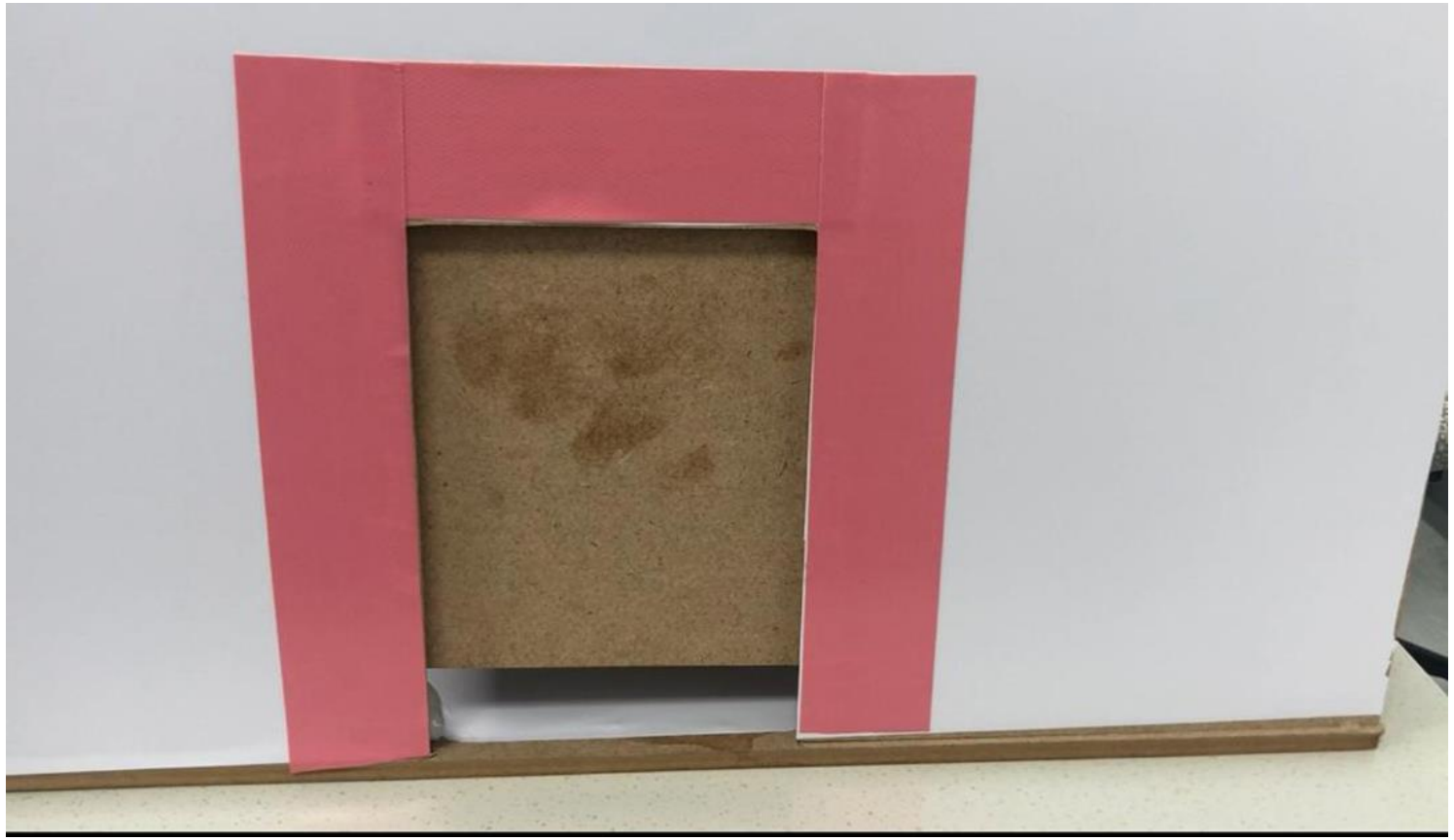
Result of Program



Door Mechanism

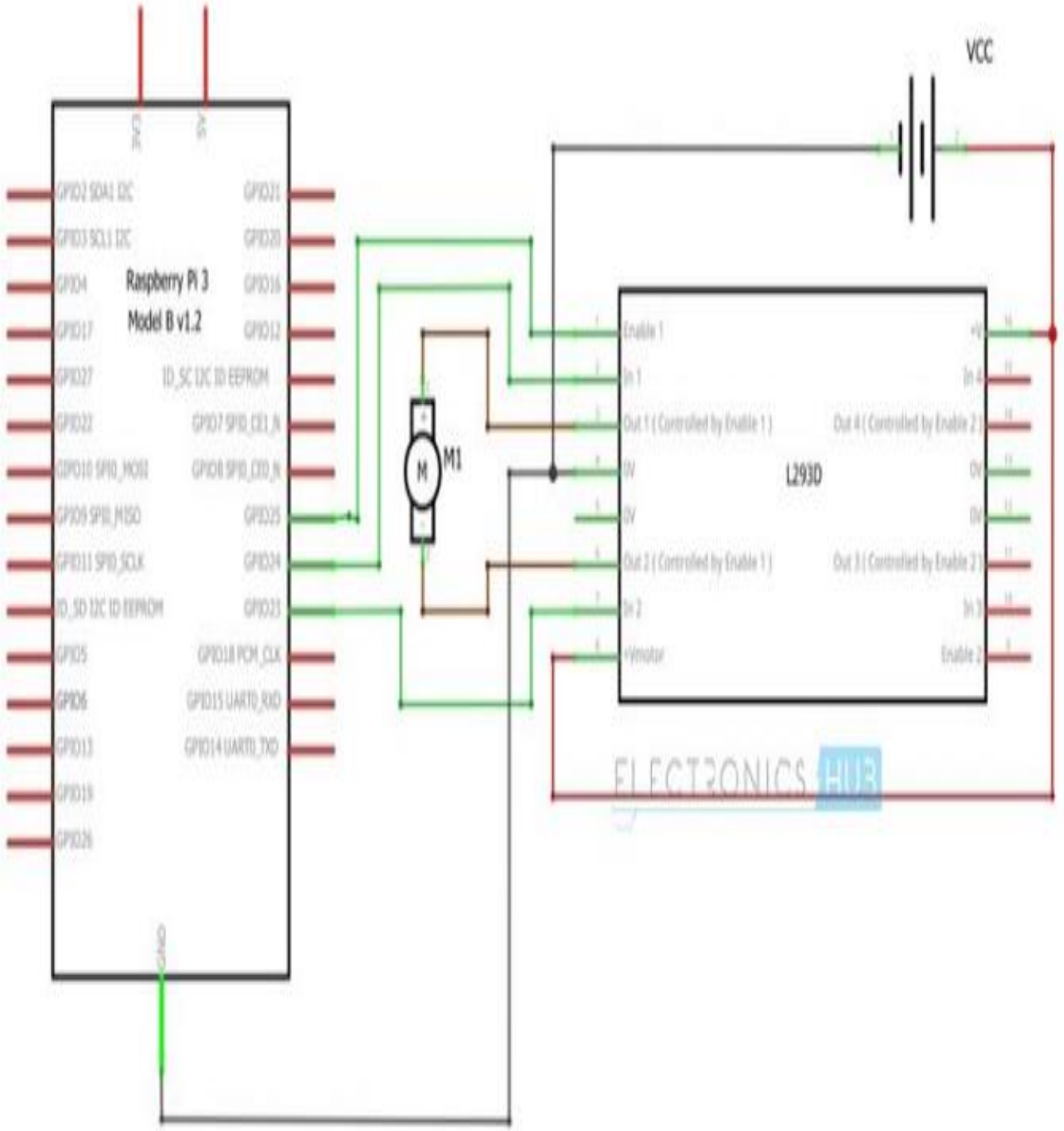
Secure door entry

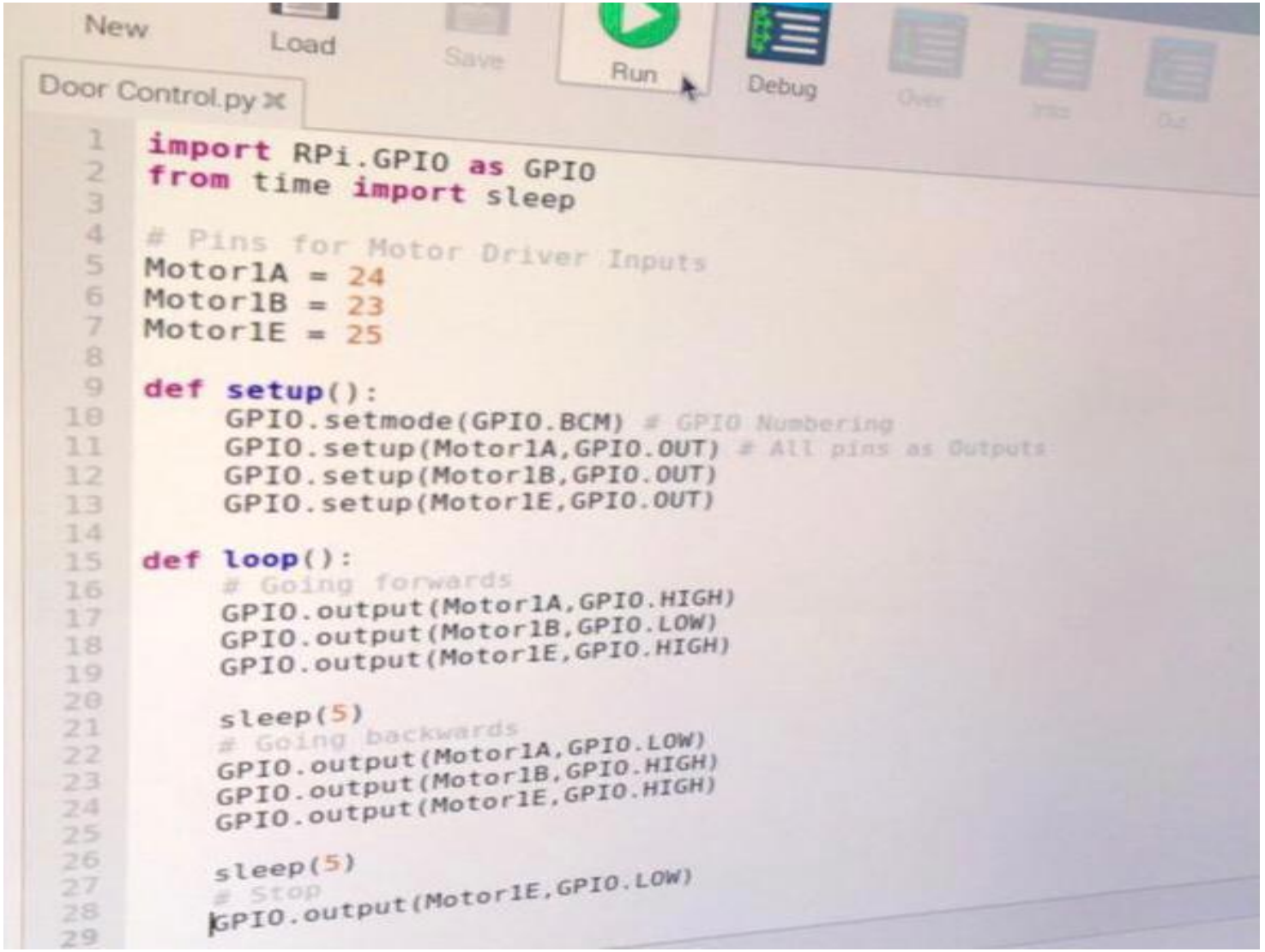
Required conditions for opening the door



- Being recognized from the camera
- Body temperature should be <= 37.5

Circuit for controlling DC Motors with Raspberry Pi





Code for controlling the DC Motors with Raspberry Pi

Completed Work

- ✓ Raspberry PI Testing
- All Subsystems
- Final Circuit

Project Management & Team Work

Task	Bader	Saleh	Fahad	Hemaid	Rayan
Search & acquire components	20%	20%	20%	20%	20%
Design & Implement Subsystem 1	35%	35%	10%	10%	10%
Design & Implement Subsystem 2	20%	15%	40%	15%	10%
Design & Implement Subsystem 3	10%	10%	15%	35%	30%
Testing	20%	20%	20%	20%	20%
Write Reports & Presentations	20%	20%	20%	20%	20%

Project Management & Team Work

#	Risk Description	Risk Management	Impact
1	Learning a new language (Python)	We learn this new language	We were able to solve this problem and finish the project
2	Losing all the information in the Raspberry Pi	We were able in getting back all the information in 24 hours	We were able to overcome this obstacle

New Skills Acquired and Applied

- Learning a new language (Python)
- Implementing Troubleshooting
- Dealing with time pressure

Components Conditions

No.	Description	Quantity	
1	Raspberry PI 4 Micro controller	1	ALL RECEIVED
2	64 GB Memory card	1	
3	MLX90614	1	
4	HDMI based LCD display (16x2)	1	
5	Connecting wires package	1	
6	PI Camera	1	

Budget Estimate

No.	Description	Quantity	Unit Cost (SR)	Total Cost (SR)
1	Raspberry PI 4 Micro controller	1	345	345
2	64 GB Memory card	1	120	120
3	MLX90614	1	49	49
4	HDMI based LCD display (16x2)	1	48	48
5	Connecting wires package	1	45	45
6	PI Camera	1	100	100
				Final Cost(SR)
	....			707 SR
				15% VAT
				813 SR

References

1. *J. Güttler, C. Georgoulas and T. Bock, "Contactless fever measurement based on thermal imagery analysis," 2016 IEEE Sensors Applications Symposium (SAS), Catania, 2016, pp. 1-6, doi: 10.1109/SAS.2016.7479837.*
2. *S. Ali, S. Khan and A. Bermak, "Inkjet-Printed Human Body Temperature Sensor for Wearable Electronics," in IEEE Access, vol. 7, pp. 163981-163987, 2019, doi: 10.1109/ACCESS.2019.2949335.*
3. *A. Somboonkaew et al., "Mobile-platform for automatic fever screening system based on infrared forehead temperature," 2017 Opto-Electronics and Communications Conference (OECC) and Photonics Global Conference (PGC), Singapore, 2017, pp. 1-4, doi: 10.1109/OECC.2017.8114910.*
4. *P. Oğuz and G. Ertaş, "Wireless dual channel human body temperature measurement device," 2013 International Conference on Electronics, Computer and Computation (ICECCO), Ankara, 2013, pp. 52-55, doi: 10.1109/ICECCO.2013.6718227.*

Final Presentation Video

- https://www.youtube.com/watch?v=BtTZ0pdo1Nw

Questions & Ansewrs