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Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

Review 3

Course Title: Biometric Systems

Course Code: SWE1015

Topic: Multimodal Biometric System
Team name: Matrix
Team Number:2

GROUP MEMBERS:	
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REVIEW 2:

PROBLEM STATEMENT FOR CHOSEN BIOMETRIC:

Problem:
Design and develop an individual authentication system using suitable biometric traits

Outcomes:
1. Demonstration of the suitability of the chosen biometrics for various test cases (ex. Genuine Authentication, Imposter Detection, Noisy Conditions,
Occlusion etc.
2. Identification of best tools used to implement the problem solution.

PROPOSED SOLUTION WITH ARCHITECTURE DIAGRAM:

Proposed Solution: Multi-Modal Biometric Authentication System with Fingerprint and Face Recognition

1. Overview:

The proposed solution is a multi-modal biometric authentication system designed for individual identification and attendance management. It utilizes both fingerprint and face recognition technologies to enhance security and accuracy in authentication processes.

2. System Architecture:

The system consists of the following key components:

Fingerprint Module: Captures and processes fingerprint data for initial identification.
Face Recognition Module: Performs facial recognition for further verification after successful fingerprint authentication.
Biometric Database: Stores biometric data (fingerprint templates and facial features) for comparison and authentication.
User Interface: Provides an intuitive interface for users to interact with the system and perform authentication operations.

3. Authentication Workflow:

Fingerprint Identification:

Upon user request for authentication, the system prompts the user to scan their fingerprint.
The fingerprint module captures the fingerprint image and extracts unique features.
The extracted features are matched against the fingerprint templates stored in the biometric database.

If a match is found, the user proceeds to the next step. Otherwise, authentication fails.

Face Recognition:

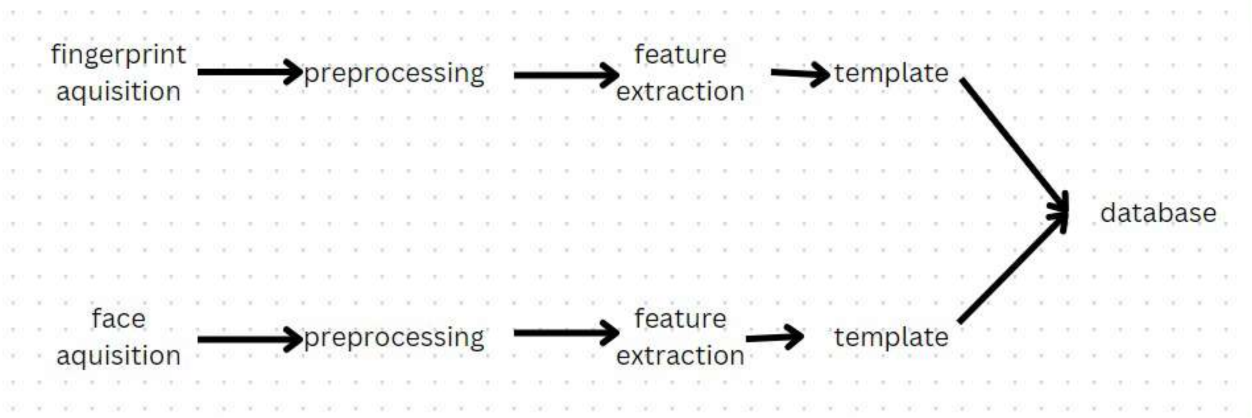
After successful fingerprint identification, the system prompts the user to position their face within the camera view.
The face recognition module captures the facial image and extracts facial features.
The extracted features are compared against the facial features stored in the biometric database.
If the facial features match, the user is successfully authenticated.

4. Advantages of the Proposed Solution:

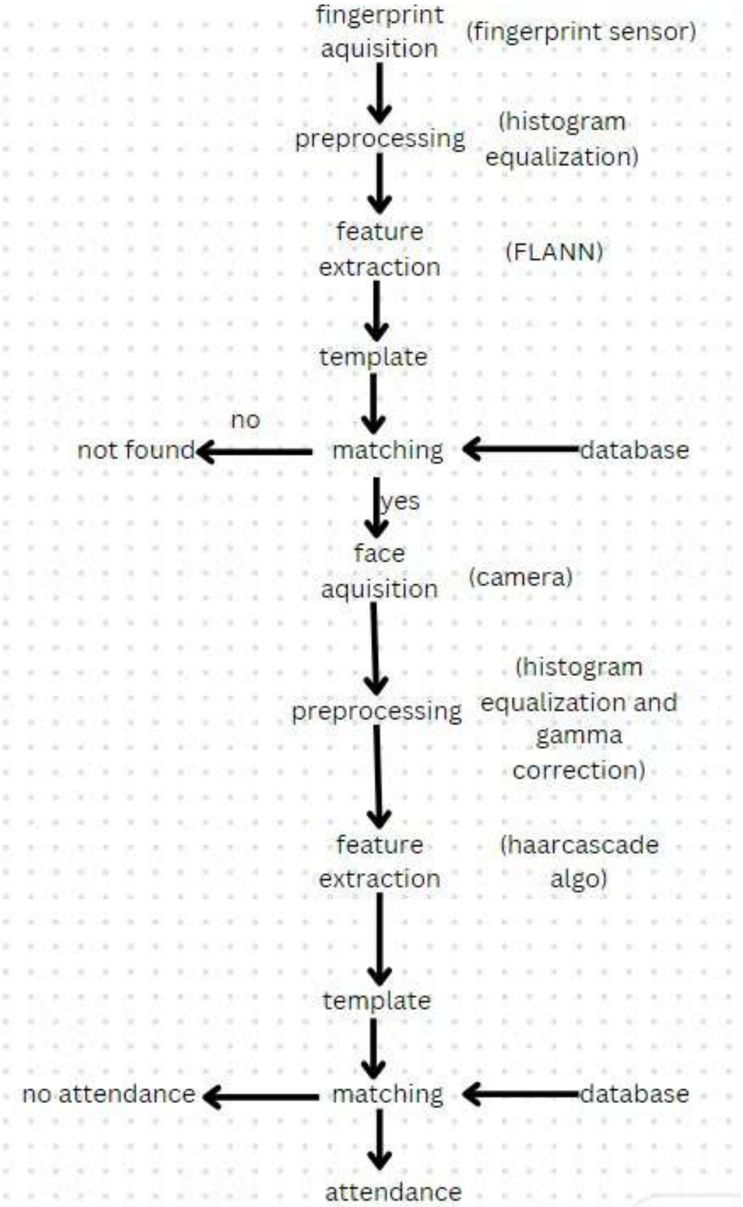
Enhanced Security: The use of multiple biometric modalities (fingerprint and face) significantly enhances the security of the authentication process by reducing the likelihood of false positives and impostor attacks.
Improved Accuracy: By combining fingerprint and face recognition technologies, the system achieves higher accuracy in individual identification, even in noisy conditions or situations with partial occlusion.
Reduced False Acceptance Rate (FAR): The multi-modal approach helps in reducing the false acceptance rate by requiring successful authentication in both fingerprint and face recognition stages.
Versatility: The system is versatile and can be deployed in various environments, including offices, educational institutions, and high-security facilities, for attendance management and access control purposes.
Scalability: The modular architecture of the system allows for easy scalability to accommodate a large number of users without compromising performance or security.
User-Friendly Interface: The system provides a user-friendly interface for seamless interaction, making it convenient for users to authenticate themselves quickly and efficiently.

General Architecture on **Study of Face And Fingerprint Multimodal Biometric System**

Registration



Identification and verification



Face Recognition Module:

Algorithm: Haar Cascade

Trains on positive and negative images to create a classifier identifying facial features like eyes, nose, and mouth.

Fingerprint Recognition Module:

Algorithm: FLANN (Fast Library for Approximate Nearest Neighbors)

Facilitates finding similar fingerprint patterns, enabling swift and precise matching against a stored fingerprint database.

DATASET USED WITH DESCRIPTION:

Dataset Used:

The dataset used for training and testing the multi-modal biometric authentication system consists of both fingerprint images and facial images. Here's a description of each dataset:

1. Fingerprint Dataset:

Description: The fingerprint dataset comprises high-quality fingerprint images captured using optical or capacitive fingerprint sensors. Each fingerprint image is of sufficient resolution and contains clear ridge patterns necessary for accurate feature extraction.
Characteristics:
High-resolution images: Each fingerprint image has a resolution of at least 500 dpi to ensure fine details are captured.
Varied Finger Conditions: The dataset includes fingerprints with varying conditions such as dry, wet, oily, or worn-out, to simulate real-world scenarios.
Multiple Fingerprints per User: To account for multiple fingers enrolled per user, the dataset contains fingerprint images from different fingers of the same individual.

2. Facial Image Dataset:

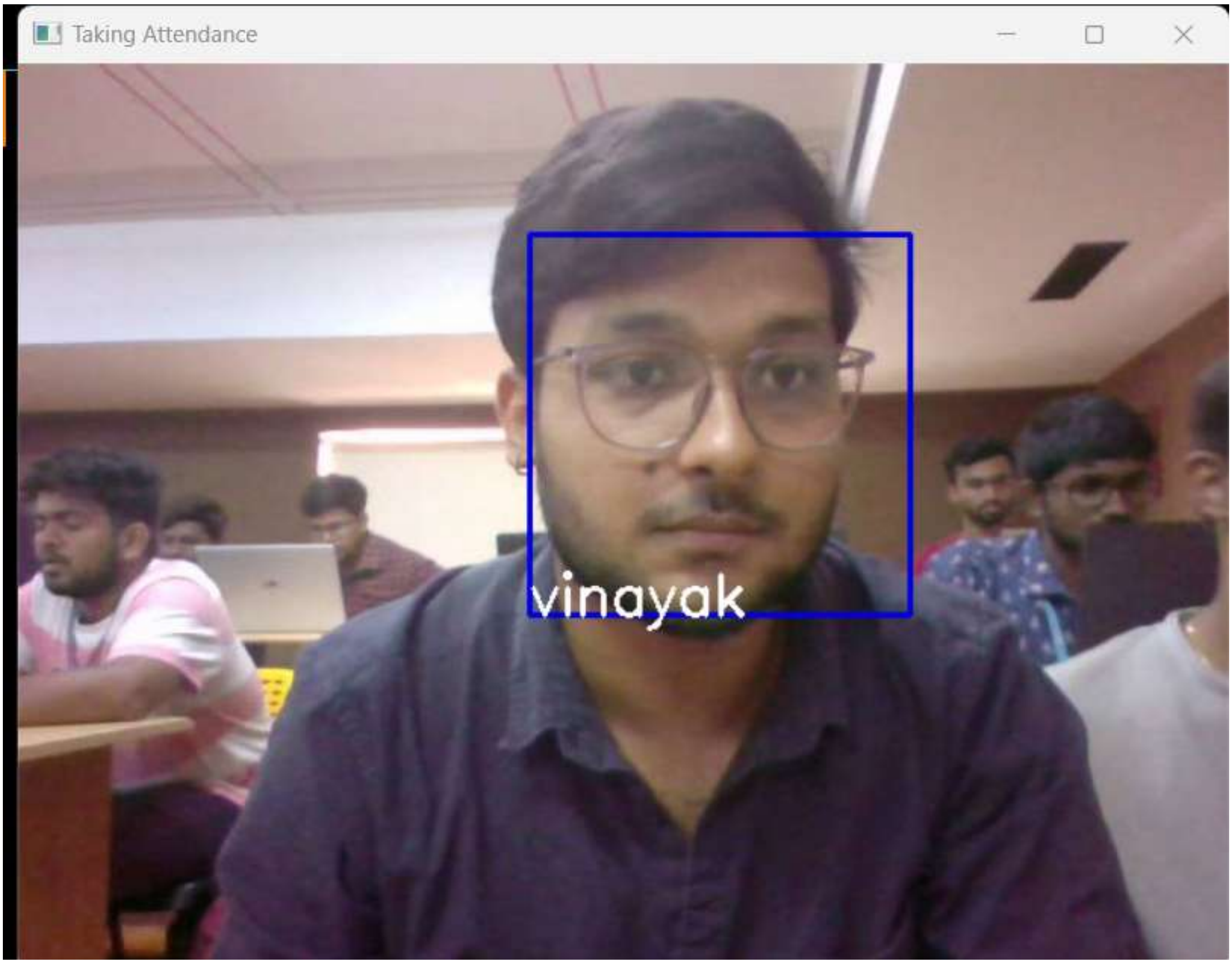
Description: The facial image dataset consists of high-quality facial images captured using digital cameras or webcam devices. Each facial image is properly aligned and cropped to focus on the face region, ensuring consistent feature extraction.

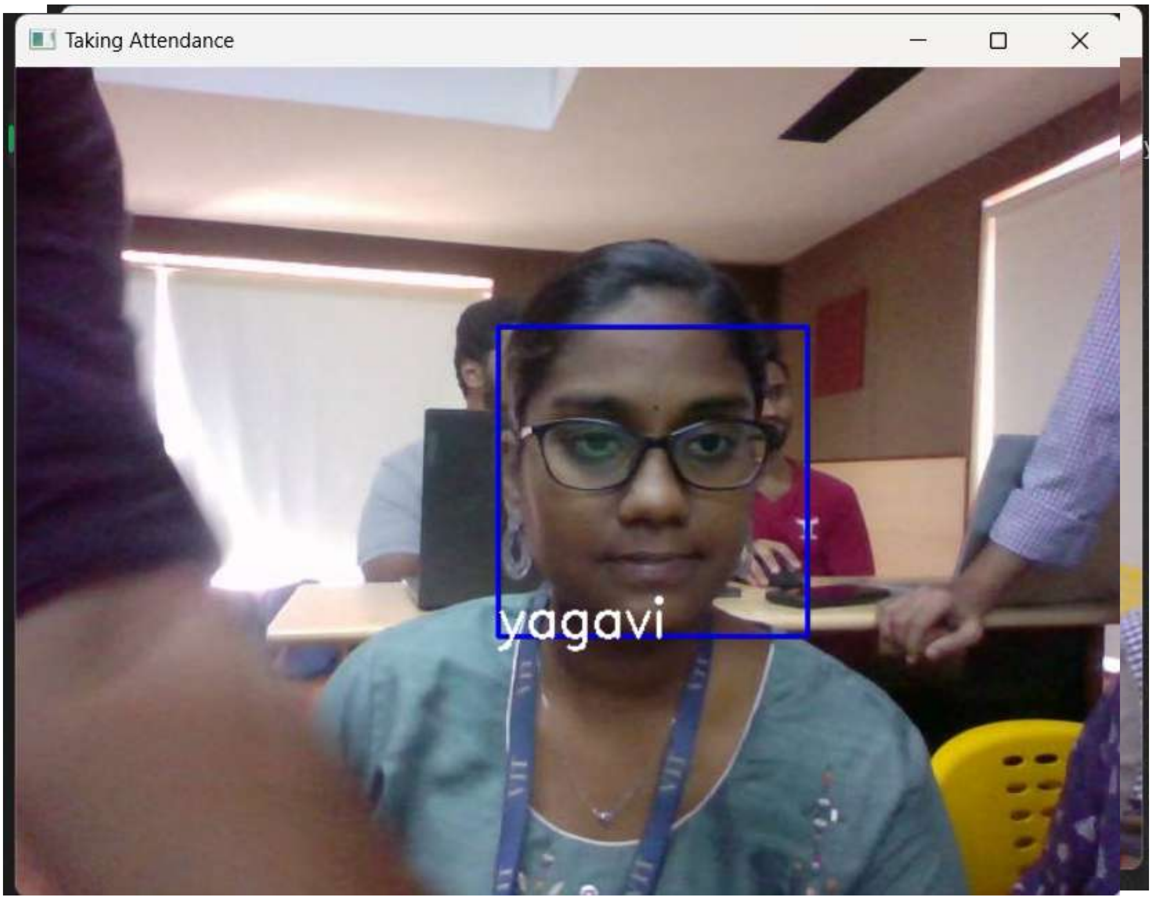
Characteristics:
Diverse Facial Expressions: The dataset includes facial images with diverse facial expressions, such as neutral, smiling, or frowning, to account for variations in user appearance.
Varied Lighting Conditions: Images are captured under different lighting conditions, including indoor and outdoor environments, to assess the system's robustness to lighting variations.

Occlusions and Noisy Backgrounds: Some facial images may contain occlusions (e.g., glasses, hats) or noisy backgrounds to simulate real-world scenarios and evaluate the system's performance in challenging conditions.

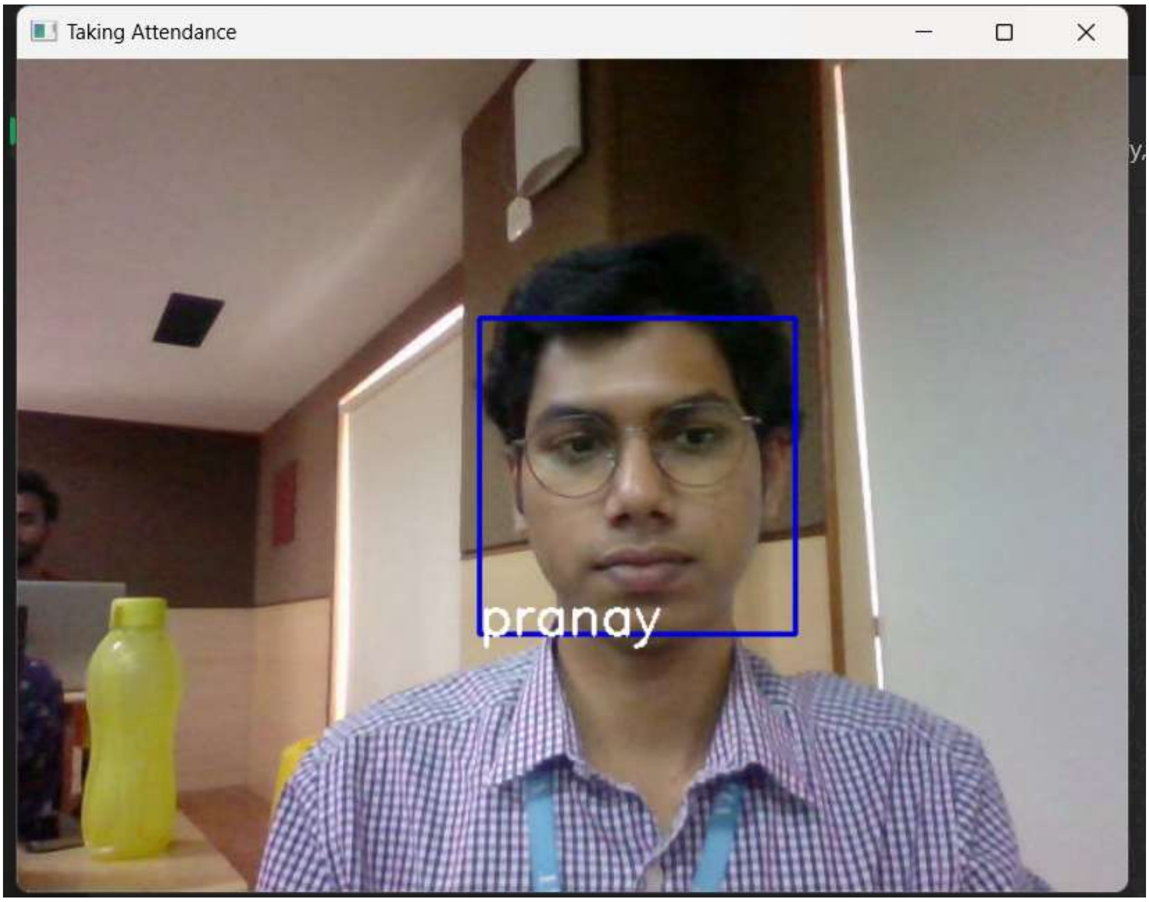
TEST CASES WITH SNAPSHOTS AND CODING:

TestCase 1: Faces Identified

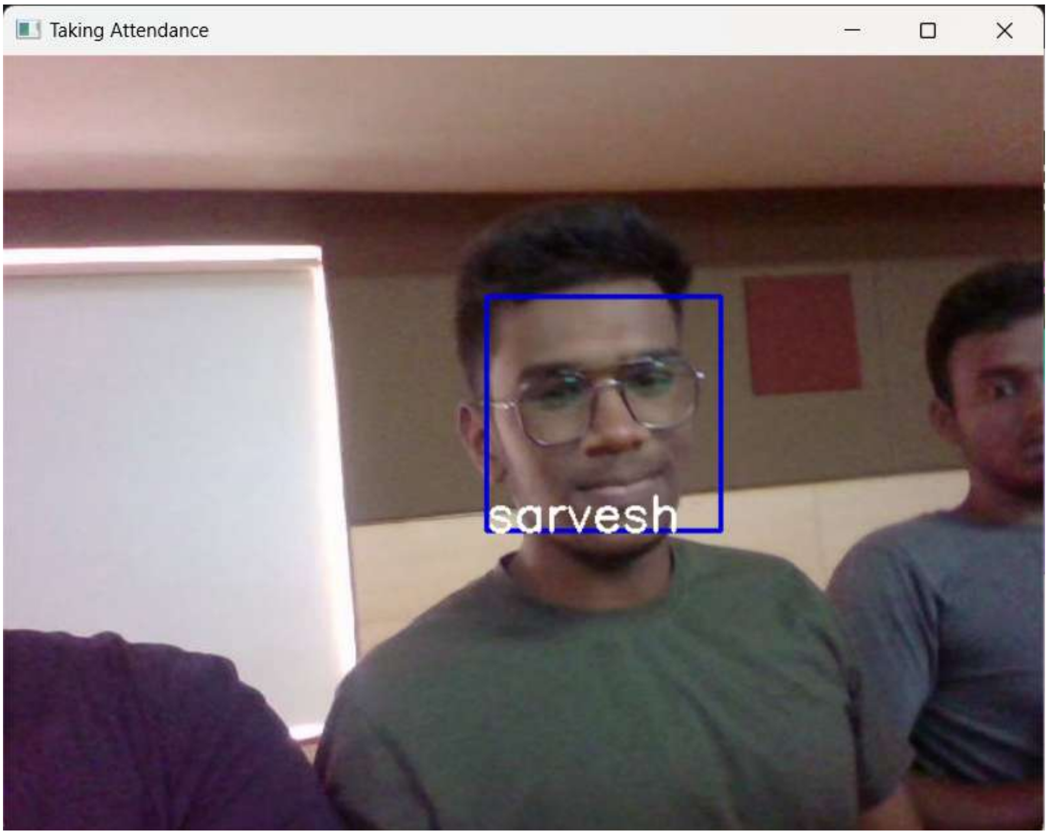




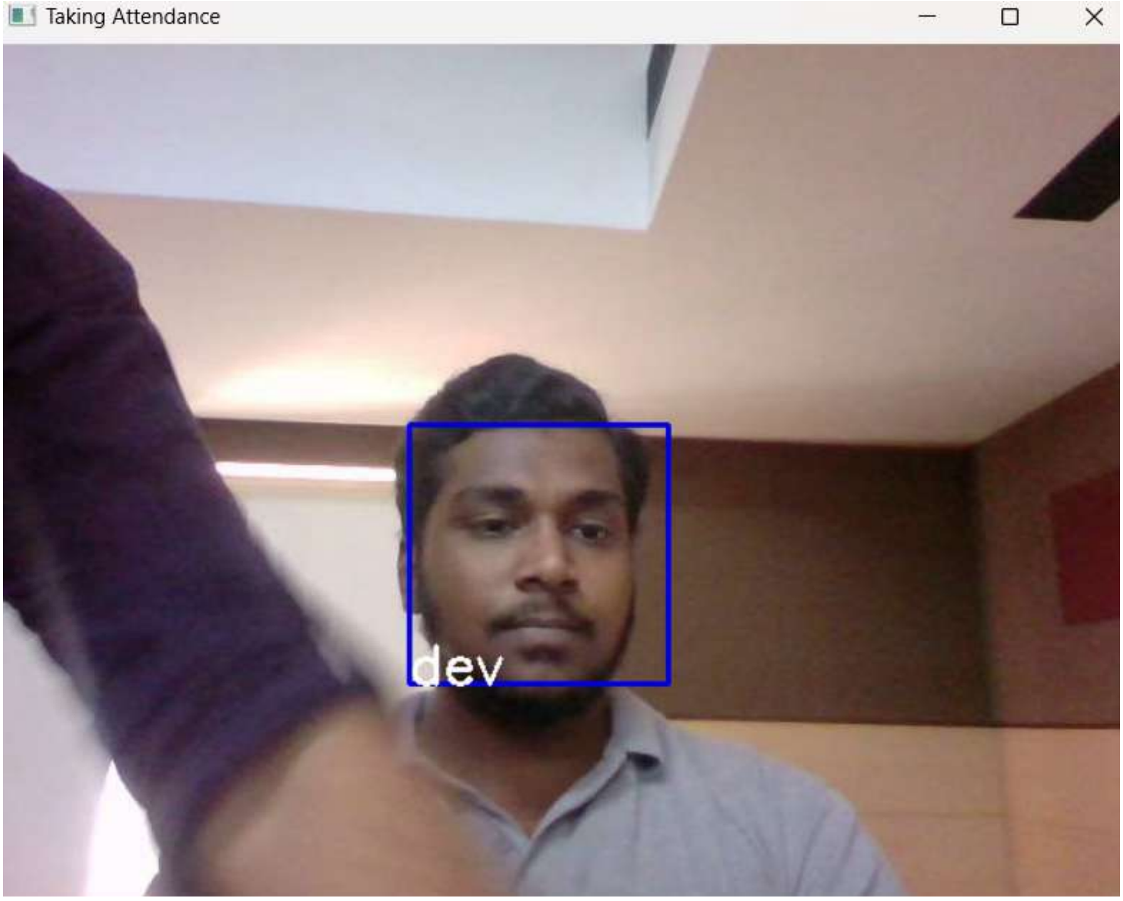
Taking Attendance
yagavi



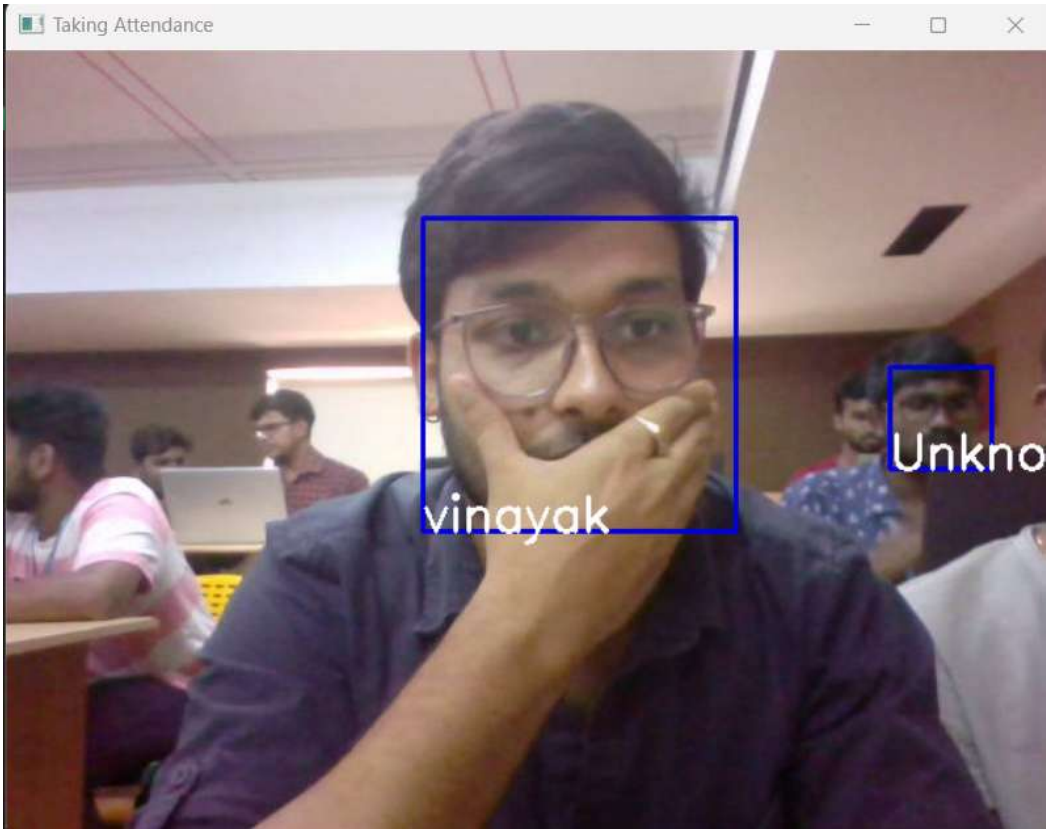
Taking Attendance
pranay

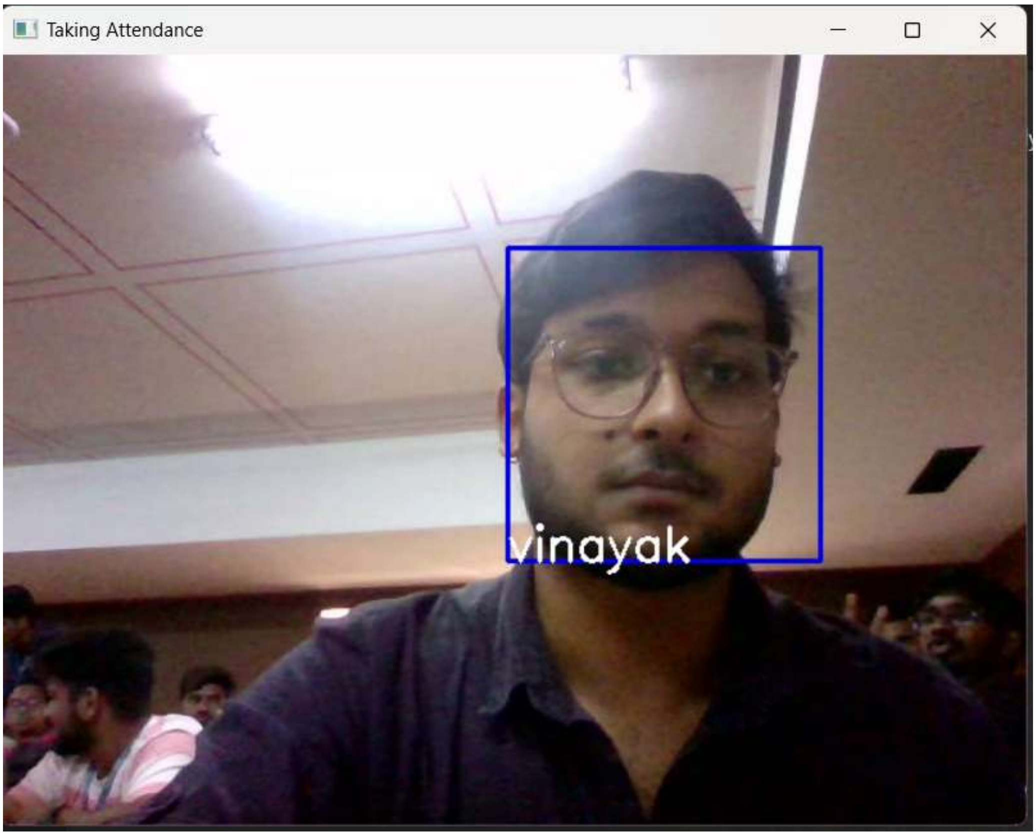


TestCase2: Lighting Condition

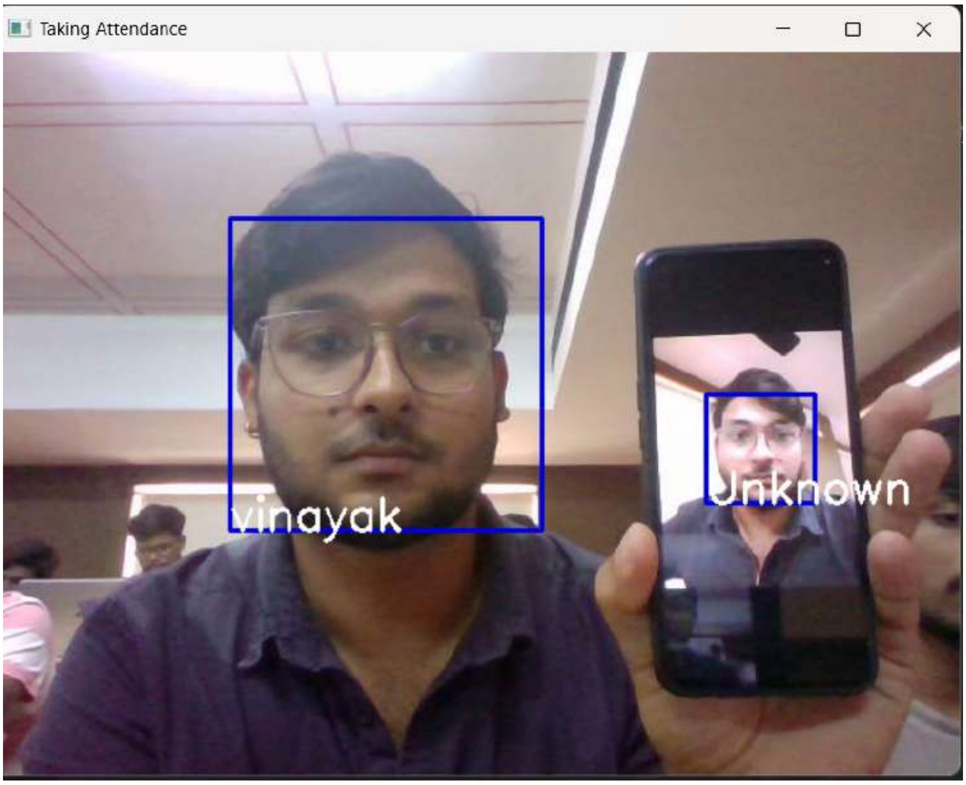


Test Case 3 : Occlusion

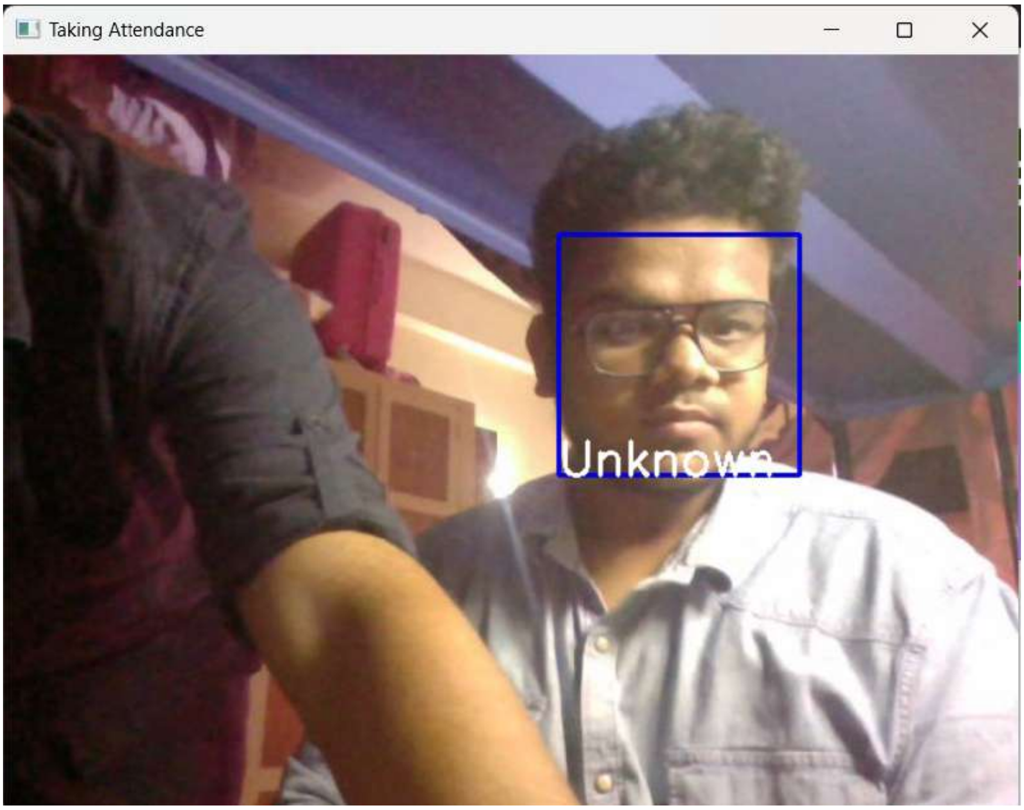




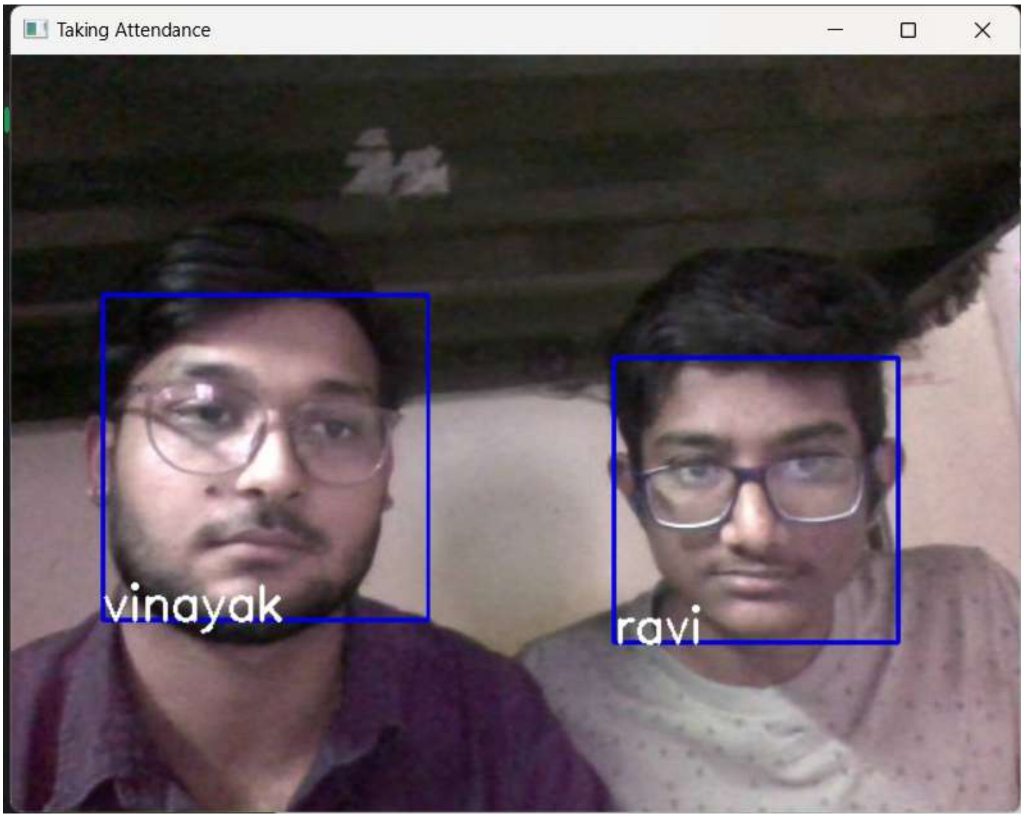
Test Case 4: Liveliness Detection Using Photo



Test Cases 5: Unknown Testcase



Test Cases 6: Multi-Face Detection:



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Review 1

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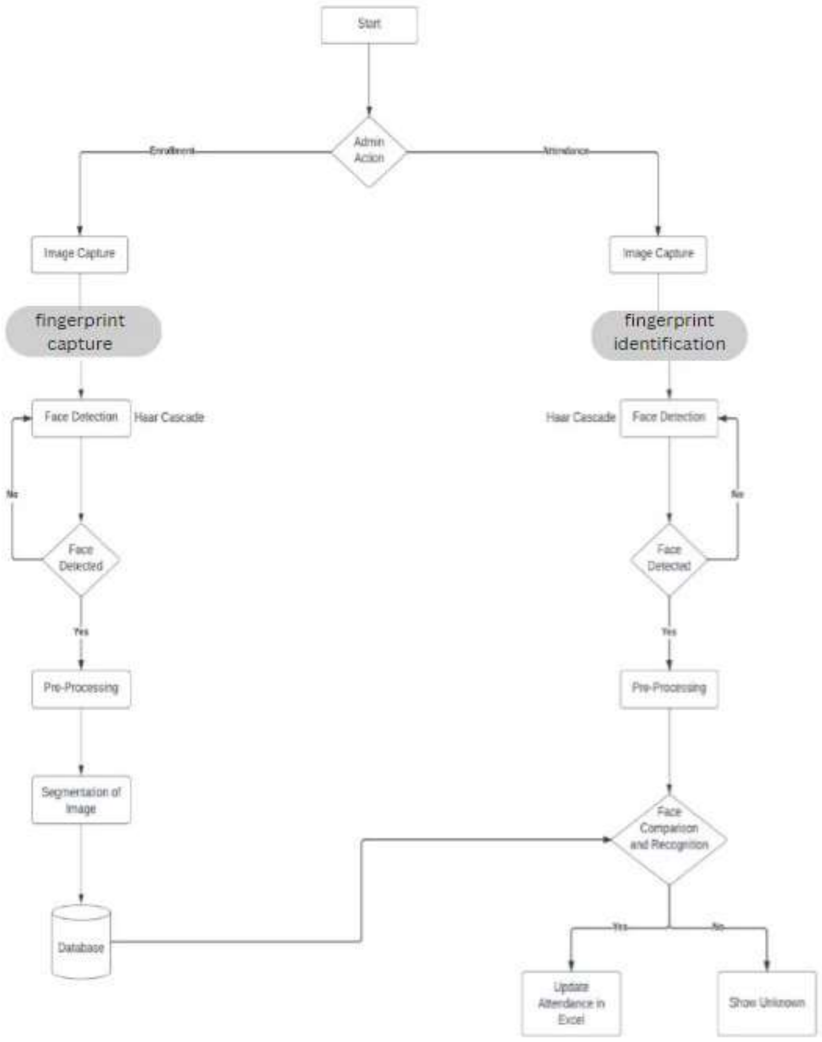
Architecture of the proposed system



Face Recognition code

```
import tkinter as tk

from tkinter import ttk

from tkinter import messagebox as mess

import tkinter.simpledialog as tsd

import cv2,os

import csv

import numpy as np

from PIL import Image

import pandas as pd

import datetime

import time


def assure_path_exists(path):

    dir = os.path.dirname(path)

    if not os.path.exists(dir):

        os.makedirs(dir)


def tick():

    time_string = time.strftime('%H:%M:%S')

    clock.config(text=time_string)

    clock.after(200,tick)
```

```
def contact():

    mess._show(title='Contact us', message="Please contact us on : 
'vinayakpant123@gmail.com ")




def check_haarcascadefile():

    exists = os.path.isfile("D:\\biometric\\Face\\Face\
\haarcascade_frontalface_default.xml")

    if exists:

        pass

    else:

        mess._show(title='Some file missing', message='Please contact us for help')

        window.destroy()




def save_pass():

    assure_path_exists("TrainingImageLabel\\")

    exists1 = os.path.isfile("D:\\biometric\\Face\\Face\\TrainingImageLabel\\psd.txt")

    if exists1:

        tf = open("D:\\biometric\\Face\\Face\\TrainingImageLabel\\psd.txt", "r")

        key = tf.read()

    else:
        master.destroy()
        new_pas = tsd.askstring('Old Password not found', 'Please enter a new password below', show='*')
        if new_pas == None:
            mess._show(title='No Password Entered', message='Password not set!! Please try again')
        else:
            tf = open("D:\\biometric\\Face\\Face\\TrainingImageLabel\\psd.txt", "w")
            tf.write(new_pas)
            mess._show(title='Password Registered', message='New password was registered successfully!!')
            return
    op = (old.get())
    newp= (new.get())
    nnewp = (nnew.get())
    if (op == key):
        if(newp == nnewp):
            txf = open("D:\\biometric\\Face\\Face\\TrainingImageLabel\\psd.txt", "w")
            txf.write(newp)
        else:
            mess._show(title='Error', message='Confirm new password again!!!')
            return
    else:
        mess._show(title='Wrong Password', message='Please enter correct old password.')
        return
    mess._show(title='Password Changed', message='Password changed
successfully!!')
    master.destroy()



def change_pass():
    global master
    master = tk.Tk()
    master.geometry("400x160")
    master.resizable(False,False)
    master.title("Change Password")
    master.configure(background="white")
    lbl4 = tk.Label(master,text='    Enter Old Password',bg='white',font=('comic', 12, '
bold '))
    lbl4.place(x=10,y=10)
    global old
    old=tk.Entry(master,width=25 ,fg="black",relief='solid',font=('comic', 12, ' bold
'),show='*')
    old.place(x=180,y=10)
    lbl5 = tk.Label(master, text='   Enter New Password', bg='white', font=('comic', 12,
' bold '))
    lbl5.place(x=10, y=45)
    global new
    new = tk.Entry(master, width=25, fg="black",relief='solid', font=('comic', 12, ' bold
'),show='*')
```

```
    new.place(x=180, y=45)
    lbl6 = tk.Label(master, text='Confirm New Password', bg='white', font=('comic',
12, ' bold '))
    lbl6.place(x=10, y=80)
    global nnew
    nnew = tk.Entry(master, width=25, fg="black", relief='solid',font=('comic', 12, '
bold '),show='*')
    nnew.place(x=180, y=80)
    cancel=tk.Button(master,text="Cancel",
command=master.destroy ,fg="black"  ,bg="red" ,height=1,width=25 ,
activebackground = "white" ,font=('comic', 10, ' bold '))
    cancel.place(x=200, y=120)
    save1 = tk.Button(master, text="Save", command=save_pass, fg="black",
bg="#00fcca", height = 1,width=25, activebackground="white", font=('comic', 10, '
bold '))
    save1.place(x=10, y=120)
    master.mainloop()



def psw():
    assure_path_exists("TrainingImageLabel\\")
    exists1 = os.path.isfile("D:\\biometric\\Face\\Face\\TrainingImageLabel\\psd.txt")
    if exists1:
        tf = open("D:\\biometric\\Face\\Face\\TrainingImageLabel\\psd.txt", "r")
        key = tf.read()
    else:
        new_pas = tsd.askstring('Old Password not found', 'Please enter a new password below', show='*')
        if new_pas == None:
            mess._show(title='No Password Entered', message='Password not set!! Please try again')
        else:
            tf = open("D:\\biometric\\Face\\Face\\TrainingImageLabel\\psd.txt", "w")
            tf.write(new_pas)
            mess._show(title='Password Registered', message='New password was registered successfully!!')
            return
    password = tsd.askstring('Password', 'Enter Password', show='*')
    if (password == key):
        TrainImages()
    elif (password == None):
        pass
    else:
        mess._show(title='Wrong Password', message='You have entered wrong password')


def clear():
    txt.delete(0, 'end')
    res = "1)Take Images  >>>  2)Save Profile"
    message1.configure(text=res)
```

```
def clear2():

    txt2.delete(0, 'end')

    res = "1)Take Images  >>>  2)Save Profile"

    message1.configure(text=res)




def TakeImages():

    check_haarcascadefile()

    columns = ['SERIAL NO.', '', 'ID', '', 'NAME']

    assure_path_exists("StudentDetails\\")

    assure_path_exists("TrainingImage\\")

    serial = 0

    exists = os.path.isfile("D:\\biometric\\Face\\Face\\StudentDetails\
\StudentDetails.csv")

    if exists:

        with open("D:\\biometric\\Face\\Face\\StudentDetails\\StudentDetails.csv", 'r')
as csvFile1:

            reader1 = csv.reader(csvFile1)

            for l in reader1:

                serial = serial + 1

        serial = (serial // 2)

        csvFile1.close()

    else:
        with open("D:\\biometric\\Face\\Face\\StudentDetails\\StudentDetails.csv", 'a+')
as csvFile1:

            writer = csv.writer(csvFile1)

            writer.writerow(columns)

            serial = 1

        csvFile1.close()

    Id = (txt.get())

    name = (txt2.get())

    if ((name.isalpha()) or (' ' in name)):

        cam = cv2.VideoCapture(0)

        harcascadePath = "D:\\biometric\\Face\\Face\
\haarcascade_frontalface_default.xml"

        detector = cv2.CascadeClassifier(harcascadePath)

        sampleNum = 0

        while (True):

            ret, img = cam.read()

            gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

            faces = detector.detectMultiScale(gray, 1.3, 5)

            for (x, y, w, h) in faces:

                cv2.rectangle(img, (x, y), (x + w, y + h), (255, 0, 0), 2)

                # incrementing sample number

                sampleNum = sampleNum + 1

                # saving the captured face in the dataset folder TrainingImage

                cv2.imwrite("TrainingImage\\ " + name + "." + str(serial) + "." + Id + '.' +
str(sampleNum) + ".jpg",
                            gray[y:y + h, x:x + w])
                # display the frame
                cv2.imshow('Taking Images', img)
            # wait for 100 miliseconds
            if cv2.waitKey(100) & 0xFF == ord('q'):
                break
            # break if the sample number is morethan 100
            elif sampleNum > 100:
                break
        cam.release()
        cv2.destroyAllWindows()
        res = "Images Taken for ID : " + Id
        row = [serial, '', Id, '', name]
        with open('D:\\biometric\\Face\\Face\\StudentDetails\\StudentDetails.csv', 'a+')
as csvFile:
            writer = csv.writer(csvFile)
            writer.writerow(row)
        csvFile.close()
        message1.configure(text=res)
    else:
        if (name.isalpha() == False):
            res = "Enter Correct name"
            message.configure(text=res)
```

```
def TrainImages():
    check_haarcascadefile()
    assure_path_exists("TrainingImageLabel\\")
    recognizer = cv2.face_LBPHFaceRecognizer.create()
    harcascadePath = "D:\\biometric\\Face\\Face\
\haarcascade_frontalface_default.xml"
    detector = cv2.CascadeClassifier(harcascadePath)
    faces, ID = getImagesAndLabels("TrainingImage")
    try:
        recognizer.train(faces, np.array(ID))
    except:
        mess._show(title='No Registrations', message='Please Register someone first!!!')
        return
    recognizer.save("D:\\biometric\\Face\\Face\\TrainingImageLabel\\Trainner.yml")
    res = "Profile Saved Successfully"
    message1.configure(text=res)
    message.configure(text='Total Registrations till now  : ' + str(ID[0]))



def getImagesAndLabels(path):
    # get the path of all the files in the folder
    imagePaths = [os.path.join(path, f) for f in os.listdir(path)]
    # create empth face list
    faces = []
    # create empty ID list
    Ids = []
    # now looping through all the image paths and loading the Ids and the images
    for imagePath in imagePaths:
        # loading the image and converting it to gray scale
        pilImage = Image.open(imagePath).convert('L')
        # Now we are converting the PIL image into numpy array
        imageNp = np.array(pilImage, 'uint8')
        # getting the Id from the image
        ID = int(os.path.split(imagePath)[-1].split(".")[1])
        # extract the face from the training image sample
        faces.append(imageNp)
        Ids.append(ID)
    return faces, Ids



def TrackImages():
    check_haarcascadefile()
    assure_path_exists("Attendance\\")
    assure_path_exists("StudentDetails\\")
    for k in tv.get_children():
        tv.delete(k)
    msg = ''

    i = 0

    j = 0

    recognizer = cv2.face.LBPHFaceRecognizer_create()  #
cv2.createLBPHFaceRecognizer()

    exists3 = os.path.isfile("D:\\biometric\\Face\\Face\\TrainingImageLabel\
\Trainner.yml")

    if exists3:

        recognizer.read("D:\\biometric\\Face\\Face\\TrainingImageLabel\\Trainner.yml")

    else:

        mess._show(title='Data Missing', message='Please click on Save Profile to reset
data!!')

        return

    harcascadePath = "D:\\biometric\\Face\\Face\
\haarcascade_frontalface_default.xml"

    faceCascade = cv2.CascadeClassifier(harcascadePath);



    cam = cv2.VideoCapture(0)

    font = cv2.FONT_HERSHEY_SIMPLEX

    col_names = ['Id', '', 'Name', '', 'Date', '', 'Time']

    exists1 = os.path.isfile("D:\\biometric\\Face\\Face\\StudentDetails\
\StudentDetails.csv")

    if exists1:

        df = pd.read_csv("D:\\biometric\\Face\\Face\\StudentDetails\
\StudentDetails.csv")

    else:
        mess._show(title='Details Missing', message='Students details are missing,
please check!')
        cam.release()
        cv2.destroyAllWindows()
        window.destroy()
    while True:
        ret, im = cam.read()
        gray = cv2.cvtColor(im, cv2.COLOR_BGR2GRAY)
        faces = faceCascade.detectMultiScale(gray, 1.2, 5)
        for (x, y, w, h) in faces:
            cv2.rectangle(im, (x, y), (x + w, y + h), (225, 0, 0), 2)
            serial, conf = recognizer.predict(gray[y:y + h, x:x + w])
            if (conf < 50):
                ts = time.time()
                date = datetime.datetime.fromtimestamp(ts).strftime('%d-%m-%Y')
                timeStamp = datetime.datetime.fromtimestamp(ts).strftime('%H:%M:%S')
                aa = df.loc[df['SERIAL NO.'] == serial]['NAME'].values
                ID = df.loc[df['SERIAL NO.'] == serial]['ID'].values
                ID = str(ID)
                ID = ID[1:-1]
                bb = str(aa)
                bb = bb[2:-2]
                attendance = [str(ID), '', bb, '', str(date), '', str(timeStamp)]

            else:
```

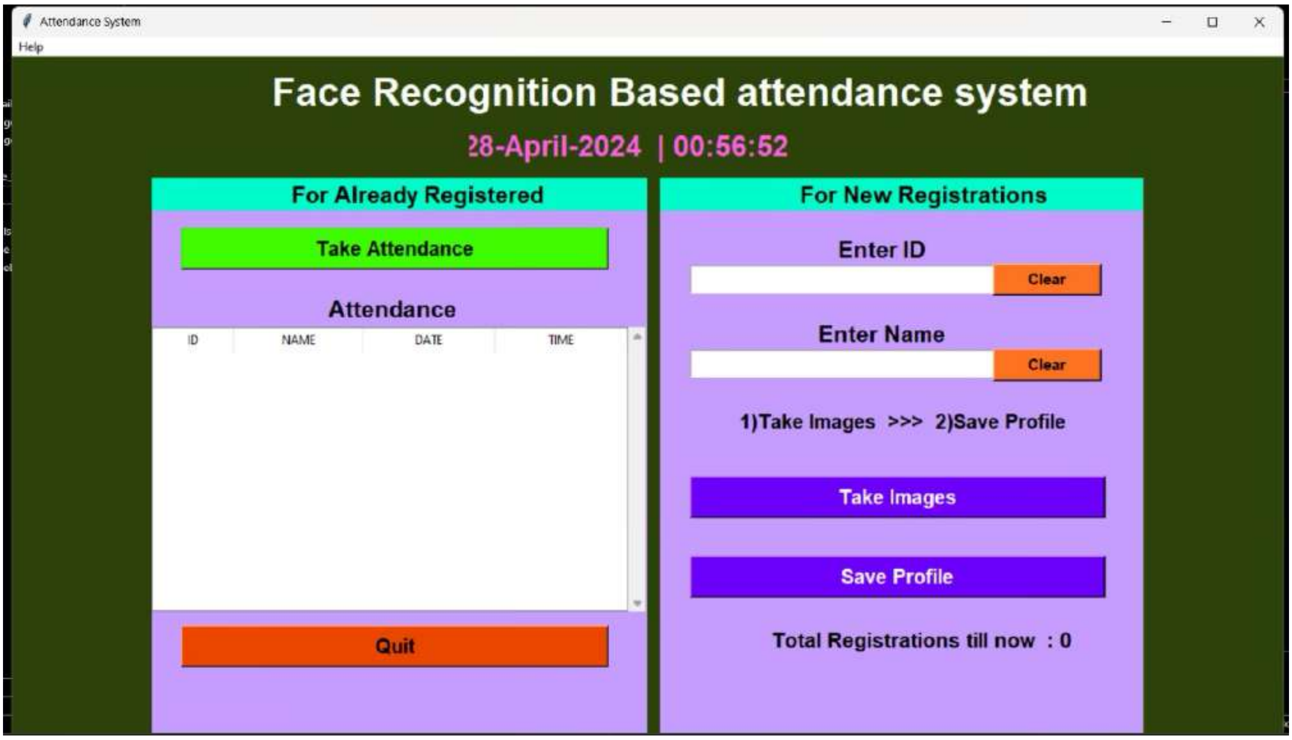
```
            Id = 'Unknown'
            bb = str(Id)
        cv2.putText(im, str(bb), (x, y + h), font, 1, (255, 255, 255), 2)
    cv2.imshow('Taking Attendance', im)
    if (cv2.waitKey(1) == ord('q')):
        break
ts = time.time()
date = datetime.datetime.fromtimestamp(ts).strftime('%d-%m-%Y')
exists = os.path.isfile("Attendance\\Attendance_" + date + ".csv")
if exists:
    with open("Attendance\\Attendance_" + date + ".csv", 'a+') as csvFile1:
        writer = csv.writer(csvFile1)
        writer.writerow(attendance)
    csvFile1.close()
else:
    with open("Attendance\\Attendance_" + date + ".csv", 'a+') as csvFile1:
        writer = csv.writer(csvFile1)
        writer.writerow(col_names)
        writer.writerow(attendance)
    csvFile1.close()
with open("Attendance\\Attendance_" + date + ".csv", 'r') as csvFile1:
    reader1 = csv.reader(csvFile1)
    for lines in reader1:
        i = i + 1
        if (i > 1):
            if (i % 2 != 0):
                iidd = str(lines[0]) + '   '
                tv.insert('', 0, text=iidd, values=(str(lines[2]), str(lines[4]), str(lines[6])))
    csvFile1.close()
    cam.release()
    cv2.destroyAllWindows()




global key
key = ''

ts = time.time()
date = datetime.datetime.fromtimestamp(ts).strftime('%d-%m-%Y')
day,month,year=date.split("-")

mont={'01':'January',
      '02':'February',
      '03':'March',
      '04':'April',
      '05':'May',
      '06':'June',
      '07':'July',
    '08':'August',

    '09':'September',

    '10':'October',

    '11':'November',

    '12':'December'

    }




window = tk.Tk()

window.geometry("1280x720")

window.resizable(True,False)

window.title("Attendance System")

window.configure(background='#2d420a')


frame1 = tk.Frame(window, bg="#c79cff")

frame1.place(relx=0.11, rely=0.17, relwidth=0.39, relheight=0.80)


frame2 = tk.Frame(window, bg="#c79cff")

frame2.place(relx=0.51, rely=0.17, relwidth=0.38, relheight=0.80)


message3 = tk.Label(window, text="Face Recognition Based attendance
system" ,fg="white",bg="#2d420a" ,width=55 ,height=1,font=('comic', 29, ' bold '))

message3.place(x=10, y=10)
```

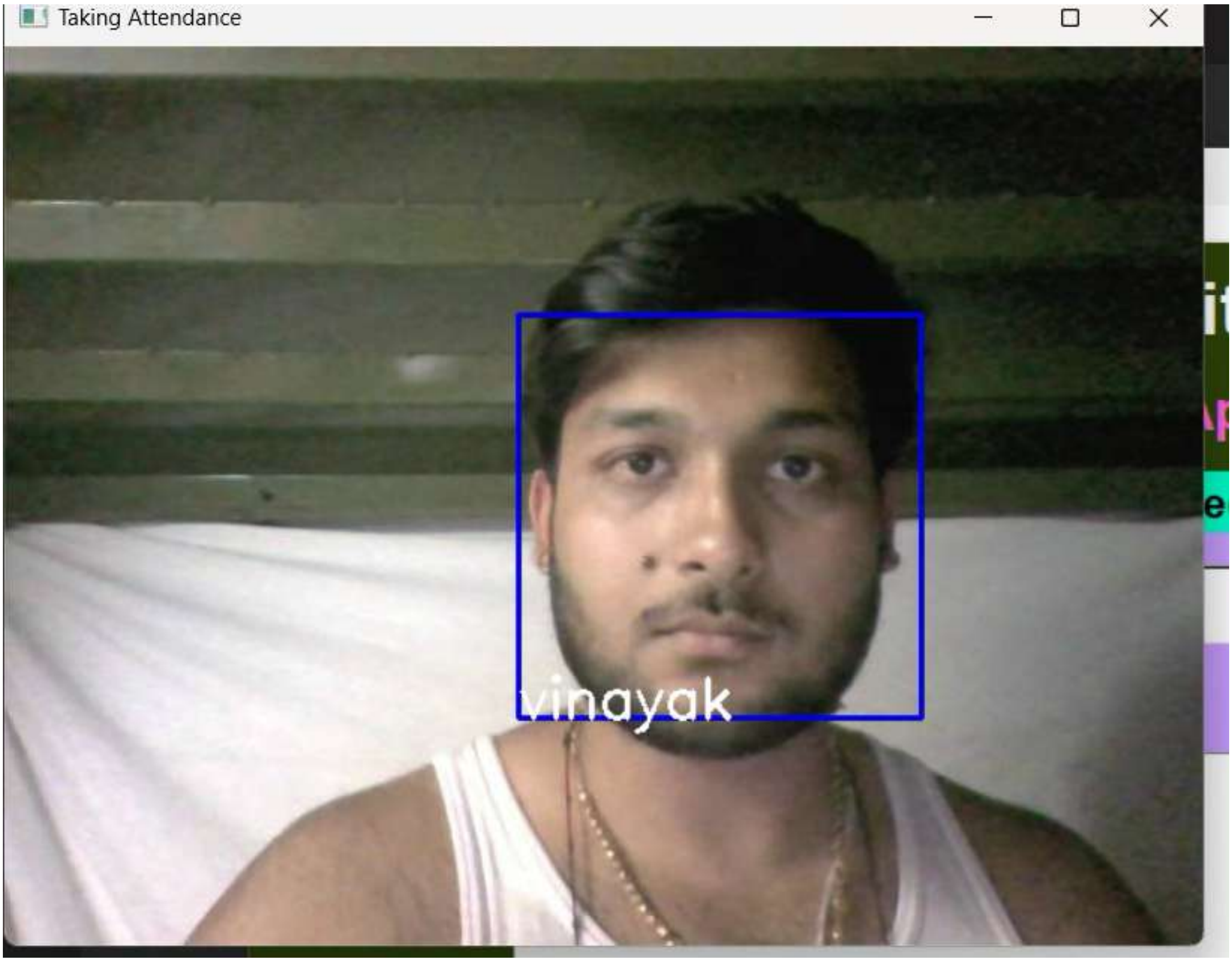
```
frame3 = tk.Frame(window, bg="#c4c6ce")

frame3.place(relx=0.52, rely=0.09, relwidth=0.09, relheight=0.07)


frame4 = tk.Frame(window, bg="#c4c6ce")

frame4.place(relx=0.36, rely=0.09, relwidth=0.16, relheight=0.07)


datef = tk.Label(frame4, text = day+"-"+mont[month]+"-"+year+"  |  ", fg="#ff61e5",bg="#2d420a" ,width=55 ,height=1,font=('comic', 22, ' bold '))

datef.pack(fill='both',expand=1)


clock = tk.Label(frame3,fg="#ff61e5",bg="#2d420a" ,width=55 ,height=1,font=('comic', 22, ' bold '))

clock.pack(fill='both',expand=1)

tick()


head2 = tk.Label(frame2, text="                       For New Registrations                       ", fg="black",bg="#00fcca" ,font=('comic', 17, ' bold ') )

head2.grid(row=0,column=0)


head1 = tk.Label(frame1, text="                       For Already Registered                       ", fg="black",bg="#00fcca" ,font=('comic', 17, ' bold ') )

head1.place(x=0,y=0)


lbl = tk.Label(frame2, text="Enter ID",width=20  ,height=1  ,fg="black"  ,bg="#c79cff" ,font=('comic', 17, ' bold ') )

lbl.place(x=80, y=55)
```

```
txt = tk.Entry(frame2,width=32 ,fg="black",font=('comic', 15, ' bold '))

txt.place(x=30, y=88)


lbl2 = tk.Label(frame2, text="Enter
Name",width=20  ,fg="black"  ,bg="#c79cff" ,font=('comic', 17, ' bold '))

lbl2.place(x=80, y=140)


txt2 = tk.Entry(frame2,width=32 ,fg="black",font=('comic', 15, ' bold ')  )

txt2.place(x=30, y=173)


message1 = tk.Label(frame2, text="1)Take Images  >>>  2)Save
Profile" ,bg="#c79cff" ,fg="black"  ,width=39 ,height=1, activebackground =
"#3ffc00" ,font=('comic', 15, ' bold '))

message1.place(x=7, y=230)


message = tk.Label(frame2, text="" ,bg="#c79cff" ,fg="black"  ,width=39,height=1,
activebackground = "#3ffc00" ,font=('comic', 16, ' bold '))

message.place(x=7, y=450)


lbl3 = tk.Label(frame1,
text="Attendance",width=20  ,fg="black"  ,bg="#c79cff"  ,height=1 ,font=('comic',
17, ' bold '))

lbl3.place(x=100, y=115)


res=0
```

```
exists = os.path.isfile("D:\\biometric\\Face\\Face\\StudentDetails\
\StudentDetails.csv")

if exists:

    with open("D:\\biometric\\Face\\Face\\StudentDetails\\StudentDetails.csv", 'r') as
csvFile1:

        reader1 = csv.reader(csvFile1)

        for l in reader1:

            res = res + 1

    res = (res // 2) - 1

    csvFile1.close()

else:

    res = 0

message.configure(text='Total Registrations till now  : '+str(res))


menubar = tk.Menu(window,relief='ridge')

filemenu = tk.Menu(menubar,tearoff=0)

filemenu.add_command(label='Change Password', command = change_pass)

filemenu.add_command(label='Contact Us', command = contact)

filemenu.add_command(label='Exit',command = window.destroy)

menubar.add_cascade(label='Help',font=('comic', 29, ' bold '),menu=filemenu)



tv= ttk.Treeview(frame1,height =13,columns = ('name','date','time'))

tv.column('#0',width=82)

tv.column('name',width=130)
tv.column('date',width=133)

tv.column('time',width=133)

tv.grid(row=2,column=0,padx=(0,0),pady=(150,0),columnspan=4)

tv.heading('#0',text ='ID')

tv.heading('name',text ='NAME')

tv.heading('date',text ='DATE')

tv.heading('time',text ='TIME')




scroll=ttk.Scrollbar(frame1,orient='vertical',command=tv.yview)

scroll.grid(row=2,column=4,padx=(0,100),pady=(150,0),sticky='ns')

tv.configure(yscrollcommand=scroll.set)




clearButton = tk.Button(frame2, text="Clear",
command=clear  ,fg="black"  ,bg="#ff7221"  ,width=11 ,activebackground =
"white" ,font=('comic', 11, ' bold '))

clearButton.place(x=335, y=86)

clearButton2 = tk.Button(frame2, text="Clear",
command=clear2  ,fg="black"  ,bg="#ff7221"  ,width=11 , activebackground =
"white" ,font=('comic', 11, ' bold '))

clearButton2.place(x=335, y=172)

takeImg = tk.Button(frame2, text="Take Images",
command=TakeImages  ,fg="white"  ,bg="#6d00fc"  ,width=34  ,height=1,
activebackground = "white" ,font=('comic', 15, ' bold '))
```

```
takeImg.place(x=30, y=300)

trainImg = tk.Button(frame2, text="Save Profile",
command=psw ,fg="white" ,bg="#6d00fc" ,width=34 ,height=1, activebackground
= "white" ,font=('comic', 15, ' bold '))

trainImg.place(x=30, y=380)

trackImg = tk.Button(frame1, text="Take Attendance",
command=TrackImages ,fg="black" ,bg="#3ffc00" ,width=35 ,height=1,
activebackground = "white" ,font=('comic', 15, ' bold '))

trackImg.place(x=30,y=50)

quitWindow = tk.Button(frame1, text="Quit",
command=window.destroy ,fg="black" ,bg="#eb4600" ,width=35 ,height=1,
activebackground = "white" ,font=('comic', 15, ' bold '))

quitWindow.place(x=30, y=450)



window.configure(menu=menubar)

window.mainloop()
```

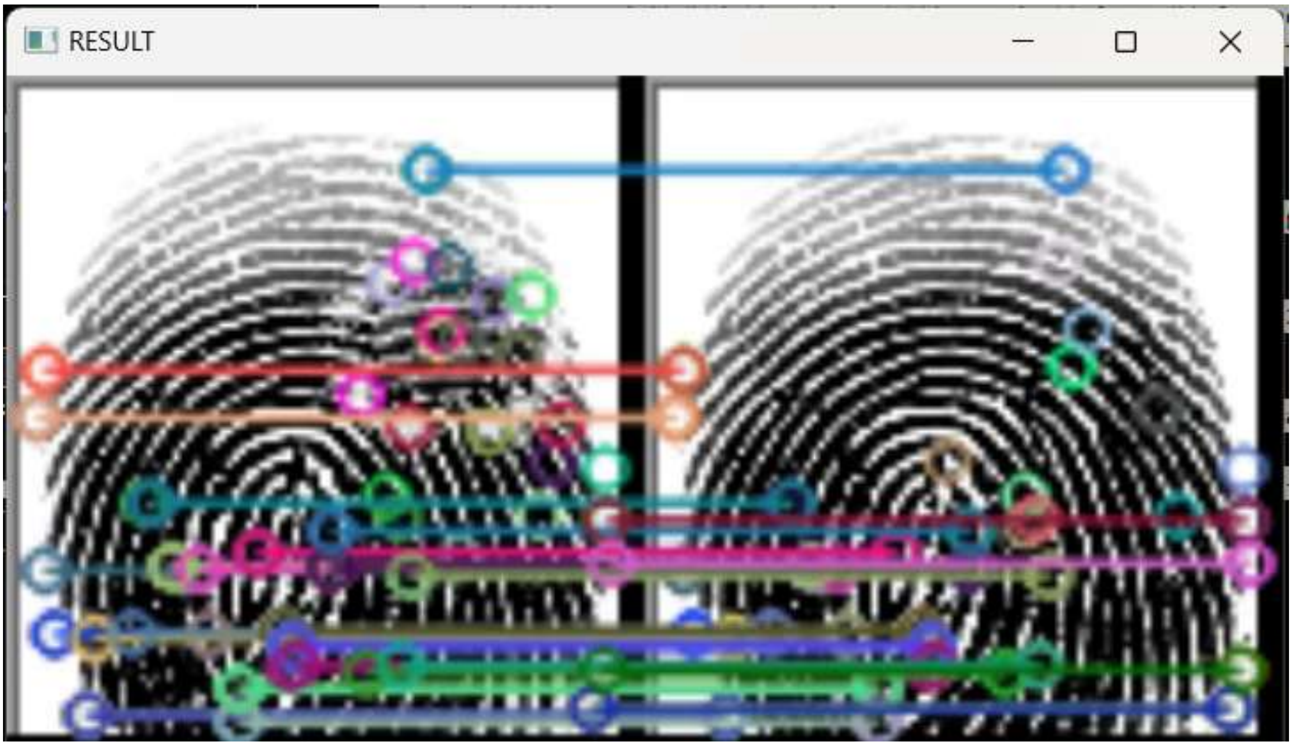




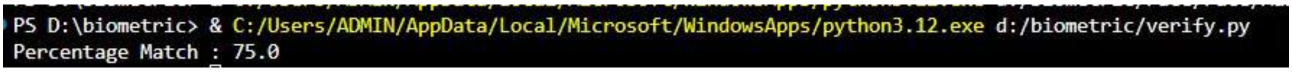
FingerPrint Recogination code

```
import os

import cv2



path= "D:\\biometric\\dbbio\\archive (2)\\SOCOFing\\Altered\\Altered-Easy\\1__M_Left_index_finger_CR.BMP"

#C:\\Users\\vaibh\\OneDrive\\Desktop\\vaibhav project\\SOCOFing\\Altered\\Altered-Easy\\1__M_Left_index_finger_CR.BMP

sample = cv2.imread(path)



counter = best_score = 0
```

```
filename = image = kp1 = kp2 = mp = None
for file in os.listdir(r"D:\\biometric\\dbbio\\archive (2)\\SOCOFing\\Real"):

    counter += 1
    fingerprint_image = cv2.imread("D:\\biometric\\dbbio\\archive (2)\\SOCOFing\
\Real\\"+ file)
    sift = cv2.SIFT_create()
    keypoint_1, descriptor_1 = sift.detectAndCompute(sample, None)
    keypoint_2, descriptor_2 = sift.detectAndCompute(fingerprint_image, None)

    matches = cv2.FlannBasedMatcher({'algorithm': 1, 'trees': 10},
{}).knnMatch(descriptor_1, descriptor_2, k=2)


    match_points = []

    for p, q in matches:
        if p.distance < 0.1 * q.distance:
            match_points.append(p)

    keypoints = 0
    if len(keypoint_1) < len(keypoint_2):
        keypoints = len(keypoint_1)
    else:
        keypoints = len(keypoint_2)
    if len(match_points) / keypoints * 100 > best_score:
        best_score = len(match_points) / keypoints * 100
        filename = file
        image = fingerprint_image
        kp1, kp2, mp = keypoint_1, keypoint_2, match_points

print("Percentage Match : " + str(best_score))

result = cv2.drawMatches(sample, kp1, image, kp2, mp, None)
result = cv2.resize(result, None, fx=3, fy=3)
cv2.imshow("RESULT", result)
cv2.waitKey(0)
cv2.destroyAllWindows()
```



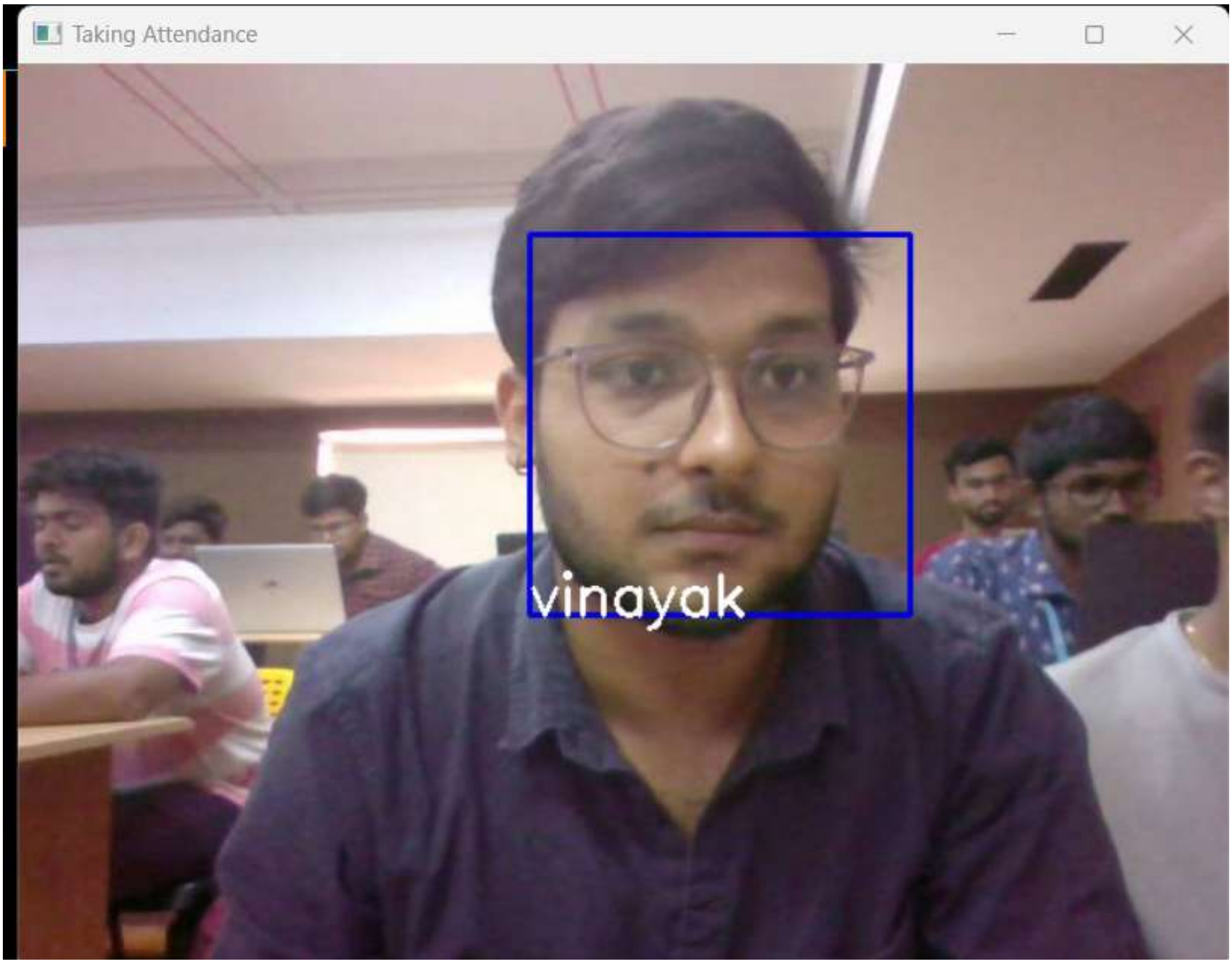
Metrix:

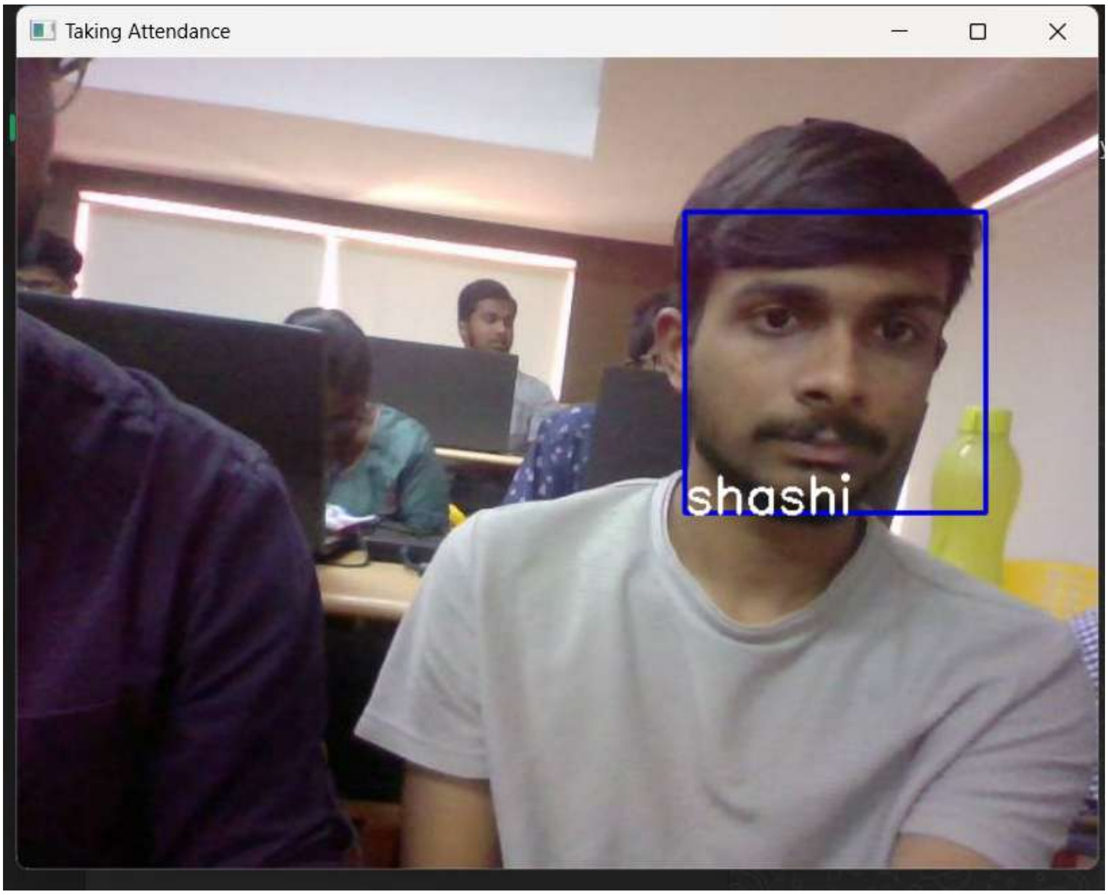


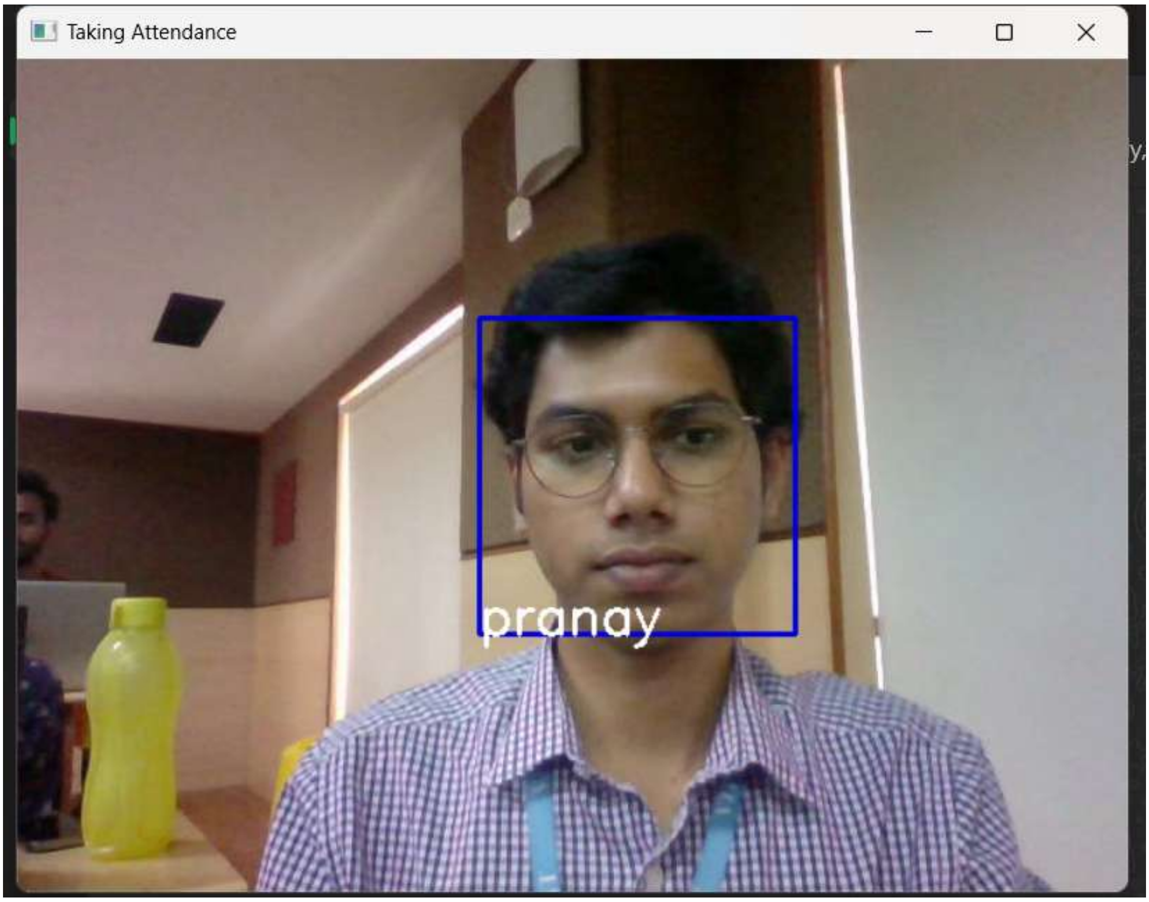
```
PS D:\biometric> & C:/Users/ADMIN/AppData/Local/Microsoft/WindowsApps/python3.12.exe d:/biometric/verify.py
Percentage Match : 75.0
```

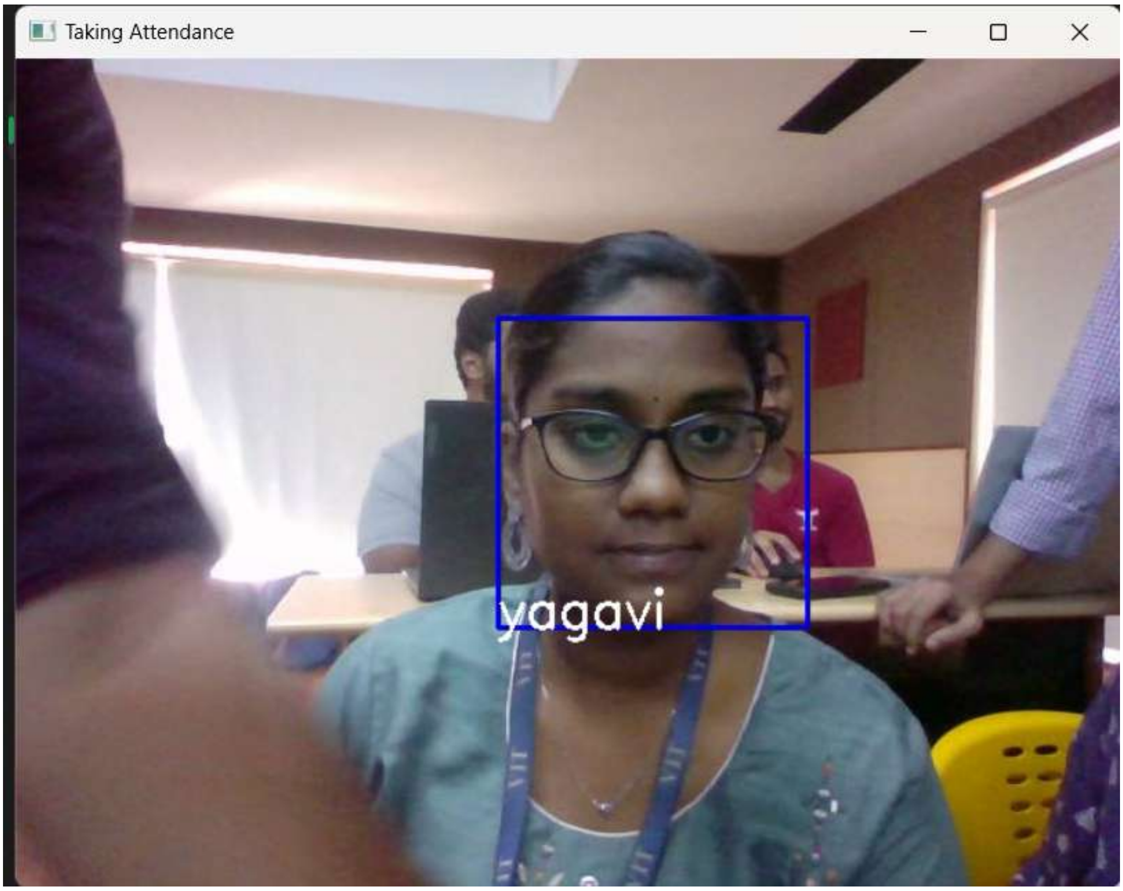
TEST CASES WITH SNAPSHOTS AND CODING:

TestCase 1: Faces Identified

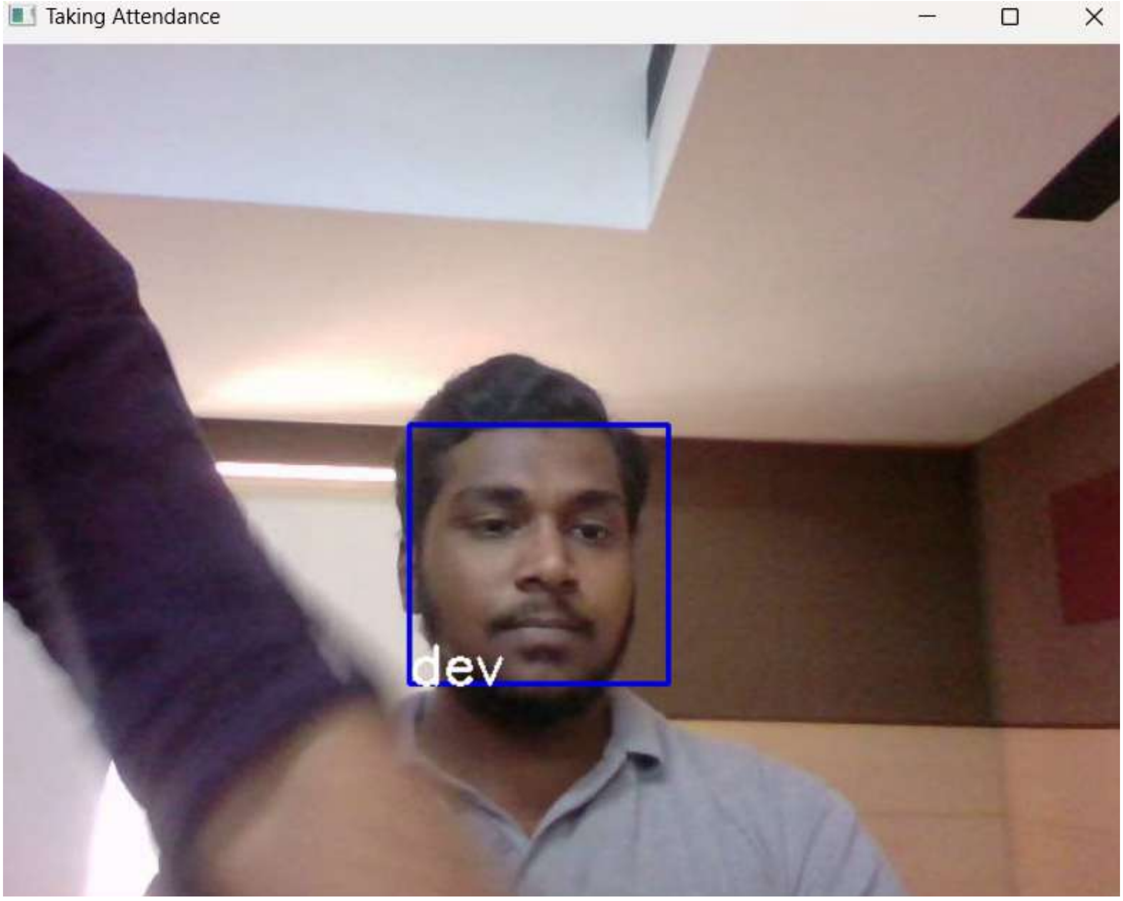



Taking Attendance
shashi

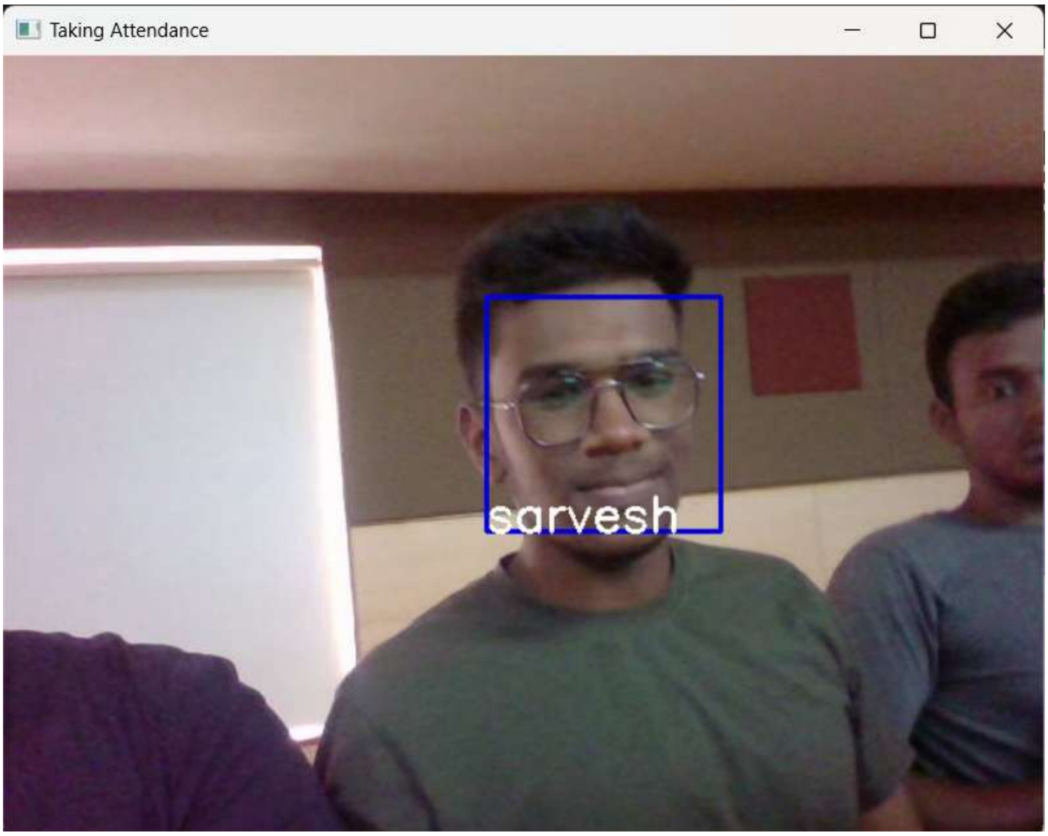

Taking Attendance
pranay

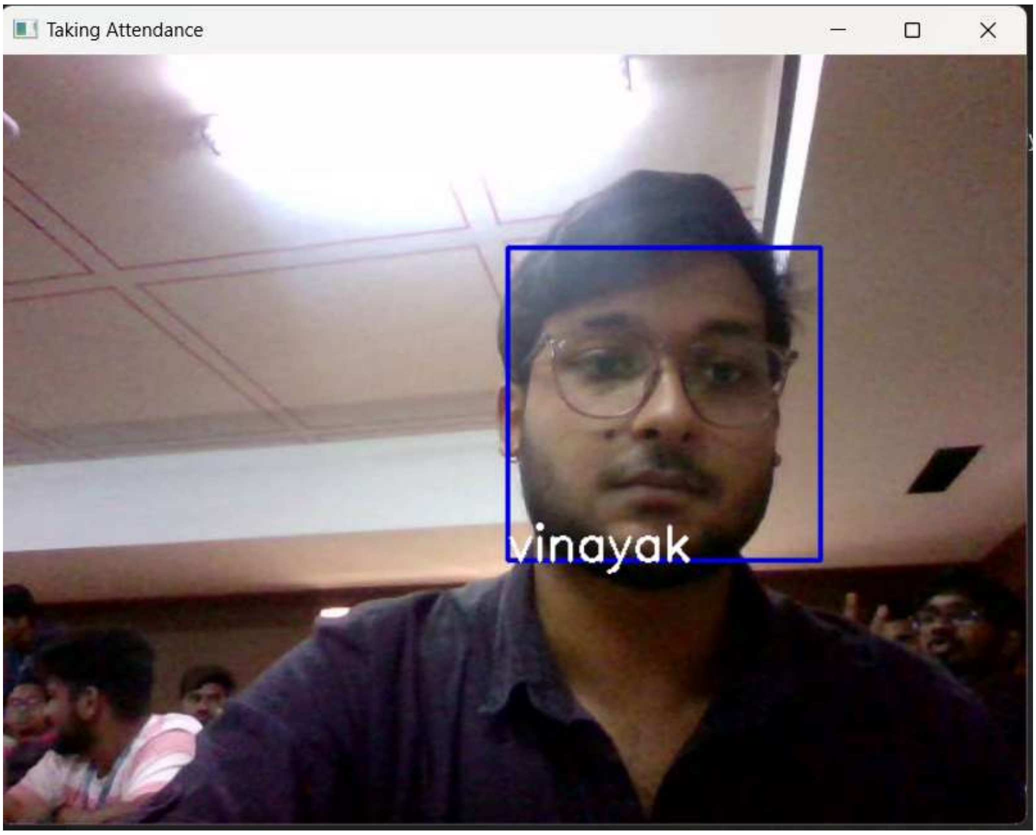


Taking Attendance
yagavi



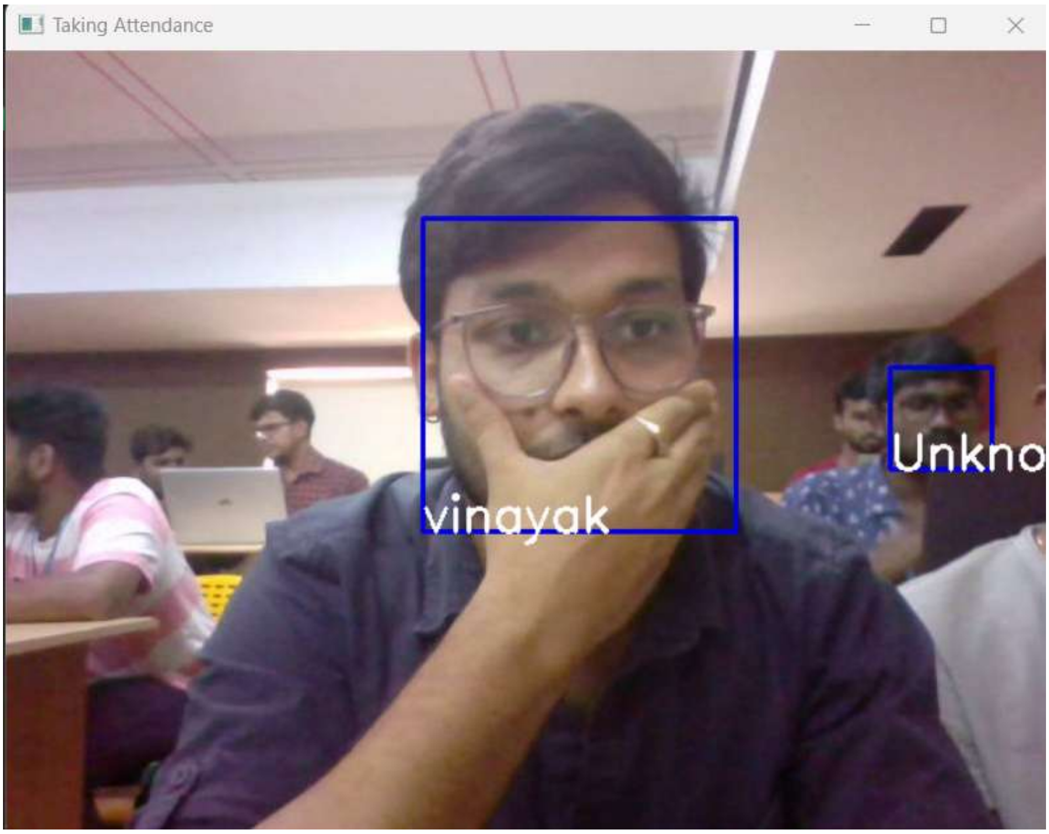
Taking Attendance
dev



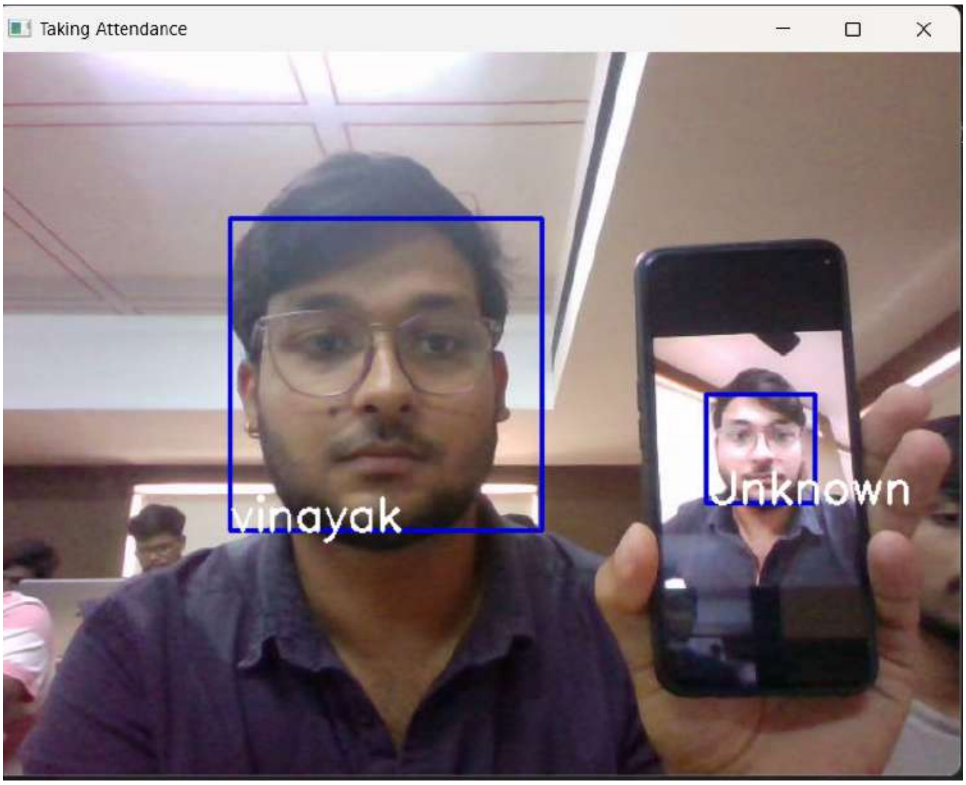


TestCase2: Lighting Condition

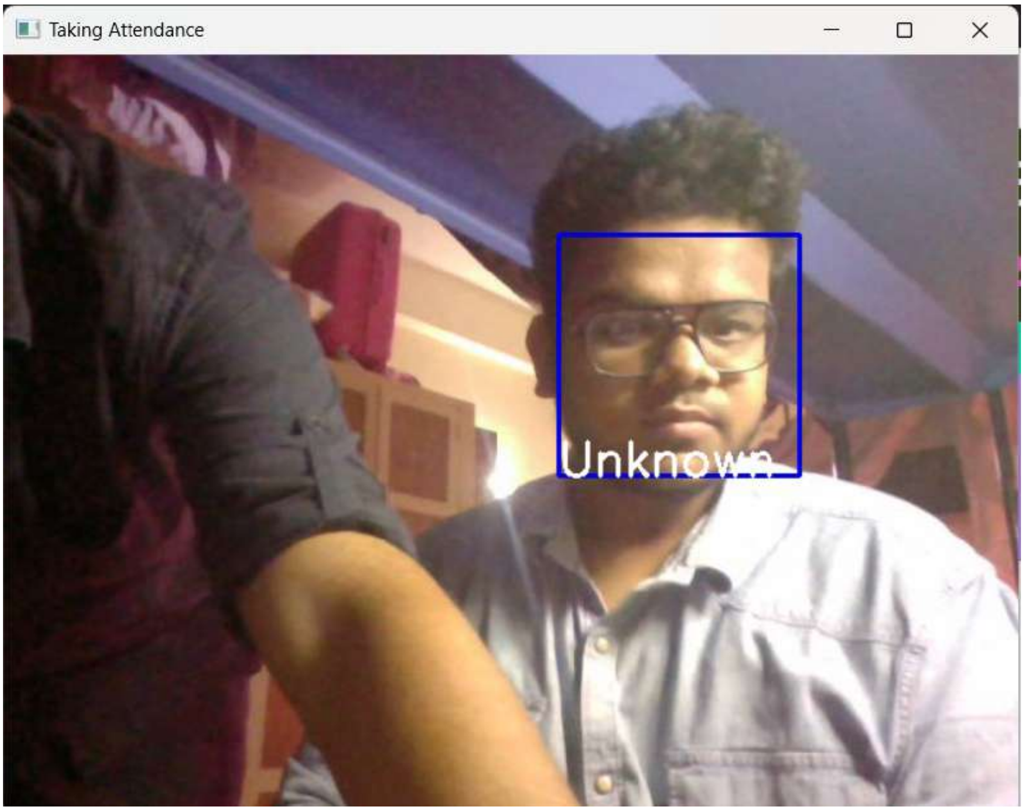
Test Case 3 : Occlusion



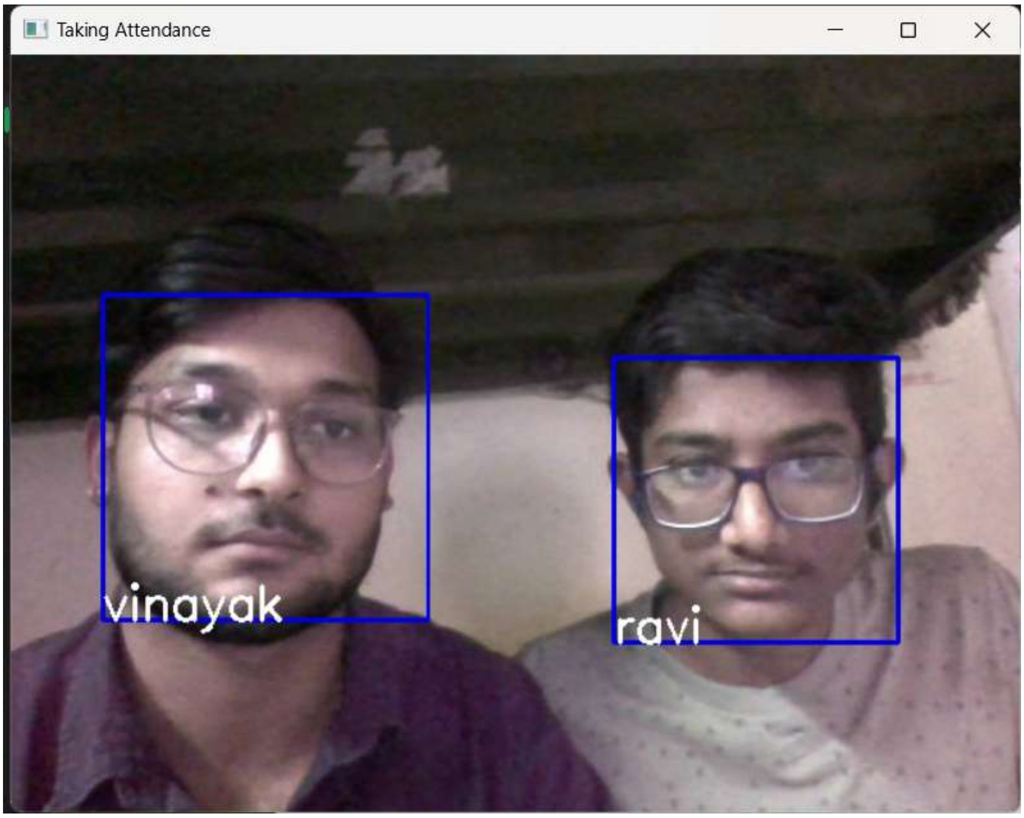
Test Case 4: Liveliness Detection Using Photo



Test Cases 5: Unknown Testcase



Test Cases 6: Multi-Face Detection:


Taking Attendance
vinayak
ravi