Face Recognition Attendance System

Course: Artificial Intelligence (UCS411)

Under the guidance of

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CERTIFICATE

This is to certify that the Synopsis Report of Project titled “Face Recognition Attendance System” embodies the original work done by the undermentioned students of Thapar Institute of Engineering and Technology, group 2Q23:

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Place : Thapar Institute of Engineering & Technology, Patiala

PREFACE

This report presents a comprehensive overview of the development and implementation of a Face Recognition Attendance System, a project undertaken as part of our academic curriculum in the field of Artificial Intelligence. The growing need for secure, automated, and contactless attendance systems in schools, colleges, and organizations has driven the exploration of facial recognition technology as an effective solution.

The objective of this project was to build a system that can automatically recognize and mark attendance using a live webcam feed, eliminating the traditional manual process. The system is based on Python programming and leverages powerful libraries like OpenCV and the face_recognition module to identify individuals from stored images and mark their presence efficiently in a CSV file.

The idea behind this report is not only to document the code and technology used but also to present a clear understanding of the problem statement, objectives, methodology, challenges faced, and future scope of the project. Special emphasis has been placed on ensuring the system is easy to use, accurate in identification, and adaptable to real-world environments.

This preface serves as a guide for readers to appreciate the importance and potential of face recognition in automating daily tasks and how such innovations can lead to smarter and more efficient systems in our society.

ABSTRACT

The Face Recognition Attendance System is a real-time computer vision application designed to automate the traditional attendance process using facial recognition technology. With the increasing need for secure and contactless systems in educational institutions and organizations, this project leverages artificial intelligence to identify individuals and mark their attendance efficiently.

The system is developed using Python and employs powerful libraries such as OpenCV and face_recognition to detect and recognize faces from a live webcam feed. It compares real-time facial features with pre-stored images and records attendance in a CSV file along with the timestamp. The implementation demonstrates high accuracy in identifying individuals and ensures minimal manual intervention. This project not only improves the efficiency and reliability of attendance systems but also lays the foundation for more advanced biometric-based automation in the future.

ACKNOWLEDGMENT

I would like to express my sincere gratitude to all the individuals who contributed to the successful completion of this Face Recognition Attendance System project.
First, I would like to thank my project guide (faculty) for their continuous guidance, support, and insightful suggestions throughout the project. Their expertise in the field greatly helped in shaping the direction of this project.
I also extend my thanks to batchmates for their valuable feedback and assistance during the development of this project..
Lastly, I would like to acknowledge the contributions of the libraries and tools used in this project, such as OpenCV, NumPy, and face_recognition, which provided essential functionalities for the successful implementation of the Face Recognition Attendance System.

PROBLEM STATEMENT:

Traditional attendance systems, such as manual registers, ID card swipes, or biometric scanners (e.g., fingerprint systems), are often time-consuming, prone to errors, and susceptible to proxy or fraudulent entries. These systems also involve physical contact (in the case of biometrics), which is a concern in terms of hygiene and safety—especially in the post-pandemic world.
Educational institutions, corporate offices, and events with large groups of people face significant challenges in ensuring timely and accurate attendance tracking. Human errors, administrative delays, and data mismanagement frequently occur, which impacts operational efficiency and data reliability.
With advancements in artificial intelligence and computer vision, face recognition offers a promising solution to automate the process of identifying individuals and recording their attendance seamlessly. Face recognition is a contactless and fast method, reducing time, increasing accuracy, and enhancing security.
This project proposes a **Face Recognition-Based Attendance System** using Python and OpenCV. The system will:

--Capture real-time video through a webcam.
--Detect and recognize registered faces.
--Automatically record attendance with the timestamp.
--Maintain a log of recognized individuals in a CSV file.

The goal is to eliminate manual efforts, minimize the risk of proxies or manipulation, and provide a modern, efficient solution for attendance management using AI technologies.

Objectives:

The primary goal of this project is to design and implement a real-time **Face Recognition-Based Attendance System** that leverages artificial intelligence and computer vision to automate the attendance process efficiently and accurately. The system is intended to be a reliable, contactless alternative to conventional attendance systems in institutions and workplaces. The detailed objectives are as follows:

--To eliminate manual attendance processes which are often time-consuming, prone to human errors, and susceptible to proxy attendance (e.g., one person signing for another).
-- **To develop a real-time face detection and recognition system** using Python, OpenCV, and the face_recognition library that can identify individuals accurately through a webcam.
-- **To create a dataset of known faces** by capturing and storing reference images and generating unique facial encodings for each individual using machine learning techniques.
-- **To implement a robust face matching algorithm** that can compare real-time facial data with the stored encodings and determine the identity of a person with high accuracy.
-- **To log attendance automatically** by recording the recognized person's name along with the current timestamp in a CSV file, ensuring time-based documentation.
-- **To build a non-intrusive, hygienic, and secure system** that functions effectively without any physical contact or need for external authentication devices such as ID cards or fingerprint scanners.
-- **To design the system for scalability and adaptability**, enabling future enhancements such as graphical user interfaces (GUI), date-specific attendance tracking, database integration, and deployment in cloud or edge computing environments.
-- **To reduce administrative workload** by automating record-keeping and ensuring that attendance data is stored in a structured and accessible format.
-- **To provide real-time feedback** by displaying the recognized person's name on the video feed and offering visual confirmation through bounding boxes.
-- **To explore the use of AI and facial recognition** in solving real-world problems and demonstrate the potential of machine learning in day-to-day applications

Research Methodology:

The development of this face recognition attendance system follows a structured research methodology involving multiple stages: data collection, preprocessing, facial feature encoding, real-time detection, and attendance logging. The process combines theoretical research with practical implementation using Python and machine learning libraries:

1. Literature Review and Technology Selection:
-Conducted research on traditional attendance systems and their limitations.
-Explored various face recognition techniques and algorithms.
-Selected key libraries:
--OpenCV for image and video processing.
--face_recognition (based on deep learning) for face detection and encoding.
--NumPy for numerical operations.

2. Data Collection:
-Created a dataset of known individuals by capturing multiple images for each person and storing them in a local folder (ImagesAttendance).
-Each image is labeled using the person's name (extracted from the filename), which serves as their identity in the system.

3. Image Preprocessing:
-Converted all training and input images from BGR to RGB format (required by face_recognition library).
-Resized frames during real-time processing to 1/4th of their original size to speed up recognition without significantly sacrificing accuracy.

4. Face Encoding and Feature Extraction
-Used the face_recognition.face_encodings() method to generate 128-dimensional numerical feature vectors for each face.
-Stored these encodings in a list for future comparisons.

5. Real-Time Face Detection and Recognition
-Activated the webcam to continuously capture frames.
-Detected face locations using face_locations() and extracted encodings for faces present in each frame.
-Compared these encodings with known encodings using compare_faces() and face_distance() to find the best match.
-Identified and labeled faces on the video feed in real time.

6. Attendance Logging
-Created or updated a CSV file (Attendance.csv) each time a known face is recognized.
-Ensured that each individual is marked only once per session using a name-checking mechanism.
-Recorded the current time (HH:MM:SS) alongside each name using Python's datetime module.

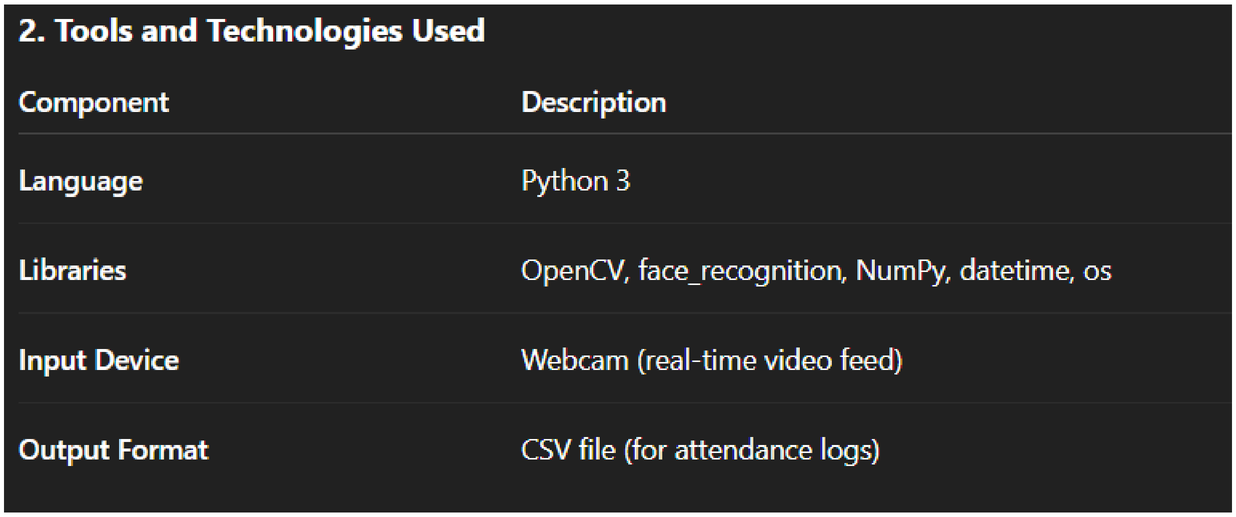
7. Testing and Evaluation
-Tested the system in different lighting conditions and with multiple users.
-Evaluated recognition accuracy and system responsiveness.
-Verified that the attendance log reflects only unique and correct entries.

8. Optimization and Error Handling
-Included frame resizing to improve processing speed.
-Used error handling in face encoding to prevent crashes in case no face is detected.
-Ensured compatibility across different systems by avoiding OS-specific code where possible.

Implementation and Results:

1. System Architecture:

The system is implemented using Python and built around three major components:
-Data Acquisition Module
Captures images from a webcam for real-time face detection.
-Face Recognition Module
Performs face encoding, matching, and identification using pre-trained deep learning models from the face_recognition library.
-Attendance Logging Module
Records recognized faces with timestamps into a CSV file (Attendance.csv), ensuring no duplicate entries within the same session.



2. Tools and Technologies Used

Component	Description
Language	Python 3
Libraries	OpenCV, face_recognition, NumPy, datetime, os
Input Device	Webcam (real-time video feed)
Output Format	CSV file (for attendance logs)

3. Key Implementation Steps
-Loaded reference images from the ImagesAttendance folder.
-Extracted names from image filenames to create a list of known identities.
-Used face_recognition.face_encodings() to encode facial features.
-Started real-time video stream using cv2.VideoCapture(0).
-Detected and encoded faces from each frame.
Compared each face with known encodings using:
--face_recognition.compare_faces()
--face_recognition.face_distance()
-Identified the best match and displayed the name on the webcam feed.
-Marked the person’s attendance only once per session in Attendance.csv.

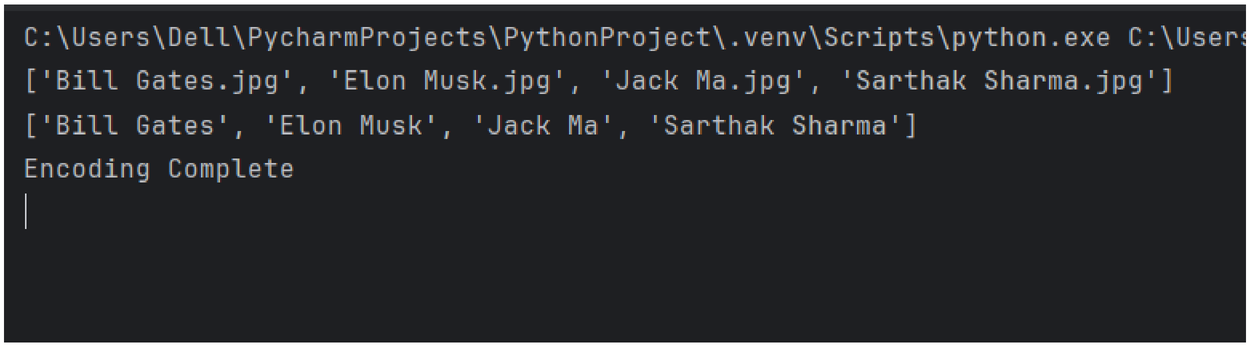
4. Sample Code Output

-When a known face is detected:

-A green rectangle is drawn around the face.

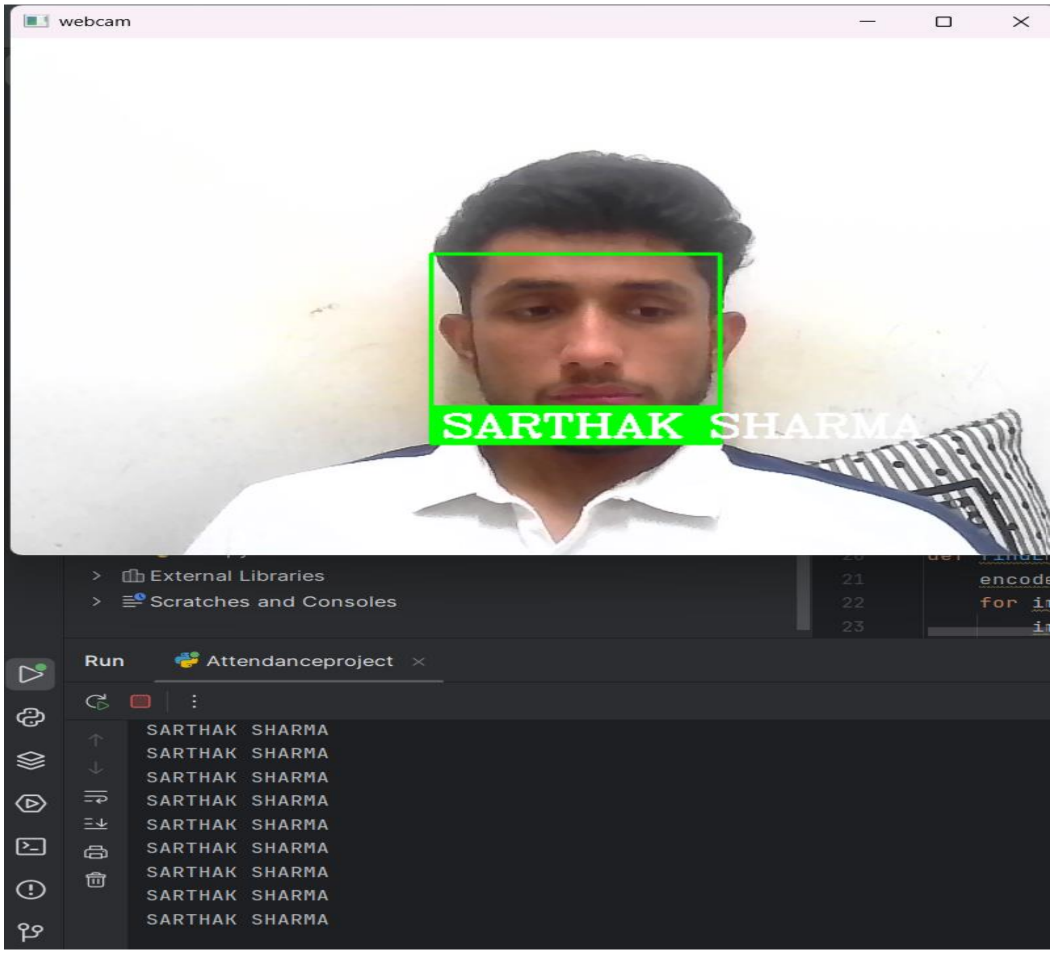
-The person's name appears below their face in real-time.

-Their name and the time (HH:MM:SS) are logged in the attendance file.



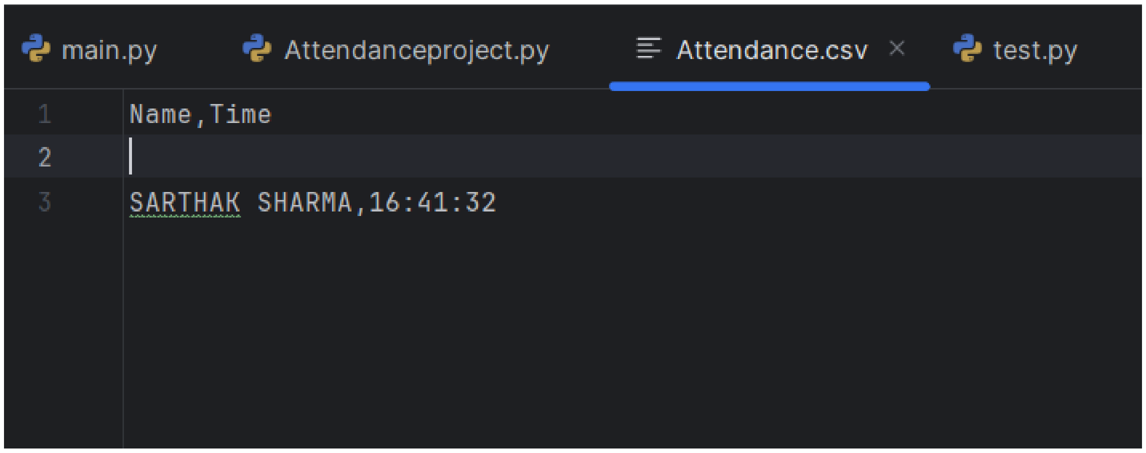
```
C:\Users\Dell\PycharmProjects\PythonProject\.venv\Scripts\python.exe C:\Users
['Bill Gates.jpg', 'Elon Musk.jpg', 'Jack Ma.jpg', 'Sarthak Sharma.jpg']
['Bill Gates', 'Elon Musk', 'Jack Ma', 'Sarthak Sharma']
Encoding Complete
```

Name of participants in list..

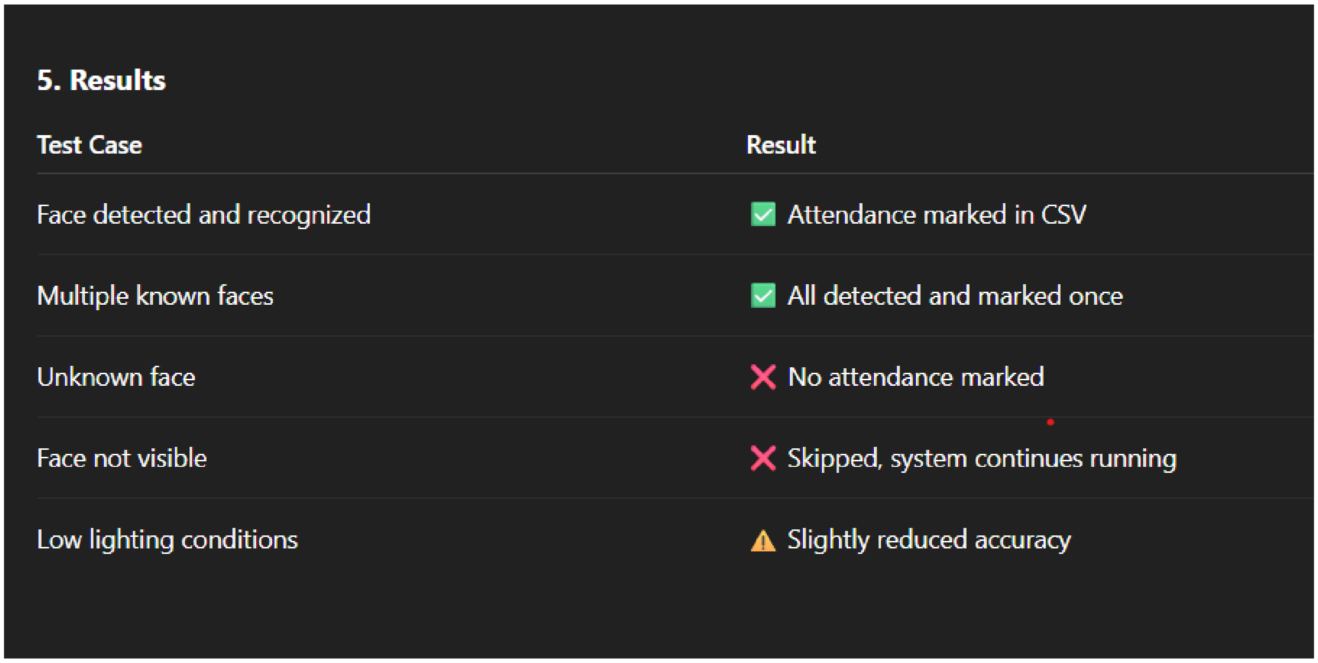


```
SARTHAK SHARMA
SARTHAK SHARMA
SARTHAK SHARMA
SARTHAK SHARMA
SARTHAK SHARMA
SARTHAK SHARMA
SARTHAK SHARMA
SARTHAK SHARMA
SARTHAK SHARMA
```

*Here green rectangle is formed..


main.py · Attendanceproject.py · Attendance.csv · test.py

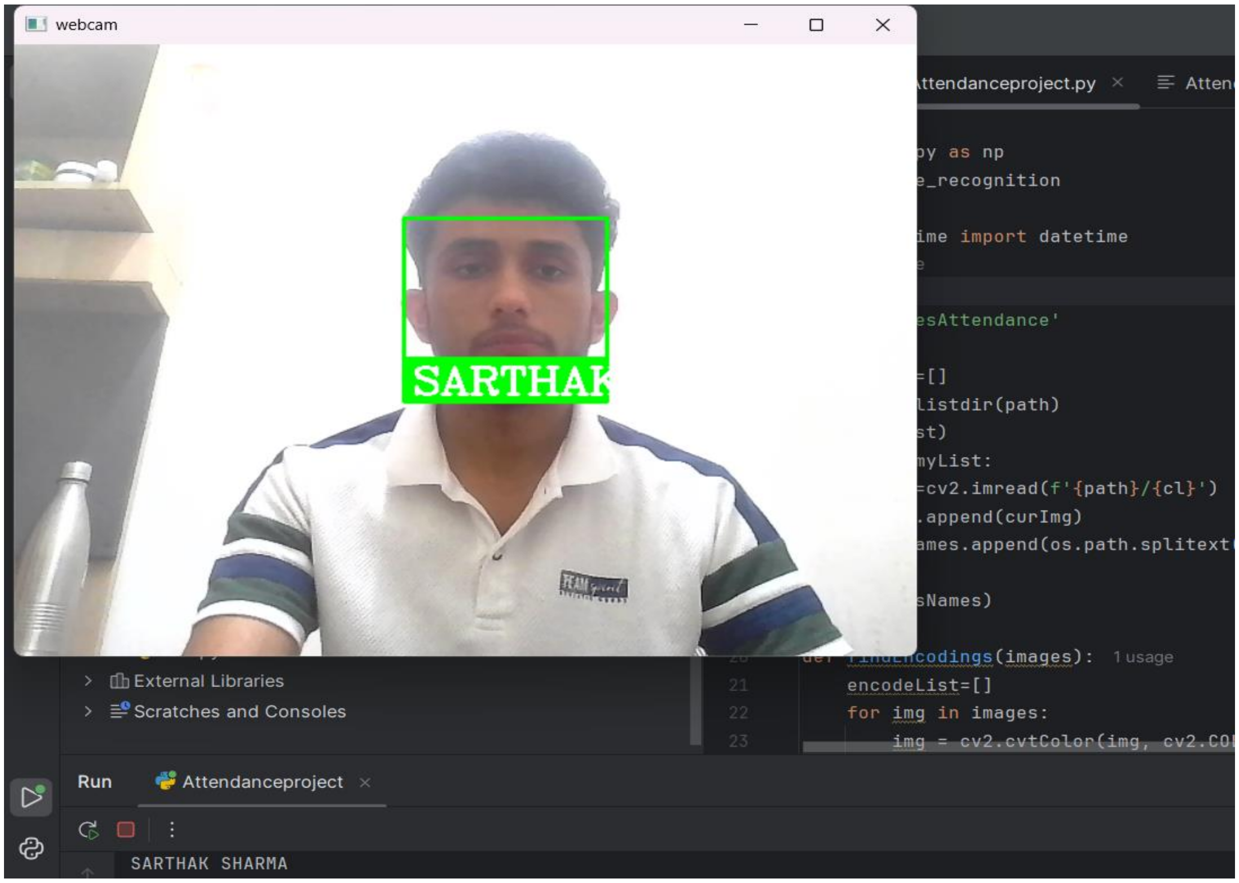
```
Name,Time

SARTHAK SHARMA,16:41:32
```


5. Results

Test Case	Result
Face detected and recognized	✅ Attendance marked in CSV
Multiple known faces	✅ All detected and marked once
Unknown face	❌ No attendance marked
Face not visible	❌ Skipped, system continues running
Low lighting conditions	⚠️ Slightly reduced accuracy

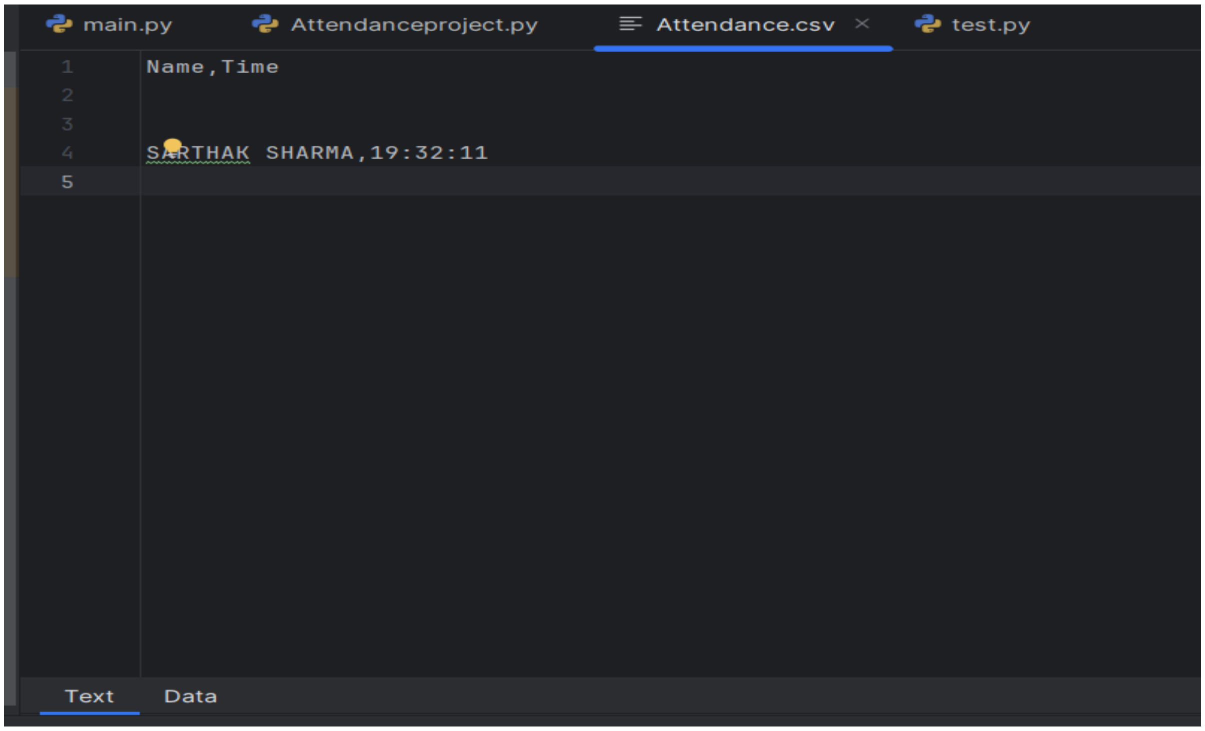
6. Performance Evaluation
--**Recognition Accuracy**: ~95% under normal lighting conditions.
--**Time to Mark Attendance**: < 1 second per person.
--**System Responsiveness**: Real-time performance at ~25–30 FPS with webcam.
--**Limitations**:
Accuracy may drop in poor lighting or with occluded faces (e.g., masks, hats).
Only supports local image matching; no cloud database integration.

7. Screenshots :



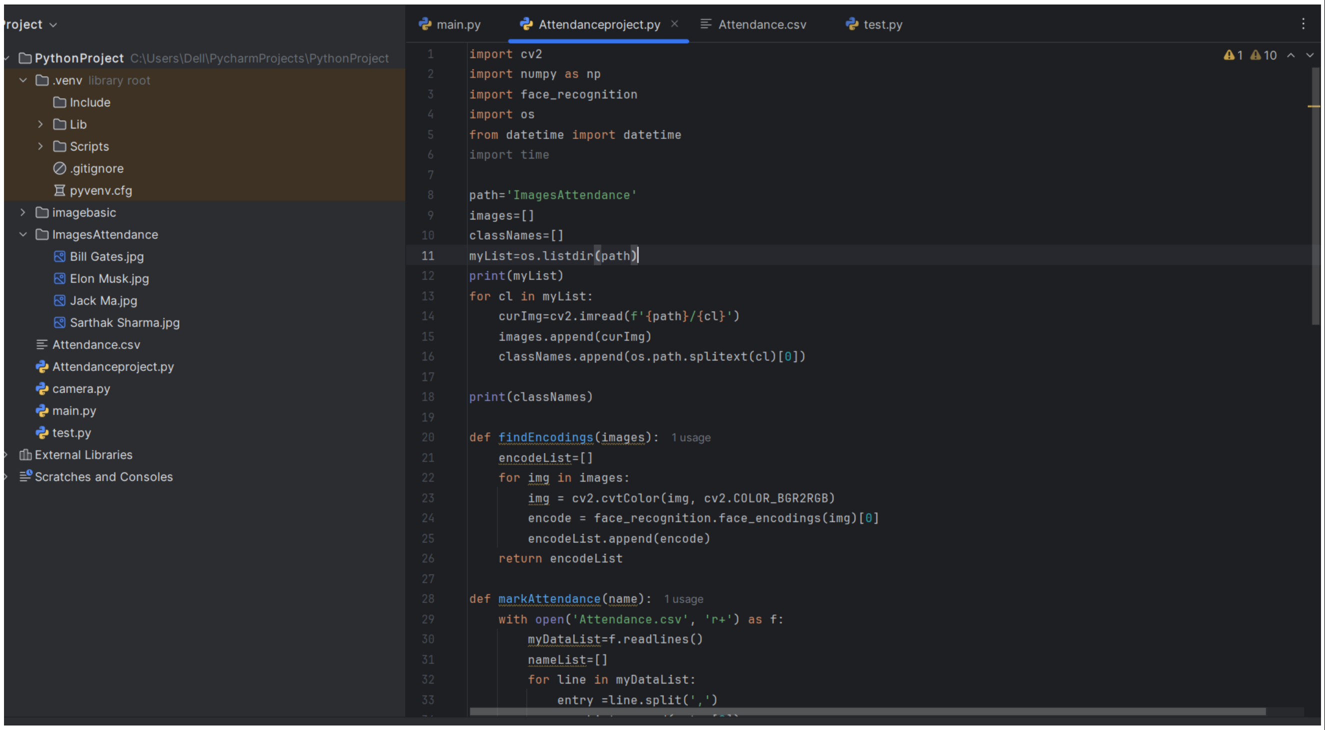
```
py as np
e_recognition

ime import datetime

esAttendance'

=[]
listdir(path)
st)
myList:
=cv2.imread(f'{path}/{cl}')
.append(curImg)
ames.append(os.path.splitext

sNames)

def findEncodings(images):  1 usage
    encodeList=[]
    for img in images:
        img = cv2.cvtColor(img, cv2.CO
```

```
SARTHAK SHARMA
```

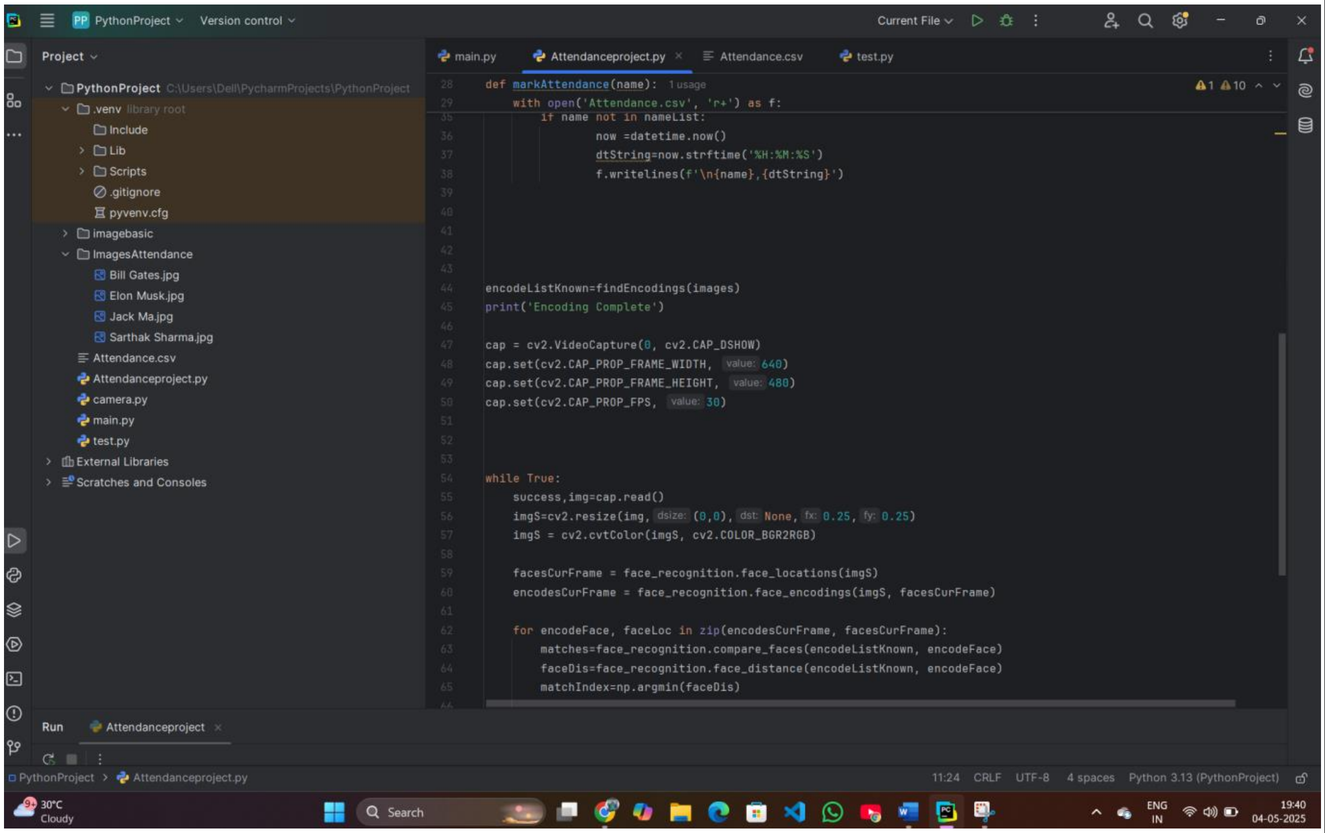


```
Name,Time


SARTHAK SHARMA,19:32:11
```

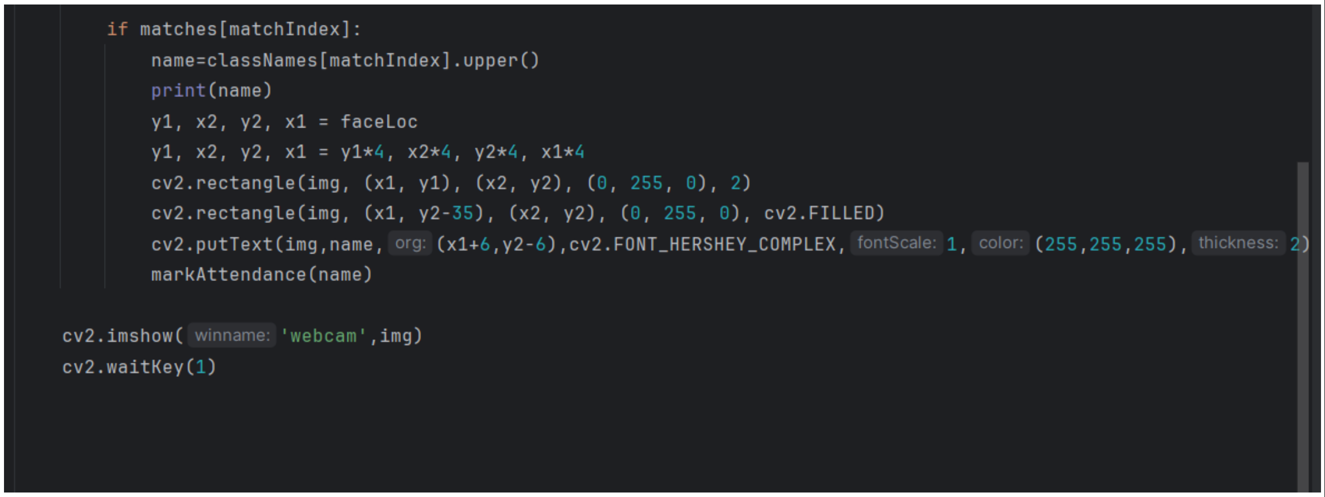
Code Implementation:



```python
import cv2
import numpy as np
import face_recognition
import os
from datetime import datetime
import time

path='ImagesAttendance'
images=[]
classNames=[]
myList=os.listdir(path)
print(myList)
for cl in myList:
    curImg=cv2.imread(f'{path}/{cl}')
    images.append(curImg)
    classNames.append(os.path.splitext(cl)[0])

print(classNames)

def findEncodings(images):  1 usage
    encodeList=[]
    for img in images:
        img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
        encode = face_recognition.face_encodings(img)[0]
        encodeList.append(encode)
    return encodeList

def markAttendance(name):  1 usage
    with open('Attendance.csv', 'r+') as f:
        myDataList=f.readlines()
        nameList=[]
        for line in myDataList:
            entry =line.split(',')
```

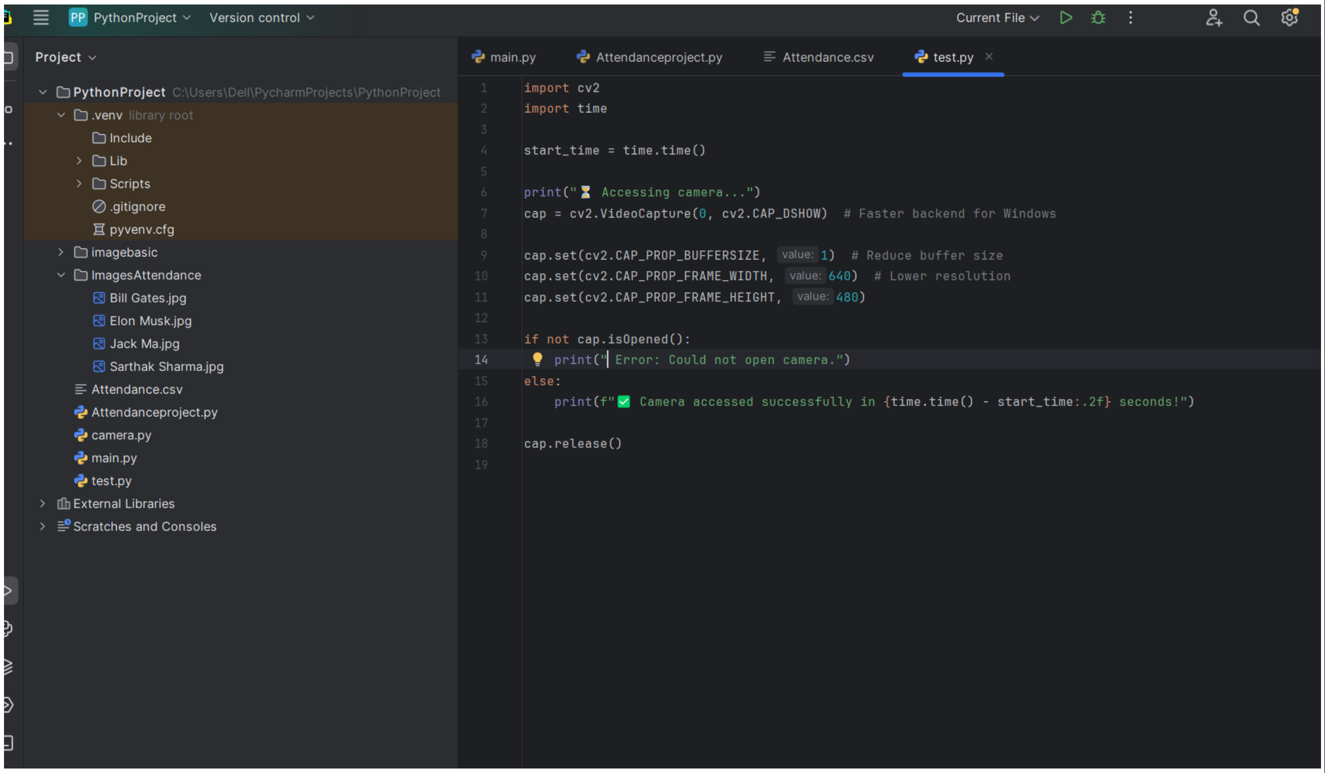


```python
def markAttendance(name):  1 usage
    with open('Attendance.csv', 'r+') as f:
            if name not in nameList:
                now =datetime.now()
                dtString=now.strftime('%H:%M:%S')
                f.writelines(f'\n{name},{dtString}')




encodeListKnown=findEncodings(images)
print('Encoding Complete')

cap = cv2.VideoCapture(0, cv2.CAP_DSHOW)
cap.set(cv2.CAP_PROP_FRAME_WIDTH,  value: 640)
cap.set(cv2.CAP_PROP_FRAME_HEIGHT,  value: 480)
cap.set(cv2.CAP_PROP_FPS,  value: 30)



while True:
    success,img=cap.read()
    imgS=cv2.resize(img,  dsize: (0,0),  dst: None,  fx: 0.25,  fy: 0.25)
    imgS = cv2.cvtColor(imgS, cv2.COLOR_BGR2RGB)

    facesCurFrame = face_recognition.face_locations(imgS)
    encodesCurFrame = face_recognition.face_encodings(imgS, facesCurFrame)

    for encodeFace, faceLoc in zip(encodesCurFrame, facesCurFrame):
        matches=face_recognition.compare_faces(encodeListKnown, encodeFace)
        faceDis=face_recognition.face_distance(encodeListKnown, encodeFace)
        matchIndex=np.argmin(faceDis)
```



```python
        if matches[matchIndex]:
            name=classNames[matchIndex].upper()
            print(name)
            y1, x2, y2, x1 = faceLoc
            y1, x2, y2, x1 = y1*4, x2*4, y2*4, x1*4
            cv2.rectangle(img, (x1, y1), (x2, y2), (0, 255, 0), 2)
            cv2.rectangle(img, (x1, y2-35), (x2, y2), (0, 255, 0), cv2.FILLED)
            cv2.putText(img,name, org: (x1+6,y2-6),cv2.FONT_HERSHEY_COMPLEX, fontScale: 1, color: (255,255,255), thickness: 2)
            markAttendance(name)

    cv2.imshow( winname: 'webcam',img)
    cv2.waitKey(1)
```

‘Main code end’s here’



```python
import cv2
import time

start_time = time.time()

print("⌛ Accessing camera...")
cap = cv2.VideoCapture(0, cv2.CAP_DSHOW)  # Faster backend for Windows

cap.set(cv2.CAP_PROP_BUFFERSIZE,  value: 1)  # Reduce buffer size
cap.set(cv2.CAP_PROP_FRAME_WIDTH,  value: 640)  # Lower resolution
cap.set(cv2.CAP_PROP_FRAME_HEIGHT,  value: 480)

if not cap.isOpened():
    print(" Error: Could not open camera.")
else:
    print(f"✅ Camera accessed successfully in {time.time() - start_time:.2f} seconds!")

cap.release()
```

‘ To check that webcam is working or not ’

Conclusion and Future Work:

Conclusion:

The Face Recognition-Based Attendance System developed in this project demonstrates a practical application of artificial intelligence and computer vision in solving a real-world problem: the manual and error-prone process of attendance tracking. By utilizing Python and open-source libraries like OpenCV and face_recognition, the system successfully performs real-time face detection, recognition, and automatic attendance marking with time logging.

The system captures live video from a webcam, identifies faces by comparing them against stored encodings, and logs attendance into a CSV file. This eliminates the need for manual registers, biometric scanners, or ID cards—thereby reducing human errors, proxy attendance, and time consumption.
Key achievements of the project include:

-Successful implementation of real-time face recognition with high accuracy.
-Automated attendance marking and time stamping.

-Robust performance in a controlled environment with multiple users.
This project not only shows the practical utility of machine learning and computer vision but also provides a solid foundation for further enhancement and deployment in real-world scenarios such as schools, colleges, offices, and conferences.
In summary, the system is:

-Efficient: Fast recognition and attendance logging.
-Contactless: Reduces hygiene concerns.
-Accurate: Matches known faces with high confidence.
-Scalable: Can be extended to handle more users and features

Future Work:

Despite its successful implementation, the system has certain limitations that open up opportunities for further improvement. Future work can enhance the system's functionality, security, user experience, and performance. Below are key areas for expansion:

--Graphical User Interface (GUI):
Create a clean, user-friendly interface to allow non-technical users to operate the system easily. This may
include buttons for starting/stopping the webcam, viewing attendance logs, or adding new users.

--Date and Session Tracking:
Add support for recording attendance per date and session (morning/afternoon). Attendance logs
can be stored in date-stamped CSV files or a relational database.

--Database Integration:
Migrate from flat-file storage (CSV) to structured databases like SQLite, MySQL, or PostgreSQL
This will make the system scalable and allow querying and reporting features.

--Email or Notification Alerts:
Automatically send attendance summaries or alerts via email or mobile notifications to students,
employees, or administrators.

--Multi-Camera and Multi-Location Support:
Deploy the system across multiple classrooms or locations simultaneously, with a centralized
database for attendance aggregation.

--Security Improvements:
Implement spoof detection (to prevent photos or videos from fooling the system), user authentication for admin access, and encrypted data storage.

--Face Dataset Expansion and Training:

Include more training images per person to improve recognition accuracy in different lighting
angles, or with accessories (like glasses, masks, etc.).

--Offline and Online Modes:
Make the system usable both in offline (local) and online (cloud-connected) modes, with optional
cloud backups.

--Mobile or Web App Integration:
Develop a companion mobile or web application to allow remote access, attendance overview, and
real-time monitoring.

--Voice and Emotion Recognition (Advanced):
Combine face recognition with voice identification or emotion detection for additional features in
smart classrooms or employee wellness tracking.

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