FACE RECOGNITION BASED REAL TIME ATTENDANCE SYSTEM

A Project Report submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

Submitted by

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DECLARATION

I/We, hereby declare that the project report entitled **FACE RECOGNITION BASED REAL TIME ATTENDANCE SYSTEM** is an original work done in the Department of Computer Science and Engineering, GITAM School of Technology, GITAM (Deemed to be University) submitted in partial fulfillment of the requirements for the award of the degree of B.Tech. in Computer Science and Engineering. The work has not been submitted to any other college or University for the award of any degree or diploma.

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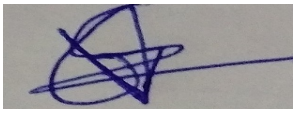
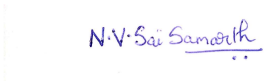
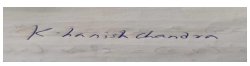
222010306022	GUNDLAPALLY VENKATA SAI SHESHAGIRI RAO	
222010306023	NADIMPALLI VENKATA SAI SAMARTH	
222010306036	KOLLA HANISH CHANDRA	

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CERTIFICATE

This is to certify that the project report entitled **FACE RECOGNITION BASED REAL TIME ATTENDANCE SYSTEM** is a bonafide record of work carried out by **KASINADHUNI PRANAV SAI(222010305025),GUNDLAPALLY VENKATA SAI SESHAGIRI RAO(222010306022),NADIMPALLI VENKATA SAI SAMARTH(222010306023),KOLLA HANISH CHANDRA(222010306036)** students submitted in partial fulfillment of requirement for the award of degree of Bachelors of Technology in Computer Science and Engineering.

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Sincerely,

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1. Introduction

In an era driven by technological advancements, the utilization of innovative solutions for workplace efficiency, security, and contactless participation is paramount. This mini project centers on the development and implementation of a face recognition system aimed at automating the participation of representatives in the workplace room environment, thereby eliminating the need for their direct involvement. The proposed system encompasses two fundamental stages of face recognition: face detection, where faces are identified within an image, and verification, where these recognized faces are compared with a dataset for authentication. For this project, OpenCV, dlib, and Python are employed to facilitate the detection of faces.

1.1 Problem Definition

The traditional methods of recording workplace attendance often rely on manual inputs, badge-based systems, or other means that require direct intervention by employees. These approaches can be time-consuming, prone to errors, and lack the capacity to adapt to the growing need for contactless and secure access control in modern workplaces. Thus, the problem at hand revolves around developing a system that addresses these challenges by automating attendance tracking and promoting workplace security.

1.2 Objective

The primary objective of this mini project is to create a face recognition system that enables programmed participation of representatives in the workplace room environment without necessitating their active engagement. This entails:

- Developing a robust face detection system using OpenCV and dlib.
- Designing a secure and efficient system for face verification.
- Implementing an attendance management system to track representatives' presence seamlessly.
- Enhancing workplace security by ensuring that only authorized individuals gain access.

1.3 Limitations

While this project demonstrates a promising approach to programmed participation and workplace security through face recognition, it is essential to acknowledge the following limitations:

- Variations in lighting conditions may affect the accuracy of face detection and recognition.

- Changes in facial expressions and image quality can impact system performance.
- The effectiveness of the system may be influenced by hardware constraints, including camera quality and placement.

1.4 Outcomes

The expected outcomes of this mini project encompass:

- The development of a functional face recognition system that can be seamlessly integrated into the workplace environment.
- The automation of attendance tracking, reducing manual recording and improving accuracy.
- Enhanced workplace security through contactless access control.
- A foundation for further advancements in attendance management and security solutions in the workplace.

1.5 Applications

The potential applications of the proposed system extend beyond workplace attendance management, including:

- Airports and transportation hubs for security and passenger identification.
- Access control systems in residential and commercial buildings.
- Smart cities for public services and safety.
- Event management for ticketing and security.
- Healthcare facilities for patient identification and access control.

This mini project leverages OpenCV, dlib, and Python to create a robust and adaptable system, offering an innovative solution for attendance management and secure access control, with broader implications for diverse industries and applications.

2. Literature Review

Introduction

The use of face recognition for automated workplace attendance has gained significant interest due to its potential to streamline the attendance tracking process. This literature review explores the various components of face recognition technology, specifically the detection of faces using OpenCV, dlib, and Python. The process typically involves two stages: face detection and face verification, which ensures accurate and efficient attendance tracking.

1. Face Recognition in Workplace Attendance

Face recognition is a biometric technology that has shown promise in workplace attendance systems. It offers non-intrusive and accurate means of identifying employees or participants.

2. Face Detection: Role of OpenCV

OpenCV (Open Source Computer Vision Library) is a widely used open-source computer vision library that plays a fundamental role in face detection. It offers various pre-trained face detection models and provides extensive tools to process images and videos for face recognition.

Haar Cascade Classifiers: OpenCV's Haar Cascade Classifiers are a popular choice for real-time face detection. These classifiers use machine learning techniques to identify patterns in images, making them effective in locating faces.

Deep Learning Models: Modern face detection techniques have evolved with the integration of deep learning models. OpenCV now supports deep learning-based models like Single Shot MultiBox Detector (SSD) and Faster R-CNN, which have enhanced accuracy in identifying faces.

3. Face Detection with dlib

dlib is a versatile toolkit that is particularly well-known for its face detection and facial landmark identification capabilities. It provides a range of pre-trained models that can be used for accurate face detection.

HOG (Histogram of Oriented Gradients) Features: dlib's HOG-based face detection is highly robust and can identify faces under various conditions, including occlusion and pose changes.

Face Landmark Detection: dlib goes beyond face detection by offering facial landmark detection, which can be useful for facial feature analysis and improved face recognition accuracy.

4. Role of Python in Face Recognition

Python is a popular programming language for implementing face recognition systems. Its simplicity, extensive libraries, and powerful frameworks like TensorFlow and PyTorch make it a preferred choice for many developers.

Ease of Integration: Python offers the advantage of being easily integrated with OpenCV and dlib. Developers can harness the power of these libraries while enjoying Python's user-friendly syntax.

Development of Custom Solutions: Python allows the development of customized face recognition solutions tailored to specific workplace requirements, such as the integration with attendance systems.

5. Face Recognition Techniques and Datasets

Researchers have proposed numerous face recognition techniques, including Eigenfaces, Fisherfaces, Local Binary Pattern Histograms (LBPH), and deep learning-based Convolutional Neural Networks (CNNs). These techniques have been tested using standard face recognition datasets like LFW (Labeled Faces in the Wild) and YTF (YouTube Faces).

Conclusion

Face recognition for automated workplace attendance using OpenCV, dlib, and Python has become increasingly reliable and efficient. OpenCV offers multiple face detection models, dlib excels in HOG-based detection and facial landmark identification, while Python provides a versatile programming environment for custom implementations. As technology continues to advance, the potential for accurate and non-intrusive workplace attendance systems using face recognition is promising, offering benefits in terms of efficiency, security, and user experience. Future research should focus on fine-tuning these systems to meet the specific needs of various workplace environments.

3. Problem Analysis

The problem analysis section provides a detailed examination of the existing challenges and the proposed solutions within the context of the mini project.

3.1 Problem Statement

The problem at hand is to devise a system that automates attendance tracking and ensures secure participation of workplace representatives in a room environment without their direct involvement. Traditional attendance tracking methods often rely on manual data entry or badge-based systems, which can be time-consuming and prone to errors. Additionally, these methods do not readily adapt to the growing need for contactless and secure access control.

3.2 Existing System

In the existing system, attendance tracking in workplace environments typically involves manual data entry or badge-based systems. These methods require active participation from representatives, which may lead to inaccuracies and do not address the need for contactless access control. Existing security measures often rely on keys, badges, or PINs, which can be lost, stolen, or shared, compromising security.

3.3 Flaws & Disadvantages

The flaws and disadvantages of the existing system are as follows:

- **Manual Data Entry:** Manual attendance recording is time-consuming and can lead to errors, affecting the accuracy of attendance data.
- **Badge-Based Systems:** Badge-based systems can be cumbersome, as employees are required to carry and use physical badges or keycards.
- **Limited Security:** The existing system's reliance on keys, badges, or PINs poses security risks, as these can be easily lost, stolen, or shared.
- **Lack of Contactless Access:** The current system does not cater to the need for contactless access control, which is essential in environments emphasizing health and safety.

3.4 Proposed System

The proposed system addresses these issues by implementing a face recognition approach that enables programmed participation of representatives. This system automates attendance tracking, enhances security, and offers a contactless access solution. The system comprises two main stages: face detection using OpenCV and dlib, and face verification for attendance management.

3.5 Functional Requirements

The functional requirements of the proposed system include:

- **Face Detection:** The system must be able to detect faces within images.
- **Face Verification:** It should verify recognized faces against a database for attendance tracking.
- **Attendance Recording:** The system should automatically record attendance data.
- **Access Control:** It must ensure secure access control by recognizing authorized individuals.
- **Seamless Integration:** The system should seamlessly integrate into the workplace room environment.

3.6 Non-Functional Requirements

The non-functional requirements of the proposed system include:

- **Robustness:** The system should be robust against variations in lighting conditions, facial expressions, and image quality.
- **Accuracy:** It should exhibit high accuracy in face detection and verification.
- Scalability: The system should be capable of handling a growing database of representatives.
- **Security:** It must prioritize data security and secure access control.
- **Efficiency:** The system should operate efficiently, with minimal response time.
- **Usability:** It should offer a user-friendly interface for easy adoption by representatives and administrators.
- **Compatibility:** The system should be compatible with standard hardware and software configurations in workplace environments.

4. System Design

4.1 Proposed System Architecture

4.1.1 Architecture Diagram Of App

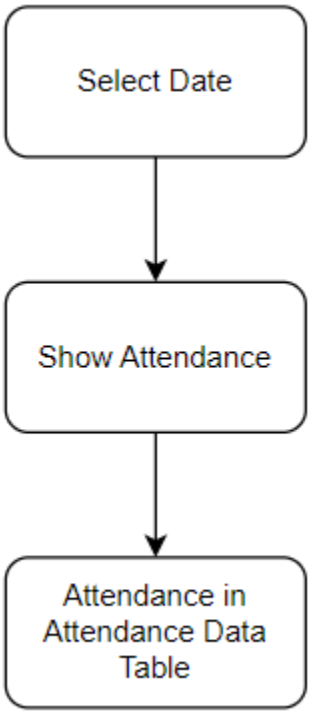


Figure 4.1.1

4.1.2 Architecture Diagram Of Attendance taker

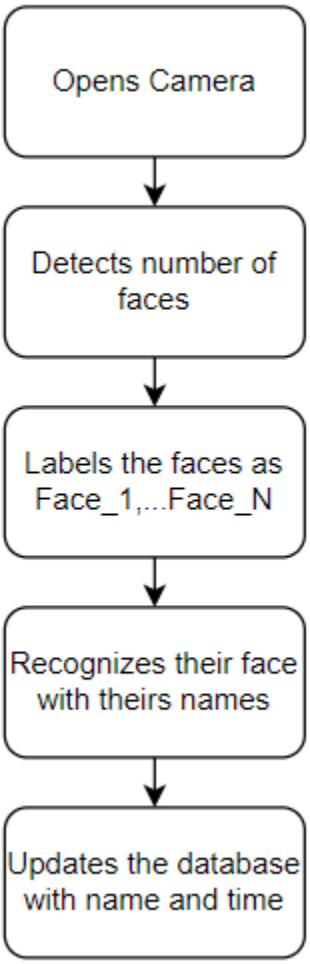


Figure 4.1.2

4.1.3 Architecture Diagram Of Importing attendance to .csv

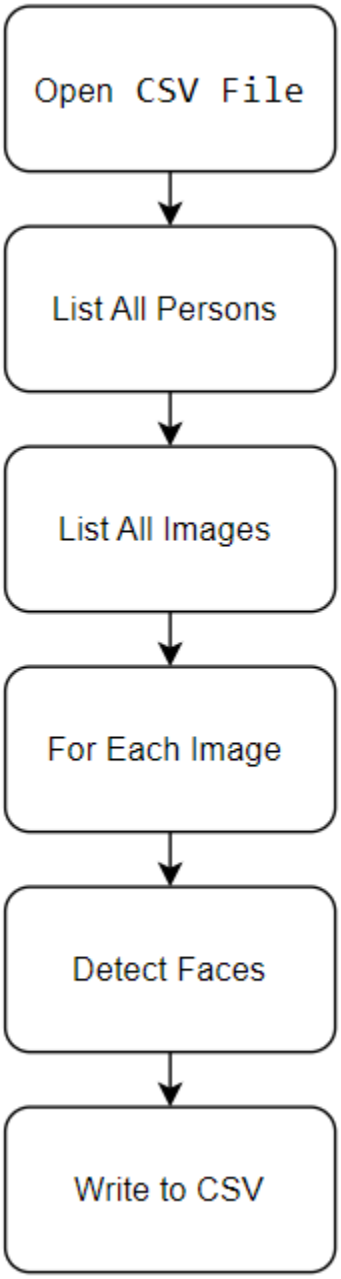


Figure 4.1.3

4.1.4 Architecture Diagram Of Getting faces from camera

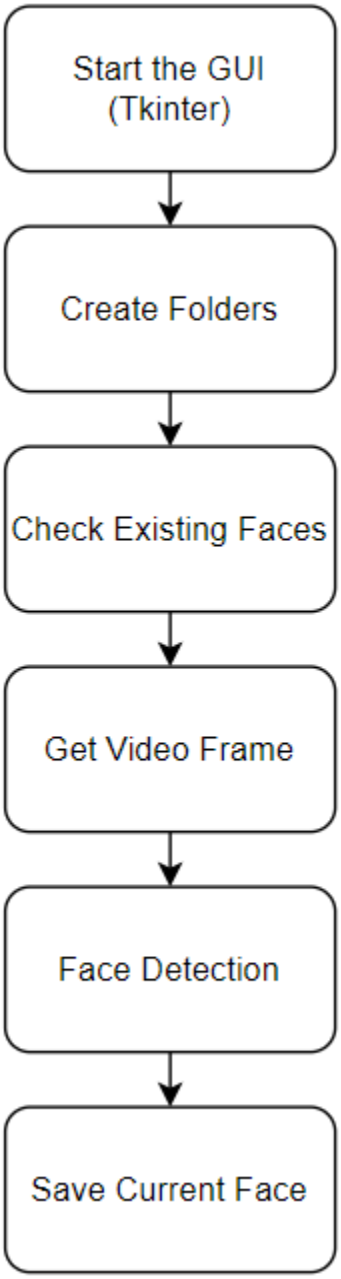


Figure 4.1.4

4.2 UML Diagrams

4.2.1 Use Case Diagram

Figure 4.2.1

4.2.2 Class Diagram

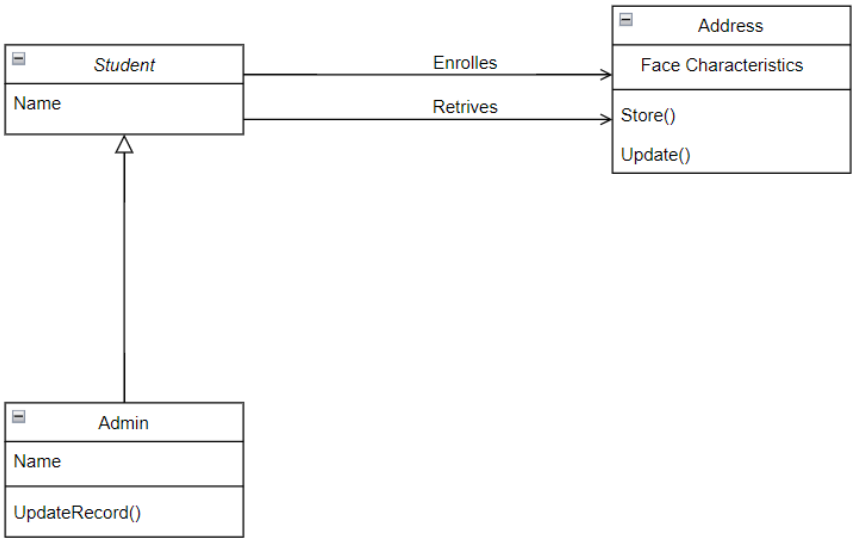


Figure 4.2.2

4.2.3 Activity Diagram

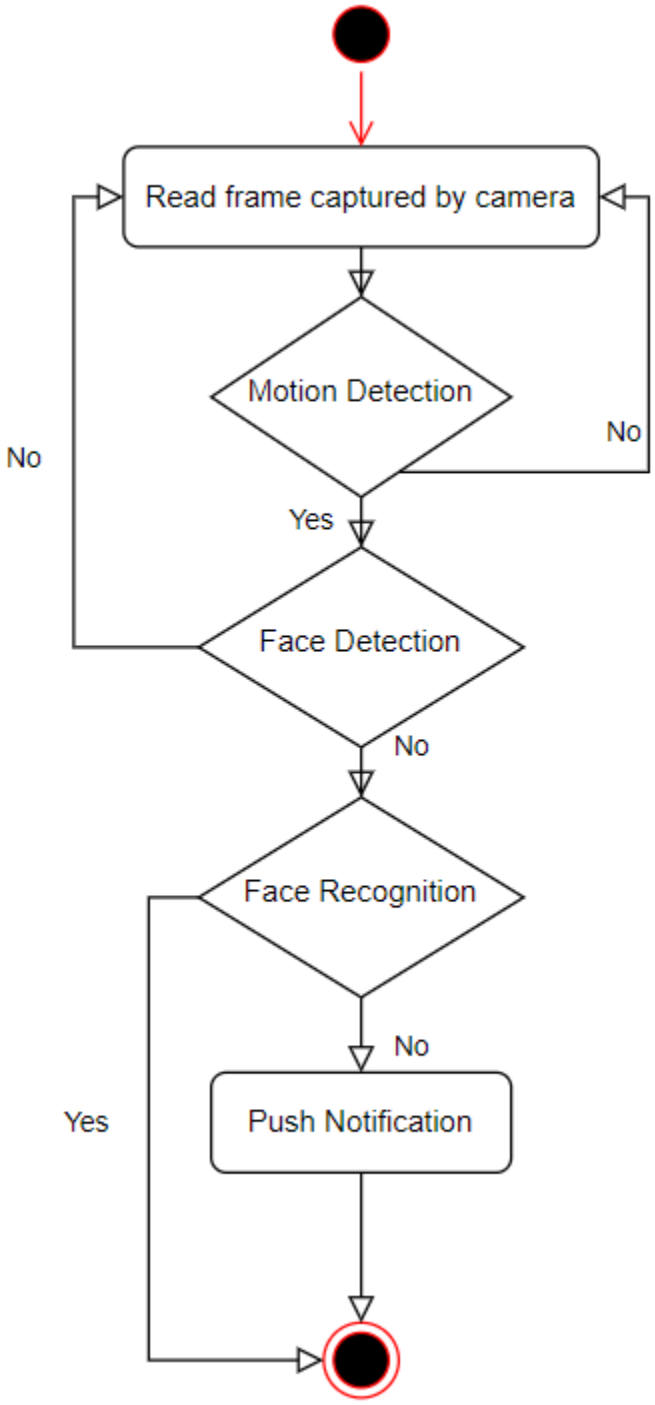


Figure 4.2.3

4.2.4 Sequence Diagram

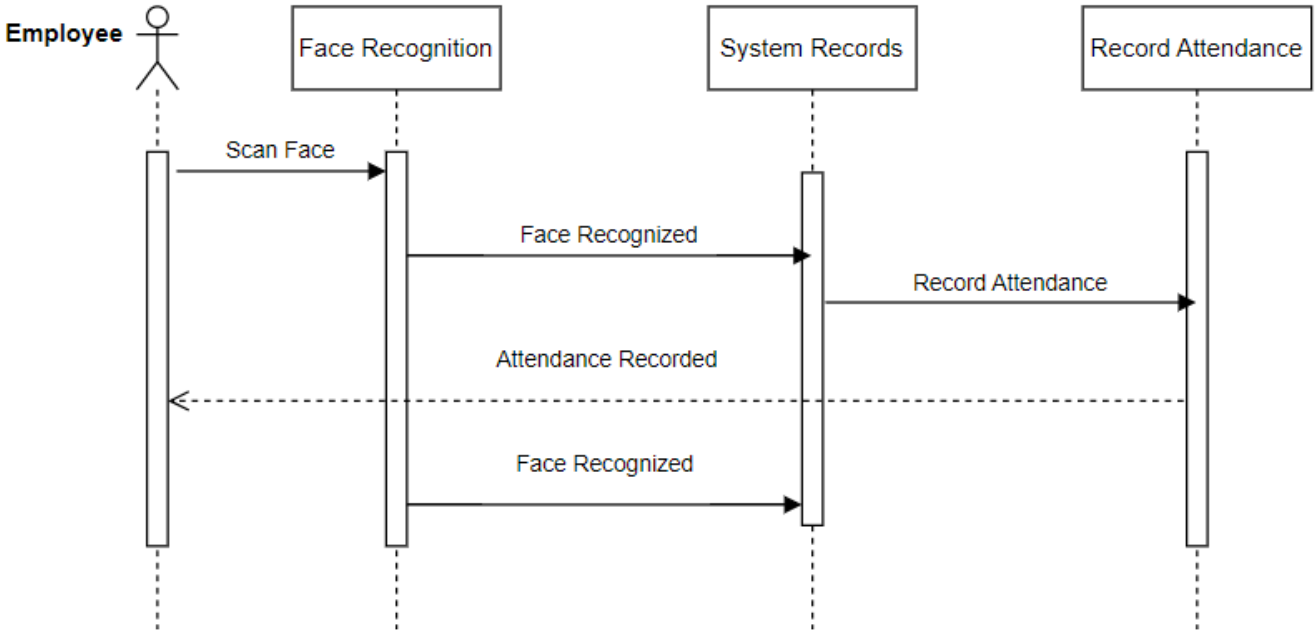


Figure 4.2.1

5. Implementation

5.1 Overview Of Technologies

In order to implement the Face Recognition approach for the automated participation of representatives in the workplace room environment without any manual intervention, we rely on several key technologies. The following components play a crucial role in our implementation:

5.1.1 Python 3

Python 3 serves as the primary programming language for this project. It provides a versatile and extensive set of libraries and tools for image processing, machine learning, and application development, making it a suitable choice for our Face Recognition system.

5.1.2 Windows OS

The implementation environment is based on the Windows operating system, which offers compatibility with the required hardware and software components.

5.1.3 Visual Studio

Visual Studio is employed as the integrated development environment (IDE) to facilitate the development and debugging of the project. It offers a range of tools and features that streamline the development process.

5.1.4 WebCam

A webcam is used as the input device to capture images of individuals in the workplace room. It provides the real-time visual data necessary for face detection and recognition.

5.1.5 OpenCV

OpenCV (Open Source Computer Vision Library) is a critical component of our implementation. It is a powerful open-source computer vision and machine learning software library that is used for various image processing tasks. OpenCV enables us to detect faces in the captured images and perform face recognition by comparing these detected faces with the information stored in the database.

The Face Recognition approach involves a two-step process: in the initial step, faces are identified within the captured images using OpenCV's face detection algorithms. Subsequently, these detected faces are compared with the information stored in the database for verification and recognition.

5.1.6 Flask

Flask, a lightweight and versatile web framework for Python, is utilized to develop the web-based user interface for our Face Recognition system. It enables easy access and interaction with the system, making it user-friendly and accessible.

5.2 Libraries Imported

In the implementation of our Face Recognition approach for the programmed participation of representatives in the workplace room environment, we make use of several essential libraries and modules to enhance the functionality and capabilities of our system. These libraries are crucial in various aspects of the project, including face detection, database operations, user interface development, and data processing. Below is a list of the libraries and modules we have imported and their respective roles in our system:

5.2.1 Dlib

Dlib is mostly used for face recognition purposes. Dlib is a powerful library for machine learning and computer vision. They analyzed the object/face using the functions called HOG (Histogram of oriented gradients) and CNN (Convolutional Neural Networks). It is used for facial feature detection and shape prediction, which is an essential component of our face recognition system.

5.2.2 Numpy

Numpy provides support for numerical and array operations in Python. It is used for efficient handling and manipulation of image data and mathematical operations within the project.

5.2.3 CV2 (OpenCV)

OpenCV is integral for computer vision tasks. We utilize it for face detection, image processing, and working with real-time video streams.

5.2.4 OS

The os module is used for interacting with the operating system, which allows us to manage file operations, directory paths, and system-level functions.

5.2.5 Shutil

Shutil is employed for file operations and management, including copying, moving, and deleting files and directories.

5.2.6 Time

The time module is used for time-related functions, scheduling tasks, and handling delays in various parts of the system.

5.2.7 Logging

The logging module is crucial for tracking and recording system events, errors, and activities, providing a detailed log for debugging and analysis.

5.2.8 Tkinter

Tkinter is a graphical user interface library for creating interactive interfaces. We use it to develop the user interface for controlling and monitoring the face recognition system.

5.2.9 Image (PIL - Python Imaging Library)

The Image module from the Python Imaging Library is used for opening, manipulating, and processing image files within the system.

5.2.10 ImageTK

ImageTK is a module used in conjunction with Tkinter to display and work with images in the user interface.

5.2.11 Flask

Flask is a web framework used to create the web-based user interface for our face recognition system, making it accessible via web browsers.

5.2.12 Datetime

Datetime is utilized for handling date and time information, which is essential for timestamping and tracking events within the system.

5.2.13 sqlite3

The sqlite3 module provides support for SQLite database operations, including creating, querying, and managing the database for user verification.

5.2.15 Pandas

Pandas is used for data manipulation and analysis, assisting in handling and processing data from the database.

5.3 Dataset

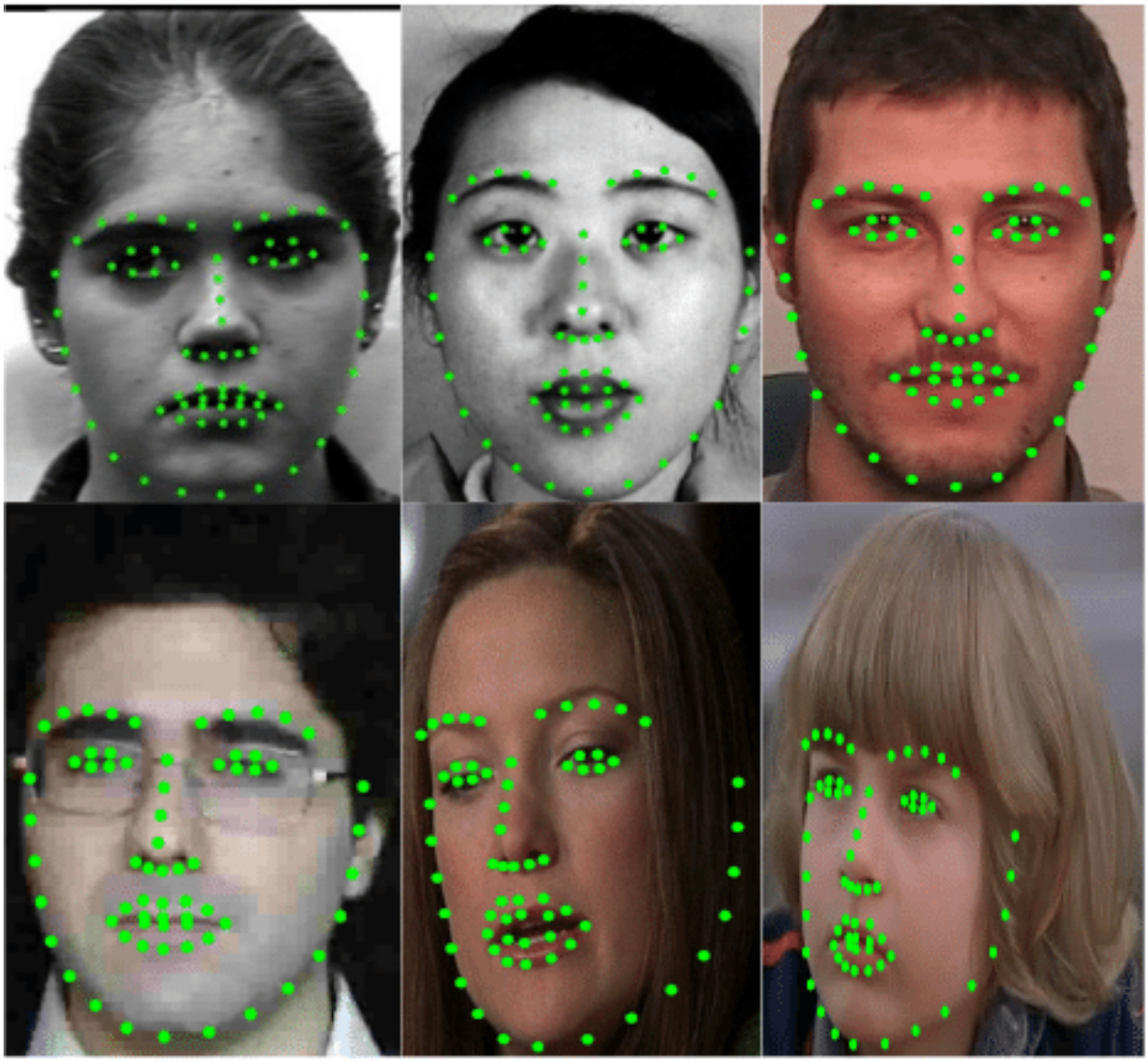
The dataset used in our Face Recognition approach for the programmed participation of representatives in the workplace room environment plays a pivotal role in the success of our system. This dataset contains essential pre-trained models and files that enable the accurate recognition of faces within captured images. Face acknowledgment within our system is carried out in two critical stages. In the initial step, faces are detected in the image, and subsequently, these recognized faces are compared with the information stored in the dataset for verification. The dataset includes the following key components:

5.3.1 dlib_face_recognition_resnet_model_v1.dat

The 'dlib_face_recognition_resnet_model_v1.dat' file is a pre-trained deep learning model provided by the dlib library. This model is instrumental for facial feature extraction and encoding. It allows us to create a unique numerical representation of each face in the dataset, commonly referred to as a face embedding or face descriptor. This model plays a vital role in the recognition phase of our face recognition system. It compares the facial features of the detected faces with the encoded representations in the dataset to verify the identity of the individuals.

5.3.2 shape_predictor_68_face_landmarks.dat

The 'shape_predictor_68_face_landmarks.dat' file contains a pre-trained facial shape predictor model also provided by the dlib library. This model is responsible for identifying key facial landmarks, such as the eyes, nose, and mouth, on detected faces. These landmarks are essential for accurately aligning and comparing faces during the recognition process. By pinpointing these landmarks, the system can ensure that the detected face is properly aligned and can be compared effectively with the data stored in the dataset.

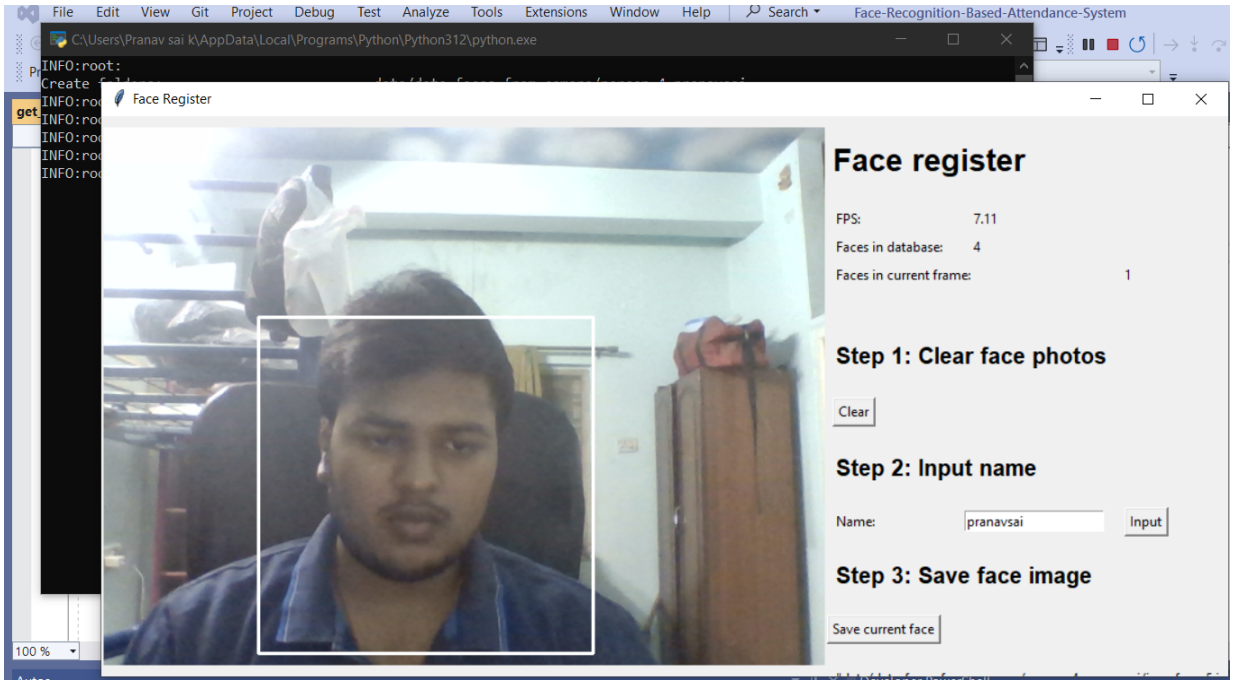


Together, these dataset components are critical for achieving high-precision face recognition within our system. The 'dlib_face_recognition_resnet_model_v1.dat' model allows for the encoding and comparison of facial features, while the 'shape_predictor_68_face_landmarks.dat' model ensures that the detected faces are aligned correctly, improving the overall accuracy of the recognition process. This dataset is a foundational part of our approach to automate the participation of representatives in the workplace room environment without the need for manual intervention, enhancing security and access control within the workplace.

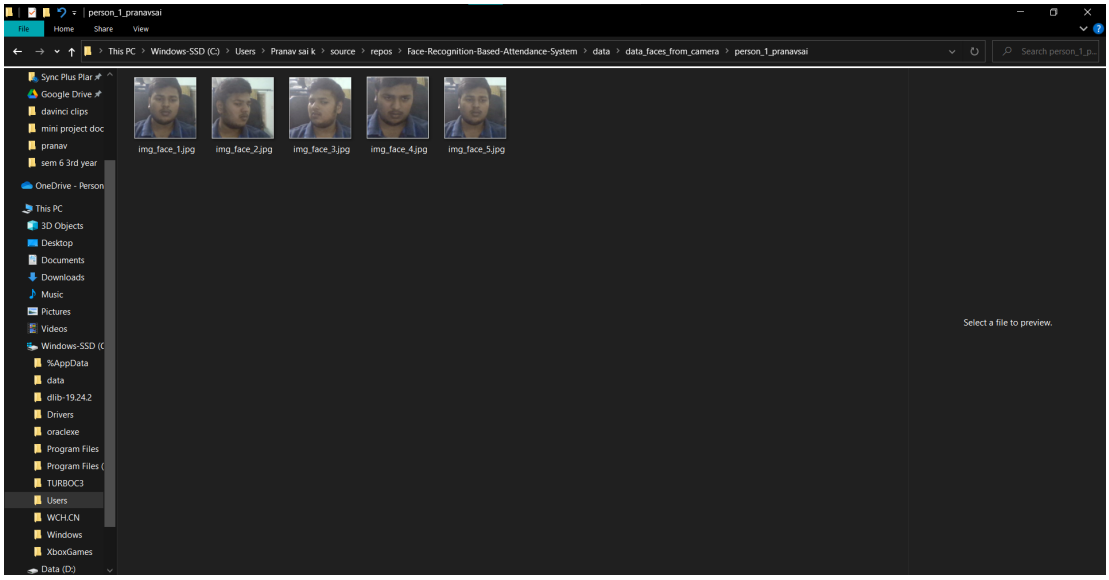
6. TESTING & VALIDATION(4 step process)

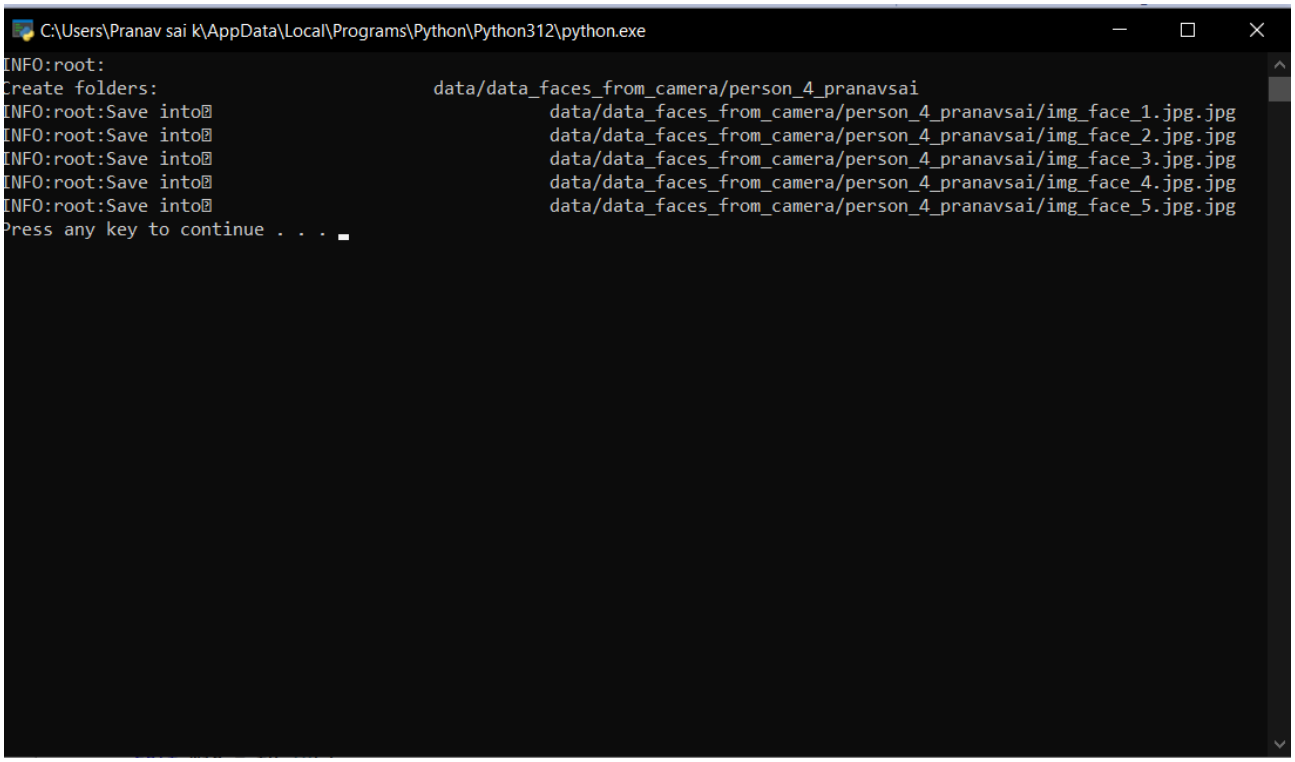
6.1 get-faces-from-camera-tkinter.py

- First step for testing is to check the program 1 which is "get-faces-from-camera-tkinter.py".
- This program allows the user to record his face with a name and insert into the database for recognition and feature extraction purposes.



- The above picture is an example for storing data which face cropped only inside the which boarded lines and saves them under a filename which is input of the user under the "name".

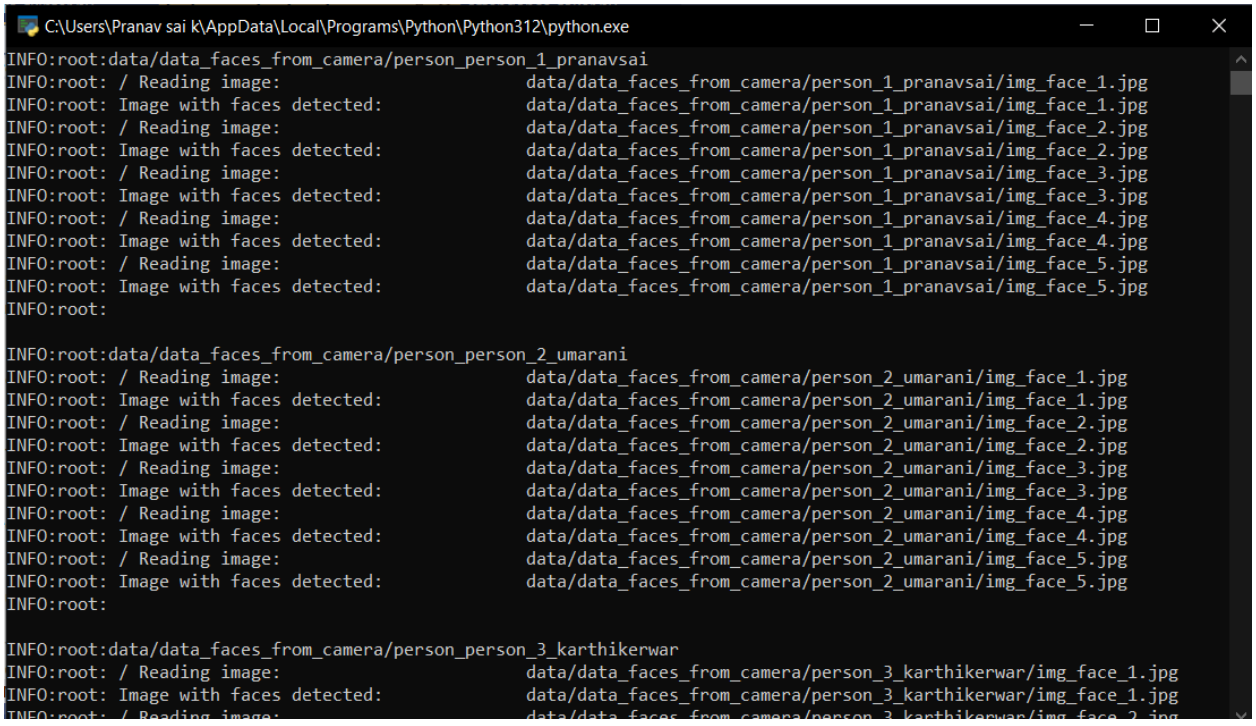




- This picture shows the images are stored after taking an image.

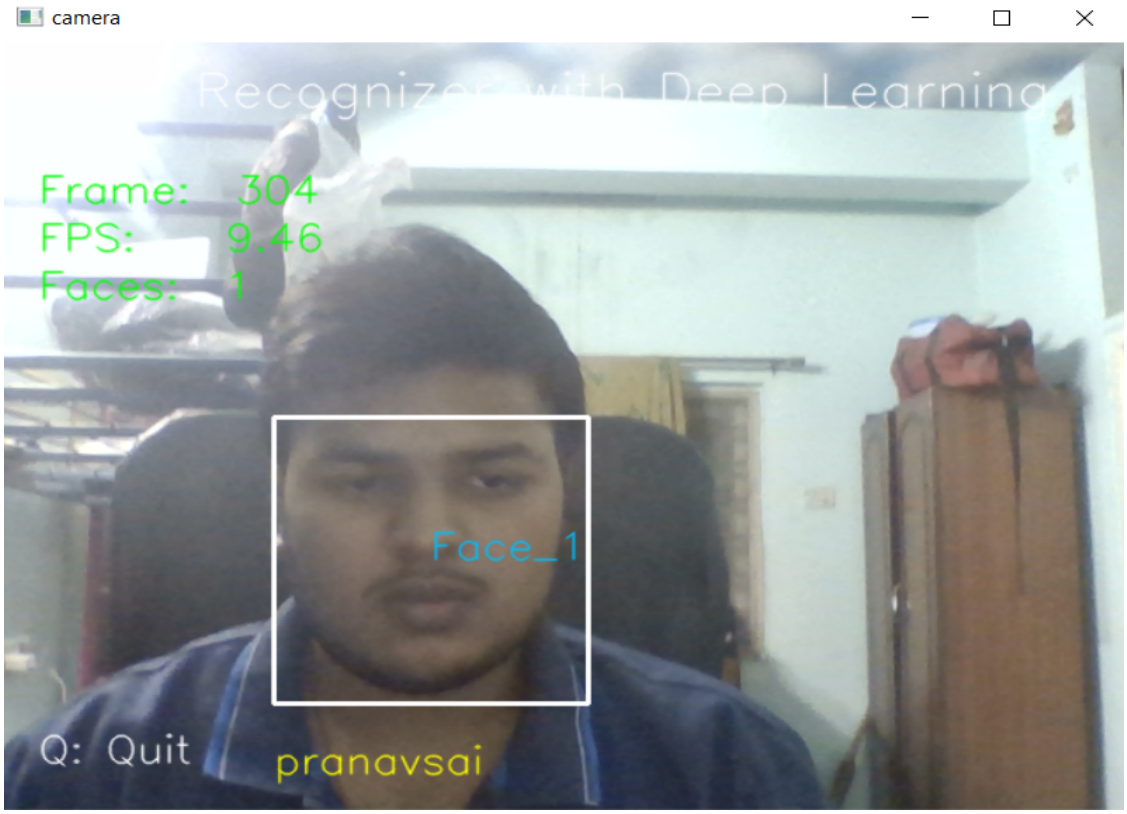
6.2 feature_extraction_to_csv.py

- Here it reads the files and assigns values to the image and trains the data image model.

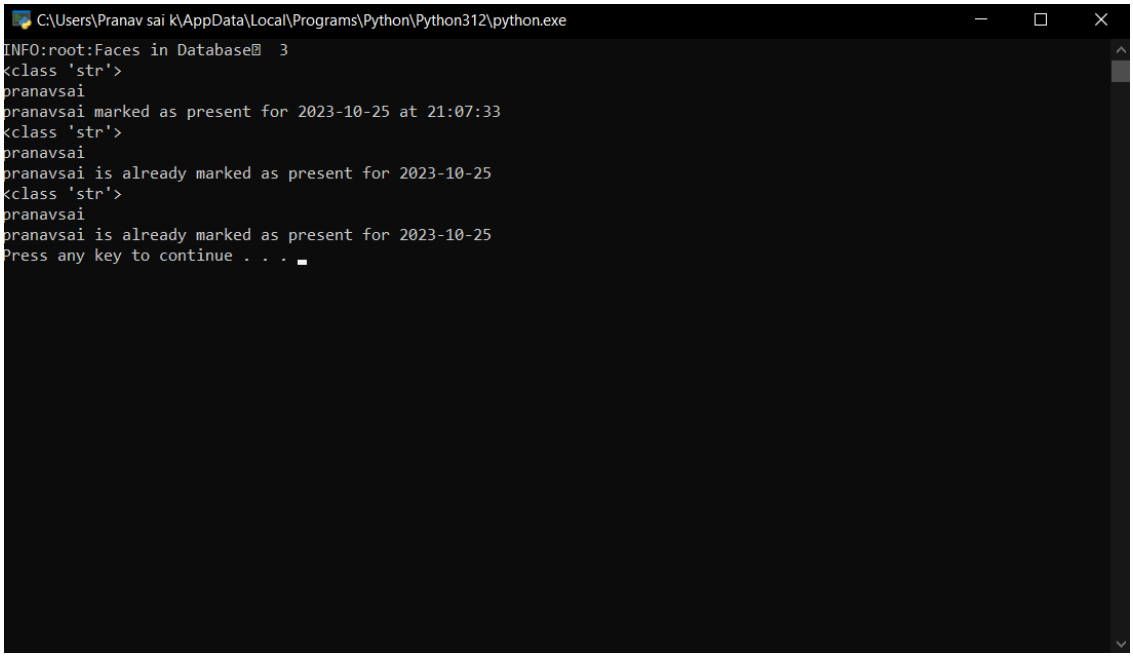


6.3 attendance_taker.py

- Here another interface opens while the code is running and if a face from the recorded database is present it shows as"face1" and displays the name.

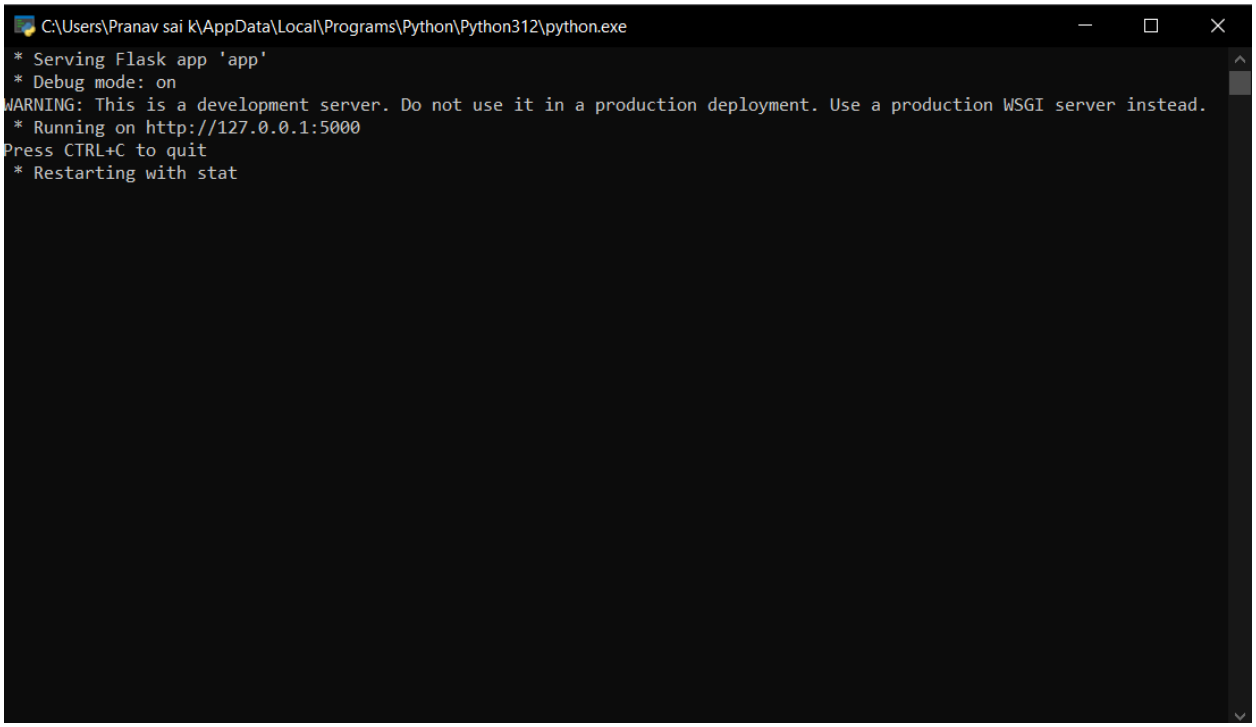


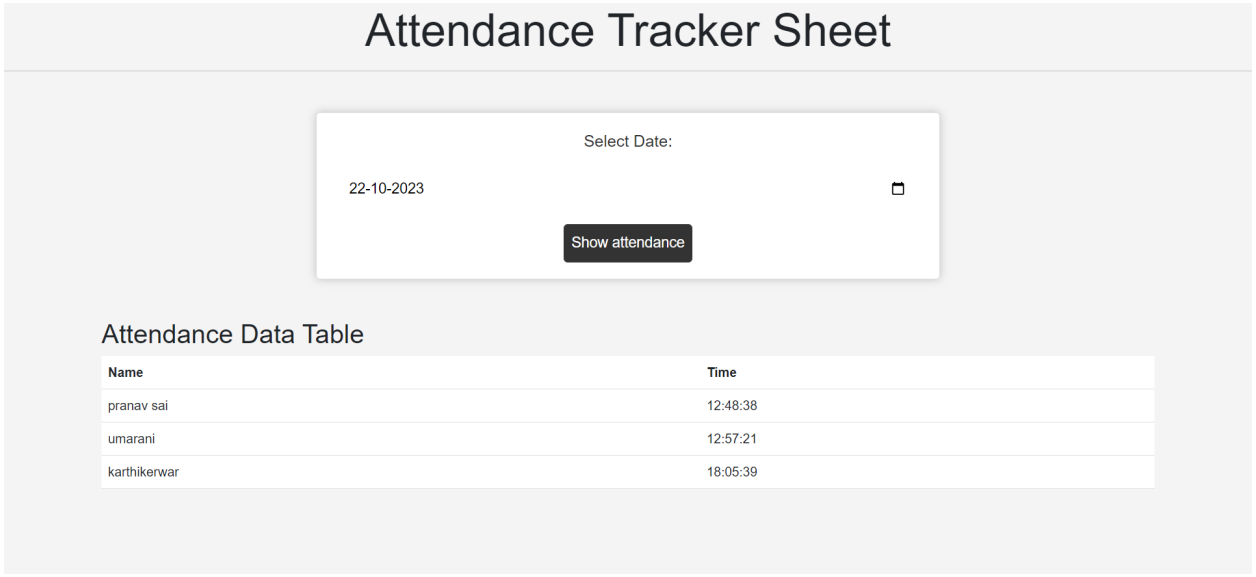
- Also as soon as the face is recognized it takes the attendance and posts it to the website.



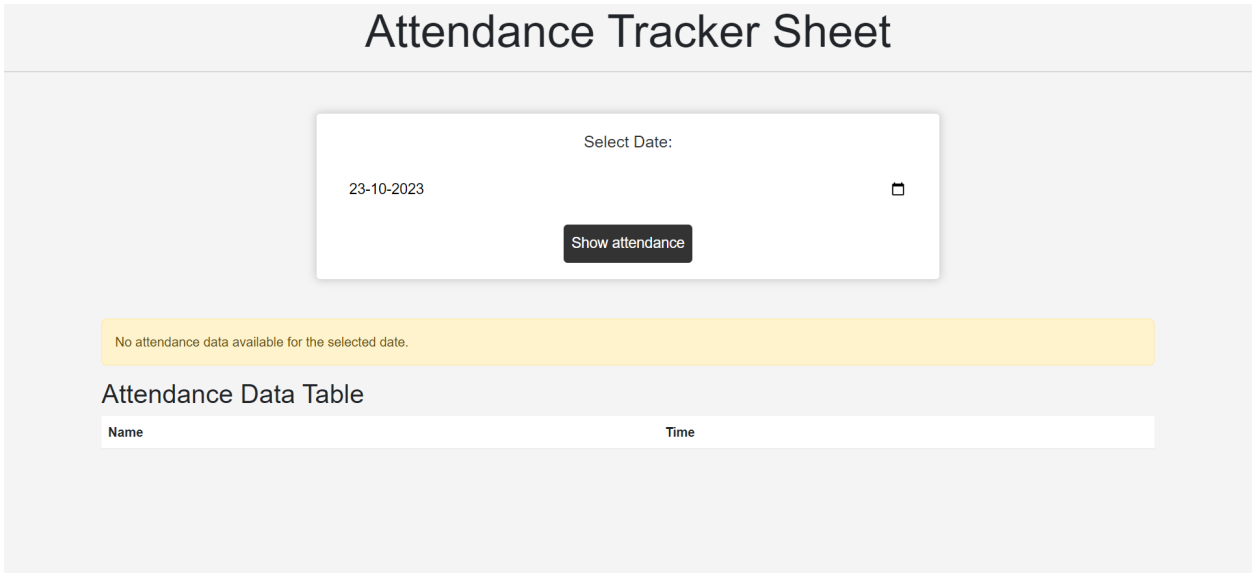
6.4 app.py

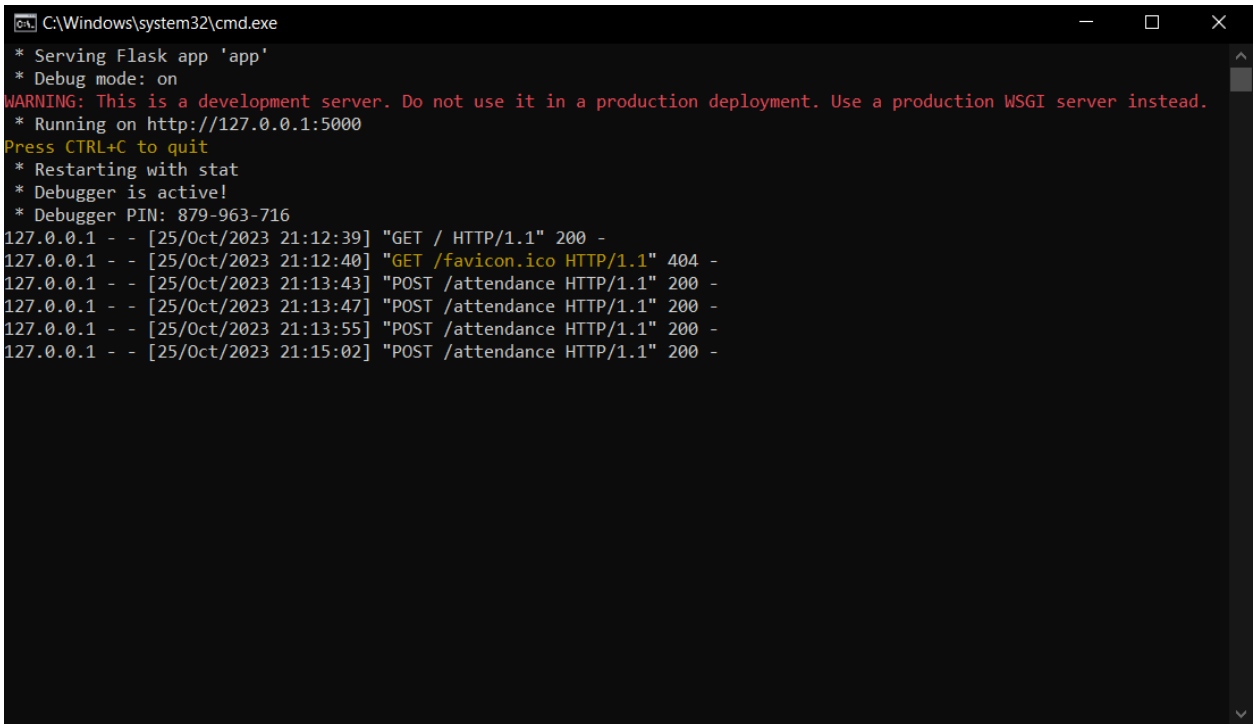
- In this program it runs a flask which generates a html page which allows the user to see the attendance according to the respective date and time.





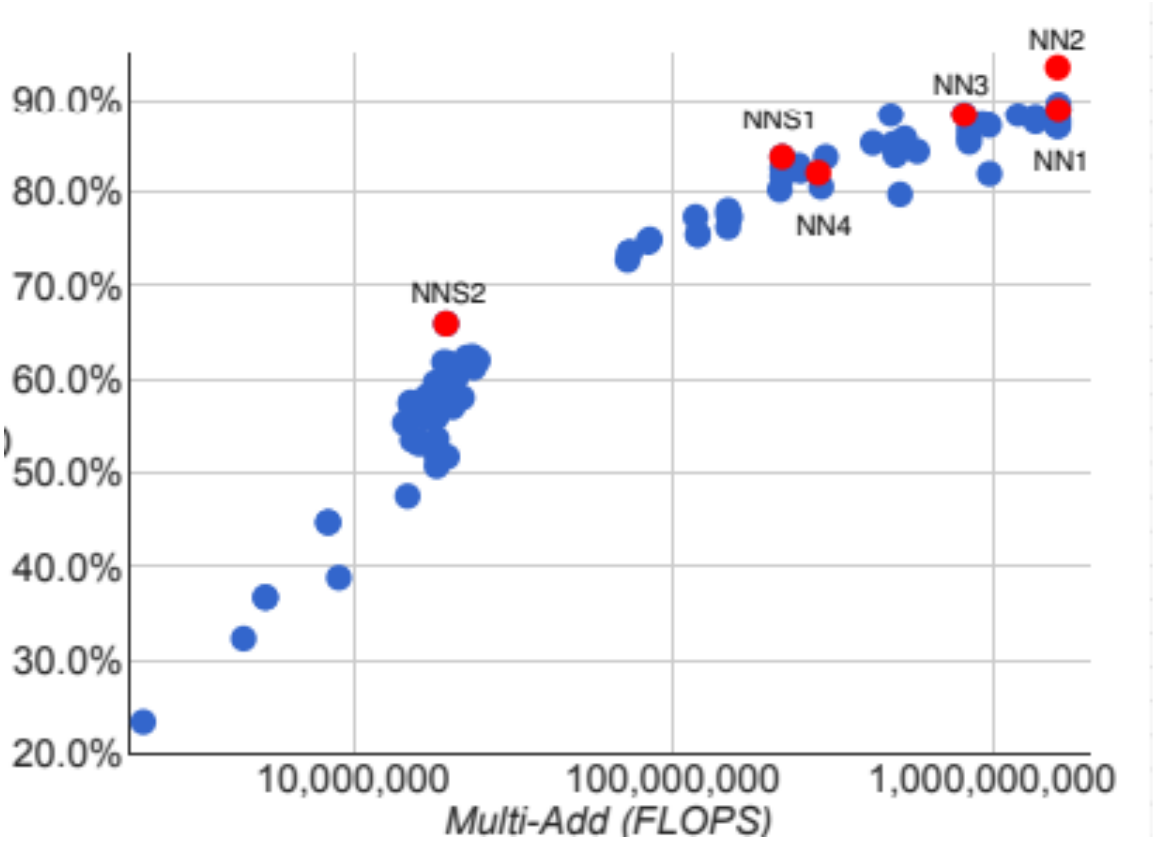
- If in any case no one is present then it displays according to the below picture.


Attendance Tracker Sheet
Select Date:
23-10-2023
Show attendance
No attendance data available for the selected date.
Attendance Data Table
Name
Time


C:\Windows\system32\cmd.exe
* Serving Flask app 'app'
* Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on http://127.0.0.1:5000
Press CTRL+C to quit
* Restarting with stat
* Debugger is active!
* Debugger PIN: 879-963-716
127.0.0.1 - - [25/Oct/2023 21:12:39] "GET / HTTP/1.1" 200 -
127.0.0.1 - - [25/Oct/2023 21:12:40] "GET /favicon.ico HTTP/1.1" 404 -
127.0.0.1 - - [25/Oct/2023 21:13:43] "POST /attendance HTTP/1.1" 200 -
127.0.0.1 - - [25/Oct/2023 21:13:47] "POST /attendance HTTP/1.1" 200 -
127.0.0.1 - - [25/Oct/2023 21:13:55] "POST /attendance HTTP/1.1" 200 -
127.0.0.1 - - [25/Oct/2023 21:15:02] "POST /attendance HTTP/1.1" 200 -

7. Result Analysis

- Our method uses a deep convolutional network trained to directly optimize the embedding itself, rather than an intermediate bottleneck layer as in previous deep learning approaches.
- To train, we use triplets of roughly aligned matching / non-matching face patches generated using a novel online triplet mining method.
- The benefit of our approach is much greater representational efficiency: we achieve state-of-the-art face recognition performance using only 128-bytes per face.
- On the widely used Labeled Faces in the Wild (LFW) dataset, our system achieves a new record accuracy of **99.63%**.
- On YouTube Faces DB it achieves **95.12%**. Our system cuts the error rate in comparison to the best published result by **30%** on both datasets.
- We also introduce the concept of harmonic embeddings, and a harmonic triplet loss, which describe different versions of face embeddings (produced by different networks) that are compatible with each other and allow for direct comparison between each othe**r.**



- In conclusion, face recognition using OpenCV with Python is a powerful and versatile technology that has the potential to revolutionize a wide range of applications, from security and surveillance to human-computer interaction and personalization.

- OpenCV's robust and efficient libraries, coupled with Python's simplicity and flexibility, make it accessible to developers of all skill levels.

- Through the use of machine learning techniques, such as deep neural networks, OpenCV can accurately and reliably detect and recognize faces, even under challenging conditions.

- This technology has the potential to enhance security systems, improve user experiences, and enable innovative applications in fields such as healthcare, retail, and entertainment.

- However, it's essential to consider ethical and privacy concerns when implementing face recognition systems.

- As the technology continues to evolve, it's crucial to strike a balance between its benefits and the protection of individual rights and privacy.

- Strict regulations and responsible development practices are essential to ensure that face recognition is used for the betterment of society.

- In summary, face recognition with OpenCV and Python is a promising field with significant potential.

- It offers numerous possibilities for enhancing various aspects of our lives, but its deployment should be approached with caution and responsibility to ensure it is used ethically and to the benefit of all.

8. References

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