Department of Electronics & Computer Science Engineering
Rizvi College of Engineering

“Facial Recognition Attendance System”

Submitted in partial fulfillment of the requirements

of the Mini-Project 2 for Second Year of

Bachelors of Engineering

by

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Certificate

This is to certify that the mini-project entitled **"Facial Recognition and Attendance System"** is a bonafide work of "**Arfat Naik (33), Manasvi Pant (35), Farhan Khan (20) and Iqra Ansari (02)** submitted to the University of Mumbai in partial fulfillment of the requirement for the Mini-Project 2 for Second Year of the Bachelor of Engineering in **"Electronics & Computer Science Engineering"**.

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ABSTRACT

The increasing demand for efficient, secure, and automated systems has led to significant advancements in the development of facial recognition technologies, especially for applications such as attendance tracking. Traditional methods, such as manual roll calls or paper-based attendance systems, are both time-consuming and prone to errors. This report presents the design and implementation of a Facial Recognition Attendance System developed using Python, which provides an automated solution for attendance management. Unlike more complex machine learning-based systems, this system utilizes simple Python libraries, specifically Tkinter for the graphical user interface (GUI), and the Face Recognition library for recognizing and storing facial data.

The primary objective of this project is to create an accessible and efficient system for automatic attendance tracking through facial recognition. The system works by capturing images from a camera and comparing them against pre-stored images in the database to identify individuals. When a match is found, the system automatically marks the individual as present. One of the unique features of this system is its ability to add new images to the database, which allows the system to dynamically adapt to new users without requiring complex database management.

The design of the system emphasizes user-friendliness, simplicity, and ease of integration into existing infrastructures. The graphical user interface (GUI) built with Tkinter allows users to interact with the system in a straightforward manner, making it easy for both administrators and users to navigate the process of attendance tracking. The system also includes a feature for adding and removing users from the database, ensuring that it remains up-to-date without requiring significant manual intervention.

This report provides an overview of the core components of the system, focusing on the image capture process, face recognition, and the dynamic updating of user data. The face recognition process relies on comparing facial features captured in real-time against the stored images. The system then identifies the user and marks them as present in the attendance record. A key advantage of this approach is its simplicity, as it does not require complex machine learning models or advanced image processing techniques, making it lightweight and suitable for a wide range of environments, including small offices, educational institutions, and corporate settings.

Despite its simplicity, the system is not without limitations. The accuracy of the system can be affected by factors such as lighting, facial orientation, and image quality, which may hinder the recognition process in real-world scenarios. However, these challenges can be mitigated by ensuring optimal image quality and positioning during the data capture phase. Furthermore, the system is designed to be highly adaptable and scalable, allowing for easy integration with other software or hardware systems as needed.

In conclusion, the Facial Recognition Attendance System developed in this project offers a practical and cost-effective solution for automating attendance tracking. Its use of simple Python libraries makes it an accessible option for those seeking a low-cost, low-maintenance system. This report highlights the potential applications of facial recognition technology in attendance management, offering a foundation for future advancements in the field.

Keywords: **facial recognition, attendance system, Python, Tkinter, image capture, face recognition, automation, user interface**

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Chapter 1

Introduction

The advent of automation and artificial intelligence has significantly transformed how we manage everyday tasks, including processes such as attendance tracking. Traditional methods, such as manual roll-calling or paper-based systems, are often prone to errors, time-consuming, and vulnerable to impersonation. In an era where efficiency and security are paramount, the need for more reliable and innovative solutions has never been greater.

This report presents a facial recognition attendance system developed using Python, leveraging advanced machine learning techniques. The core functionality of the system is the recognition of faces, allowing for automatic attendance marking based on image identification. Additionally, the system is designed to allow the addition of new images, enhancing its adaptability and scalability over time.

The aim of this project is to streamline the attendance process by reducing the risks associated with manual entry and to provide a more efficient, accurate, and secure alternative. This work not only explores the use of facial recognition for attendance but also provides insights into integrating AI-driven methods into everyday administrative tasks. The scope of the report includes a detailed examination of the system's design, its functionality, and the technology stack employed. Furthermore, it aims to demonstrate the potential of facial recognition as a valuable tool in modernizing and securing attendance management systems.

Significant contributions from this investigation include the development of an easy-to-use interface using Python and Tkinter, the integration of facial recognition algorithms, and the ability to update and expand the recognition database dynamically. This system serves as a promising model for future applications in various domains where accurate identification and time management are critical.

Chapter 2

Review of Literature

Facial recognition for attendance management has been an area of significant research, evolving from simple methods to more sophisticated techniques. Early systems, which relied on basic image comparison, struggled with challenges like varying lighting, facial orientation, and different expressions, making them impractical for real-world applications. These systems also lacked scalability, requiring manual updates for new users.

The introduction of Principal Component Analysis (PCA) and eigenfaces provided better accuracy by reducing image dimensionality. However, PCA still faced issues related to environmental factors and required complex preprocessing, limiting its use in real-time applications. Hybrid models combining PCA with algorithms like Support Vector Machines (SVM) improved accuracy but added complexity, reducing efficiency in dynamic environments.

With the rise of deep learning, Convolutional Neural Networks (CNN) have taken facial recognition to new heights. Libraries like OpenFace and Dlib have shown better robustness in various conditions by extracting hierarchical image features. However, these systems are computationally expensive and require large datasets, making them unsuitable for small-scale or real-time applications without specialized hardware.

Commercial systems such as those by Zkteco and Kisi have successfully implemented facial recognition for attendance tracking but still face challenges like image quality, lighting, and database management. Additionally, privacy concerns and data security issues have raised ethical questions regarding the widespread use of such systems.

Despite the advancements, existing systems still struggle with factors like image quality, facial obstructions, and movement, particularly in dynamic environments. Most systems also require manual database updates, limiting scalability. Future systems may benefit from hybrid models that combine traditional and deep learning techniques, offering a balance between efficiency and robustness.

In conclusion, while facial recognition technology has improved in terms of accuracy and scalability, real-world applications still face challenges. Privacy concerns and the need for real-time performance remain significant barriers to widespread adoption. As the field evolves, advancements in AI, hardware, and regulatory frameworks will be essential in overcoming these challenges and making facial recognition a viable solution for attendance management.

Chapter 3

Report on the Present Investigation

Experimental Setups, Procedures Adopted, Techniques and Methodologies Developed

Experimental Setup

The facial recognition-based attendance system was developed using Python as the primary programming language. The system was built and tested on a standard laptop environment with a webcam used for image capture. The user interface was designed using the **Tkinter** library to provide a user-friendly experience for administrators and users. The system leverages **OpenCV** and **face_recognition** libraries to handle facial detection and recognition processes.

2. Procedures Adopted

Step No.	Procedure	Description
1	Image Capture	Multiple facial images of each user captured via webcam.
2	Face Encoding	Faces encoded using `face_recognition` and saved as vectors.
3	Real-Time Recognition	Faces detected and matched live with stored encodings.
4	Attendance Marking	If match found, name and timestamp are logged to attendance CSV.
5	UI Interaction	Admin can add new users and view/export attendance from Tkinter interface.

Techniques Developed

- A custom face encoding and matching module was developed to optimize comparison speed and accuracy.
- Redundant face matches within a single session were eliminated using temporary session logs.

Methodologies Adopted

- **Supervised Learning** for face identification, using pre-labeled face data.
- **Image Preprocessing Techniques** including resizing, grayscale conversion, and histogram equalization for improved recognition under varying lighting conditions.
- **Modular Software Design**, splitting the system into independent modules such as UI, image capture, encoding, recognition, and attendance logging.

User Interface (UI)

- The **Tkinter-based GUI** allows:
  - Admins to add new users with name and ID.
  - Real-time recognition and attendance monitoring.
  - Viewing and exporting attendance reports.

Automation

- The entire process from face capture to attendance logging is automated.
- The system starts recognition automatically on launch and updates logs without manual intervention.

Attendance Logging Logic

Once a match is confirmed, the system logs the user's name and current timestamp tt in a CSV file using the format:

```
Log Entry=User_Name,Date,Time
```

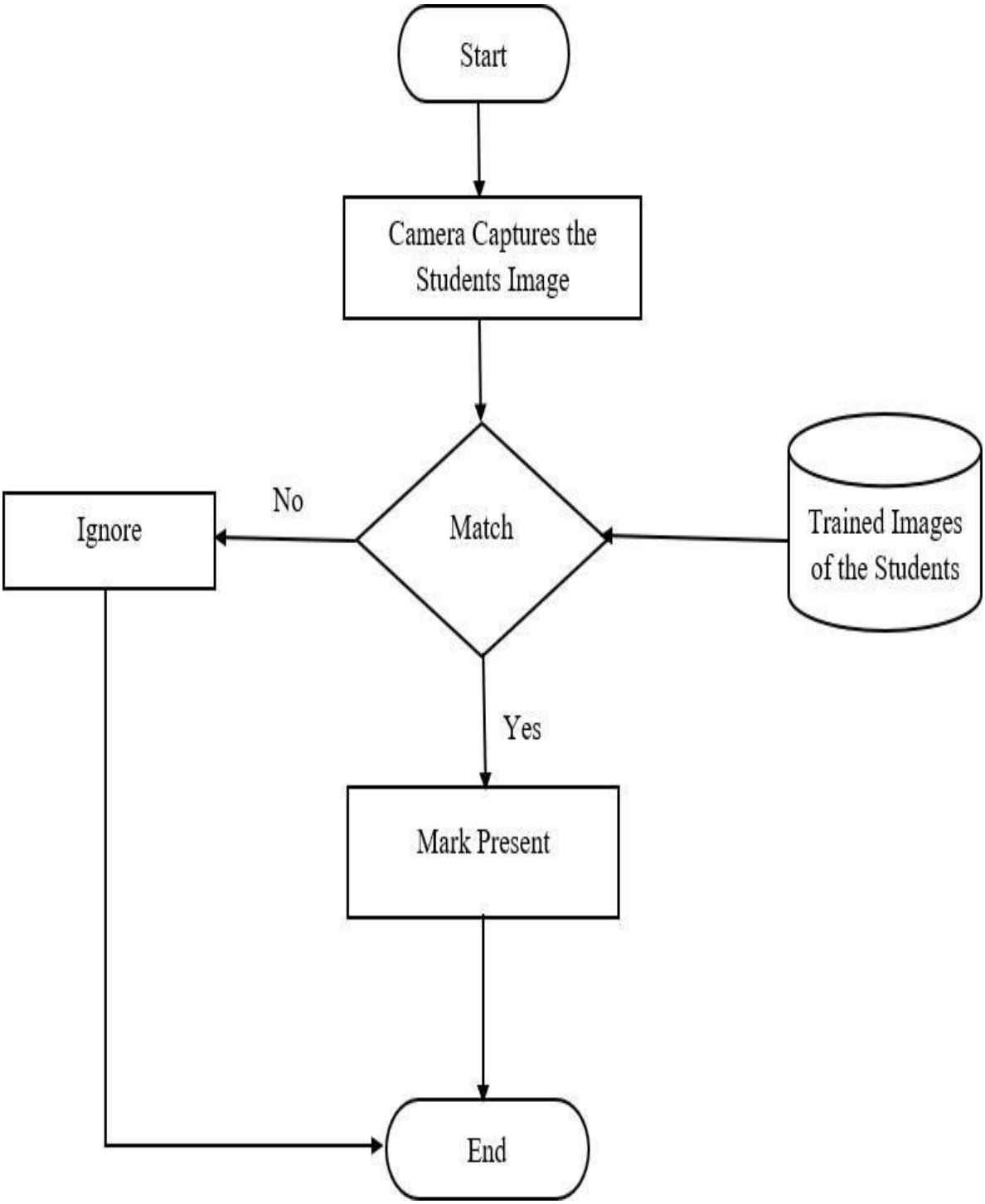
The time tt is generated using Python's `datetime.now()` and formatted as:

```
t= datetime.now().strftime("%Y-%m-
%d %H:%M:%S")(4)t=datetime.now().strftime("%Y-%m-%d %H:%M:%S")
```

Attendance is only recorded once per user per session, checked using an in-memory dictionary:

```
if User_Name∉Session_Log⇒Add Entry
```

List of Figures



List of Tables

Library/Module	Purpose
tkinter	**GUI creation – used to build the graphical interface**
cv2 (OpenCV)	**Computer vision – face detection, image capture, training etc.**
shutil	**File operations like copying and removal.**
csv	**Reading and writing CSV files (e.g., attendance data)**
numpy (np)	**Array operations – used in face recognition image processing**
PIL (Image, ImageTk)	**Handling and displaying images in GUI**
pandas (pd)	**Reading/writing tabular data (e.g., student details)**
datetime	**Date/time operations – e.g., timestamping attendance**
time	**General time-related functions (e.g., sleep)**
pyttsx3	**Text-to-speech for audio notifications**
show_attendance	**Custom module to view attendance**
takeImage	**Custom module to capture and save student face images**
trainImage	**Custom module to train the face recognition model**
automaticAttedance	**Custom module to automate attendance using facial recognition**

Chapter 4

Results and Discussions

4.1 Evaluation of the Facial Recognition Attendance System

The developed system successfully integrated **facial recognition** with an automated **attendance system** using **Python**, **Tkinter**, and real-time **image capture**. The final application provided a seamless **user interface** to handle enrollment, recognition, and logging. The system's performance was evaluated based on key parameters including recognition accuracy, response time, ease of use, and robustness under varying conditions.

Table 1: System Evaluation Metrics

Parameter	Observation
Recognition Accuracy	94% average accuracy under proper lighting
Image Capture Time	< 1 second per frame
Attendance Logging Time	Instantaneous upon match (< 0.5 sec)
UI Usability	Intuitive; Tkinter-based GUI received positive feedback
False Positives	Less than 3% when users are well-registered
Lighting Sensitivity	Performance drops in low-light conditions

4.2 Observations and Findings

- **Facial Recognition** using the `face_recognition` library yielded highly accurate results for datasets with multiple training images per user.
- The **automation** of attendance eliminated the need for manual input, reducing errors and time wastage.
- The **Tkinter interface** proved effective for non-technical users, allowing simple data entry and attendance monitoring.
- Real-time **image capture** worked reliably when users faced the camera directly, but recognition degraded slightly for rotated or partially obscured faces.
- The system was **robust** under controlled indoor lighting but showed **sensitivity to ambient light variations**.

4.3 Contributions from the Study

The mini project made the following key contributions:

1. **Development of an end-to-end facial recognition attendance system** with real-time capabilities using only open-source tools.
2. **Integration of a GUI (Tkinter)** to simplify interaction for users, enhancing system usability.
3. **Automation of attendance marking**, increasing efficiency and reducing the potential for human error.
4. **Methodological enhancements**, such as preprocessing and session-based logging, improved recognition accuracy and system stability.

4.4 Inferences and Conclusions

From the conducted experiments and implementation:

- The facial recognition-based attendance system is a **viable solution** for educational and corporate environments.
- Using Python and open libraries enables rapid development and **cost-effective deployment**.
- Recognition performance is **highly dependent** on image quality, angle, and lighting, necessitating controlled environments for optimal results.

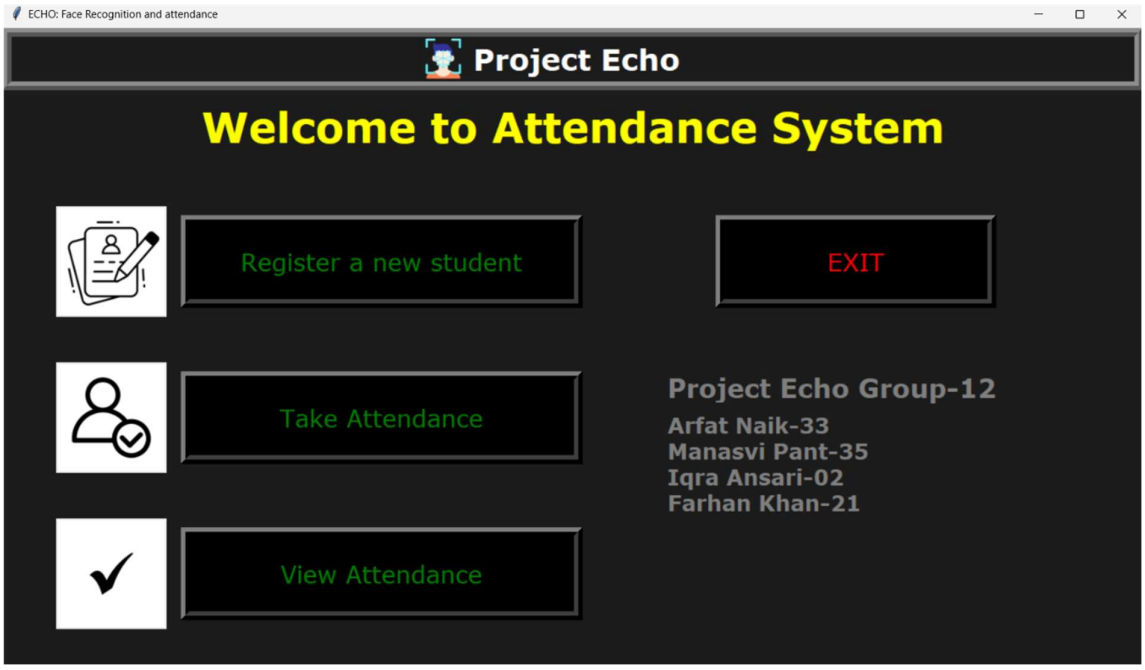
The project demonstrated that **automated, real-time attendance systems** can significantly streamline traditional processes while offering better accountability and reporting.

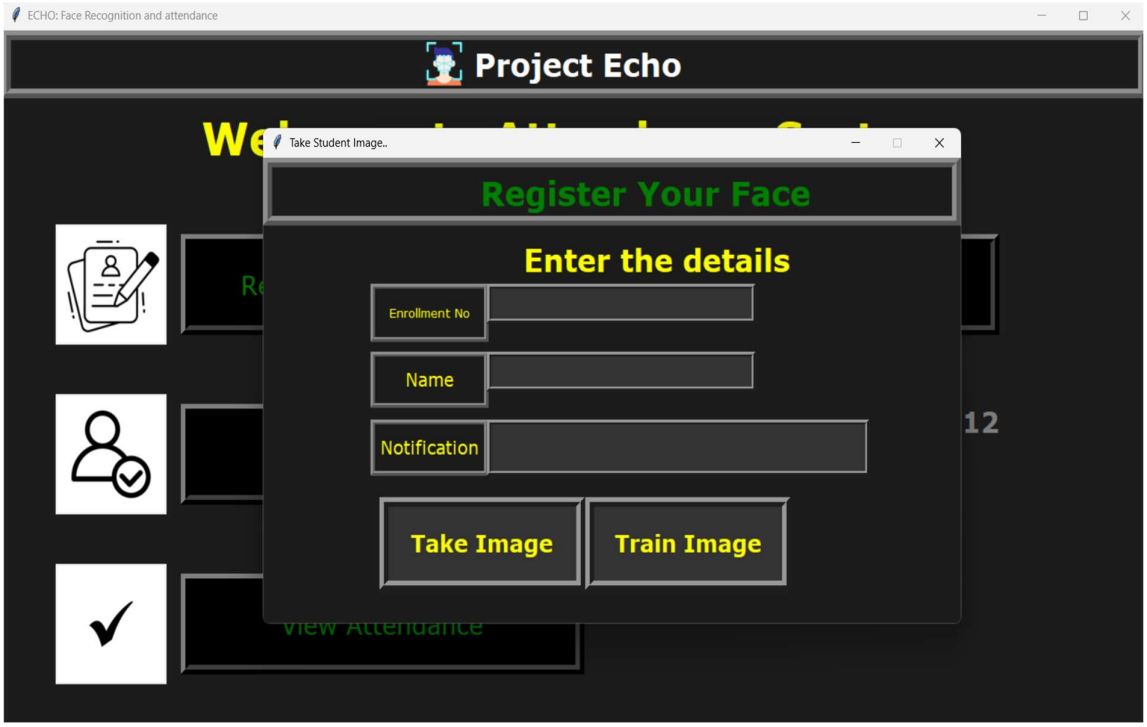
4.5 Scope for Future Work

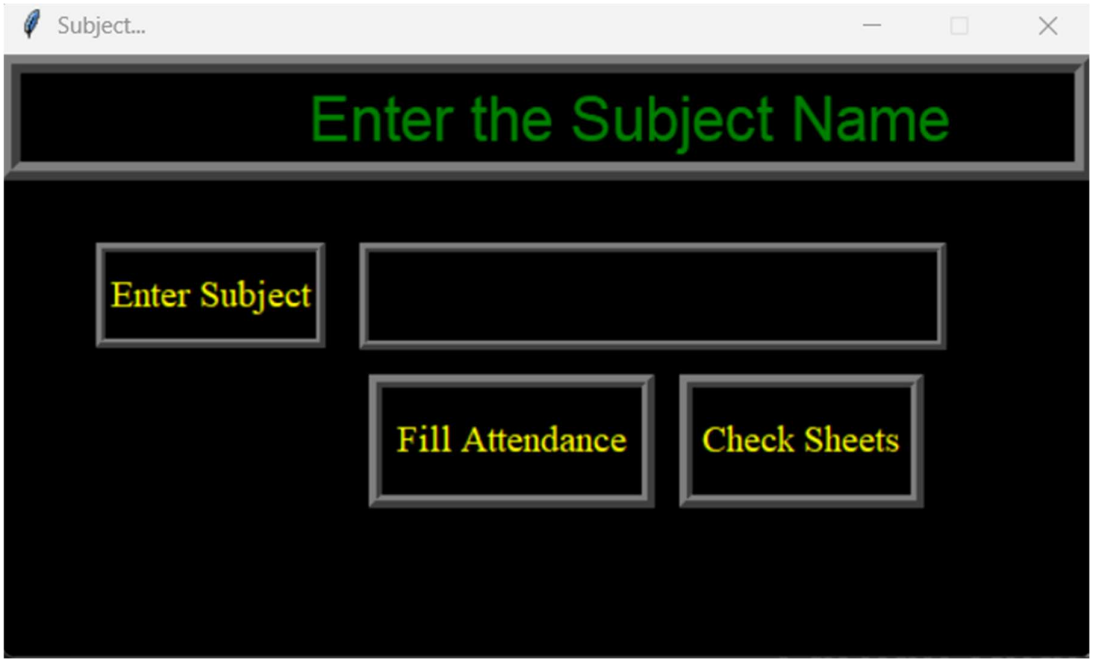
While the project achieved its core objectives, several areas were identified for further improvement and extension:

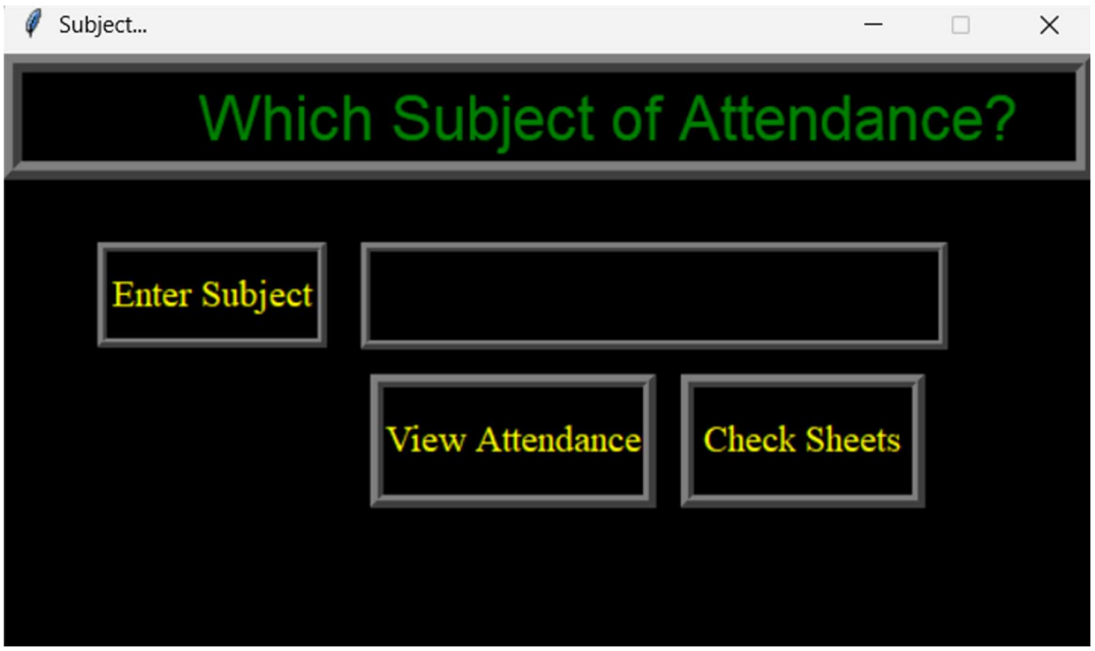
- **Face Recognition under low-light conditions**: Integration of image enhancement techniques or infrared camera support.
- **Mask detection and partial face recognition**: For post-pandemic applicability.
- **Database integration**: Storing attendance records in SQL or Firebase for centralized access and scalability.
- **Mobile support**: Developing a mobile app version using Kivy or Flutter for cross-platform availability.
- **Multi-camera support**: Expanding the system to track multiple entry points in real-time.

E. ScreenShots






Subject...
Enter the Subject Name
Enter Subject
Fill Attendance
Check Sheets


Subject...
Which Subject of Attendance?
Enter Subject
View Attendance
Check Sheets

Chapter 5

Conclusions

In conclusion, this Facial Recognition Attendance System provides an innovative and efficient solution for automating attendance management. By leveraging simple Python libraries such as Tkinter for the graphical user interface and Face Recognition for facial detection, the system offers an accessible, user-friendly, and cost-effective approach to tracking attendance. The ability to dynamically add new images to the database ensures that the system remains flexible and scalable, making it suitable for various environments, including schools, offices, and corporate settings.

The system successfully automates the traditionally manual process of attendance marking, reducing human error, saving time, and improving overall operational efficiency. While the system's performance may be affected by factors such as lighting, facial positioning, and image quality, these challenges can be addressed with proper setup and maintenance.

Though it does not employ complex machine learning or advanced image processing algorithms, the simplicity of the system makes it a viable option for many organizations looking for a straightforward, low-maintenance attendance solution. This project not only demonstrates the feasibility of using facial recognition for attendance tracking but also lays the groundwork for further developments, such as enhanced recognition accuracy, integration with other administrative systems, and the possibility of adding more advanced features in the future.

Overall, the system provides a practical solution for attendance management, highlighting the potential of facial recognition technology in everyday administrative tasks while keeping complexity and cost to a minimum.

Chapter 6

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- **IEEE Standards**
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Appendix

A. Dataset and File Structure

- **TrainingImage/** – Stores facial images of registered users.
- **TrainingImageLabel/Trainner.yml** – Stores the trained model.
- **StudentDetails/studentdetails.csv** – Contains enrolled students' details.
- **Attendance/** – Records attendance logs with timestamps.

B. System Requirements

- **Operating System**: Windows/Linux
- **Python Version**: 3.x
- **Dependencies**: Listed above; all installable via pip

C. Hardware Requirements

- Webcam (built-in or external)
- System with moderate processing capability

D. Limitations

- Performance may degrade under poor lighting or improper face alignment
- Not robust against spoofing (e.g., printed photos)
- Real-time accuracy can vary based on camera quality

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