SMART ATTENDANCE SYSTEM

Project Report

IN-HOUSE MAJOR PROJECT (BCA660)

BACHELOR OF COMPUTER APPLICATIONS

PROJECT GUIDE:

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DECLARATION

We hereby declare that this Project Report titled **SMART ATTENDANCE SYSTEM** submitted by us and approved by our project guide, Faculty of Engineering & Computing Sciences. Teerthanker Mahaveer University, Moradabad, is a Bonafide work undertaken by us and it is not submitted to any other University or Institution for the award of any degree diploma / certificate or published any time before.

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1 Project Title

Smart Attendance System using Facial Recognition

2 Project Objective

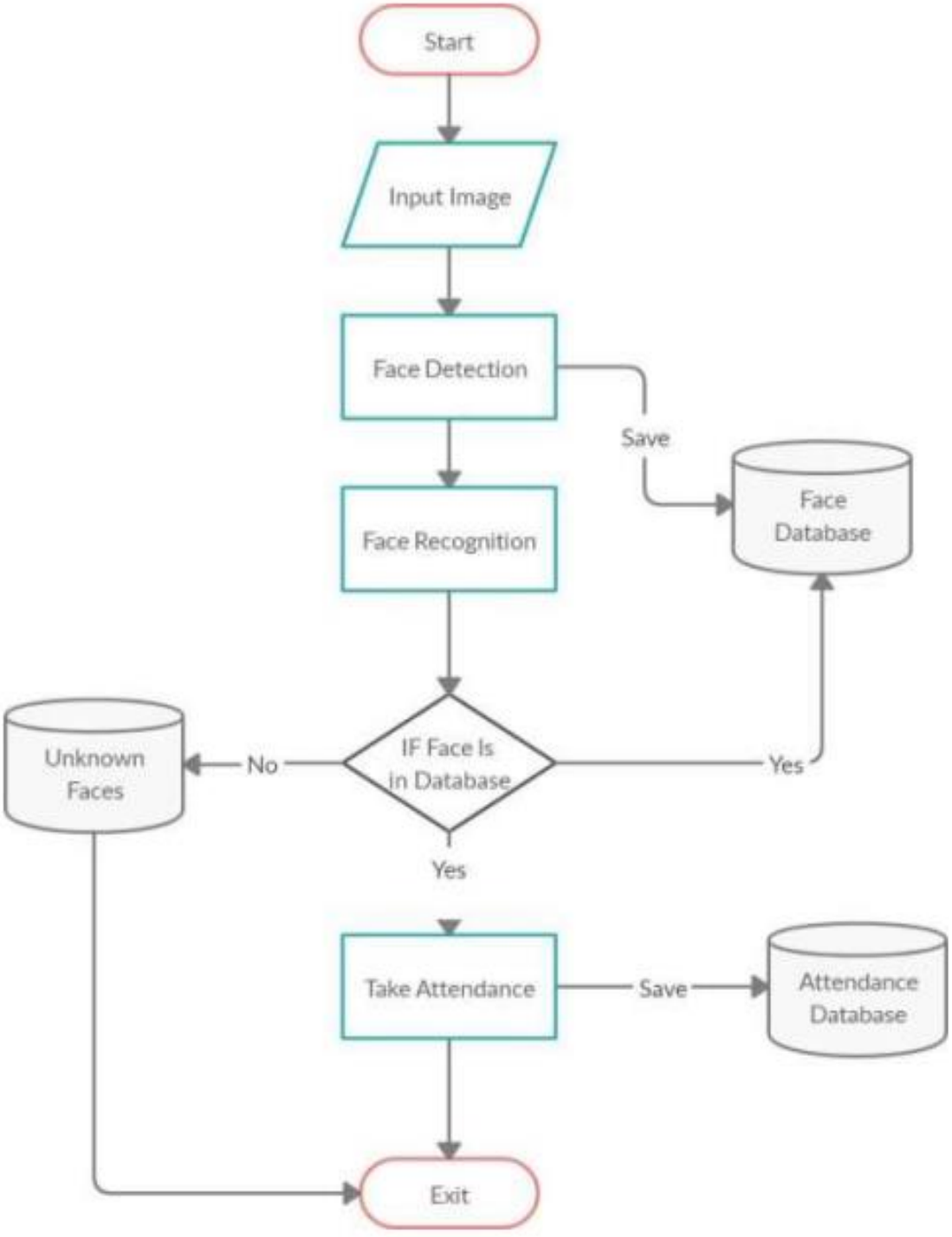
Attendance is prime important for both the teacher and student of an educational organization. So, it is very important to keep record of the attendance. The problem arises when we think about the traditional process of taking attendance in class room. Calling name or roll number of the student for attendance is not only a problem of time consumption but also it needs energy. So, an automatic attendance system can solve all above problems. There are some automatic attendances making system which are currently used by much institution. One of such system is biometric technique and RFID system. Although it is automatic and a step ahead of traditional method it fails to meet the time constraint. The student has to wait in queue for giving attendance, which is time taking. This project introduces an involuntary attendance marking system, devoid of any kind of interference with the normal teaching procedure. The system can be also implemented during exam sessions or in other teaching activities where attendance is highly essential. This system eliminates classical student identification such as calling name of the student, or checking respective identification cards of the student, which can not only interfere with the ongoing teaching process, but also can be stressful for students during examination sessions. In addition, the students have to register in the database to be recognized. The enrolment can be done on the spot through the user-friendly interface.

2.1 Aims and Objectives:

The objective of this project is to develop face recognition attendance system. Expected achievements in order to fulfill the objectives are:

- To detect the face segment from the video frame.
- To extract the useful features from the face detected.
- To classify the features in order to recognize the face detected.
- To record the attendance of the identified student.

2.2 FLOW CHART



3 Problem Statement

Traditional student attendance marking technique is often facing a lot of trouble. The face recognition student attendance system emphasizes its simplicity by eliminating classical student attendance marking technique such as 5 calling student names or checking respective identification cards. There are not only disturbing the teaching process but also causes distraction for students during exam sessions. Apart from calling names, attendance sheet is passed around the classroom during the lecture sessions. The lecture class especially the class with a large number of students might find it difficult to have the attendance sheet being passed around the class. Thus, face recognition attendance system is proposed in order to replace the manual signing of the presence of students which are burdensome and causes students get distracted in order to sign for their attendance. Furthermore, the face recognition based automated student attendance system able to overcome the problem of fraudulent approach and lecturers does not have to count the number of students several times to ensure the presence of the students. The paper proposed by Zhao, W et al. (2003) has listed the difficulties of facial identification. One of the difficulties of facial identification is the identification between known and unknown images. In addition, paper proposed by Pooja G.R et al. (2010) found out that the training process for face recognition student attendance system is slow and time-consuming. In addition, the paper proposed by Priyanka Wagh et al. (2015) mentioned that different lighting and head poses are often the problems that could degrade the performance of face recognition-based student attendance system. Hence, there is a need to develop a real time operating student attendance system which means the identification process must be done within defined time constraints to prevent omission. The extracted features from facial images which represent the identity of the students have to be consistent towards a change in background, illumination, pose and expression. High accuracy and fast computation time will be 6 the evaluation points of the performance.

4 Project Description

The Smart Attendance System is a web-based application designed to automate the attendance tracking process in educational institutions. The system aims to provide a secure, efficient, and accurate way of tracking attendance, eliminating the need for manual processes and reducing the risk of proxy attendance.

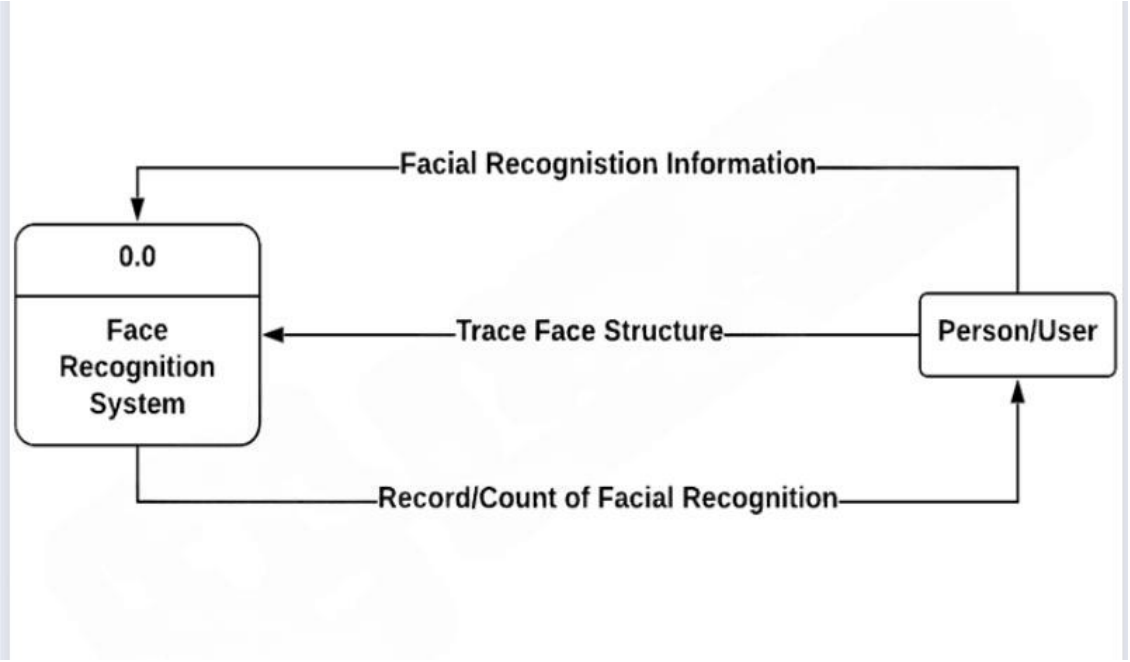
4.1 Scope of the Work

- Designing and developing a web-based attendance tracking system
- Implementing facial recognition and biometric technology for attendance tracking
- Developing a database to store attendance records
- Creating a user-friendly interface for administrators and students

4.2 Project Modules

- Attendance Tracking Module: This module is responsible for tracking attendance using facial recognition technology.
- Database Module: This module is responsible for storing attendance records in a secure and efficient manner.
- User Interface Module: This module is responsible for providing a user-friendly interface for administrators and students to interact with the system.
- Integration Module: This module is responsible for integrating the system with existing educational institution management systems (if applicable).
- Security Module: This module is responsible for ensuring the security and integrity of the system and its data.

4.3 Context Diagram (High Level)



5 Implementation Methodology

The development and deployment of the facial recognition-based attendance system follow a structured implementation methodology. This includes a detailed specification of the system's requirements, architectural design, backend and frontend development processes, the facial recognition flow, as well as the testing and deployment strategies. Each phase is crucial for ensuring the functionality, scalability, and security of the final product.

5.1 Requirements

- **Backend**

  The backend is the backbone of the system. It is developed using the Python programming language, utilizing the Django web framework due to its simplicity, built-in admin interface, and powerful ORM (Object Relational Mapping). Additional libraries used include:

  1. **OpenCV**: For image and video processing.

2. **face-recognition**: A powerful Python library built on top of dlib that simplifies face encoding, comparison, and recognition operations.

- **Frontend**

  The frontend is designed to be simple yet functional, using core web technologies:

  1. **HTML** for structuring web pages.
  5. **CSS** for styling the application interface.
  6. **JavaScript** for handling dynamic content and webcam integration.

- **Database**

  Two options are provided for the database:

  1. **SQLite**: Used during the development phase for simplicity and ease of setup.
  2. **PostgreSQL**: Preferred for deployment due to its robustness, scalability, and advanced data handling capabilities.

5.2 System Design

The system architecture is cantered around a streamlined flow of operations:

1. **User Registration**: New users register themselves by providing their name, email, and uploading a clear image of their face.
2. **Face Encoding**: Upon registration, the uploaded image is processed to extract a unique facial encoding (a numerical representation of facial features).
3. **Data Storage**: These encodings are stored in the database in a BinaryField or serialized form.
4. **Live Feed Monitoring**: The application uses the device webcam to continuously capture live feed.

5. **Recognition & Attendance**: Faces from the feed are encoded and compared with stored encodings. If a match is detected, attendance is automatically marked with the user's name, current date, and time.

5.3 Development Steps

Backend Development (Python + Django)

1. **Project Setup**
    - Initialize a Django project and create three primary apps: users, attendance, and recognition.
    - Each app is responsible for handling specific aspects of the system:
        - users: Handles registration, login, and profile data.
        - attendance: Manages attendance records.
        - recognition: Handles facial recognition logic.
2. **Face Encoding & Storage**
    - The face-recognition library is used to generate a 128-dimensional face encoding from user images.
    - These encodings are stored in the database using Django's BinaryField or TextField (if serialized using pickle or base64).
3. **API Development**
    - Django REST Framework (DRF) or Django views are used to build the following APIs:
        - **Register Face**: Accepts user details and face image, encodes and stores them.
        - **Recognize Face**: Accepts a live image, encodes it, and compares with the database.

- **View Attendance**: Fetches attendance records for a specific user or date.

5.4 Frontend Development (HTML, CSS, JavaScript)

1. **Web Pages**
    - Design and implement the following pages:
        - **Login Page**: For user authentication.
        - **Register Face Page**: Form for new users to register with an image upload feature.
        - **Mark Attendance Page**: Uses the webcam to capture images and send them to the backend.
        - **View Attendance Page**: Displays attendance logs in a tabular format.
2. **Webcam Access**
    - Use the getUserMedia () API in JavaScript to access the user's webcam.
    - Capture images at regular intervals or when prompted by the user.
3. **Communication with Backend**
    - JavaScript's fetch () method is used to send the captured image to the backend via AJAX.
    - Backend processes the image, performs recognition, and returns the result.
4. **Real-Time Feedback**
    - Once a face is recognized, the frontend updates the UI to show:
        - Name of the person
        - Attendance status (marked/not marked)
        - Timestamp

5.5 Facial Recognition Logic

The facial recognition module plays a critical role in the system. The steps are:

1. **Image Reception**
    - A captured image is sent from the frontend to the backend in base64 or blob format.
2. **Face Detection & Encoding**
    - The backend uses facerecognition. Faceencodings () to locate and extract facial features from the image.
    - This results in a numerical encoding vector.
3. **Matching**
    - The generated encoding is compared with all stored encodings in the database using face_recognition. compare_faces () and face_distance () .
    - A threshold (e.g., 0.6) is used to determine a match.
4. **Attendance Recording**
    - If a match is found, the system logs the attendance with:
        - User reference
        - Current date
        - Current time

5.6 Testing & Deployment

Testing

1. **API Testing**
    - All REST APIs are tested using tools like Postman or URL to ensure correct request handling and data response.

- Edge cases such as duplicate registration, invalid images, or camera failure are tested.

2. **Facial Recognition Accuracy**
   - Recognition accuracy is tested using different lighting conditions, angles, and facial expressions.
   - Metrics like false positives, false negatives, and recognition time are evaluated.

Deployment

1. **Hosting**
   - The Django application can be deployed on cloud platforms like:
     - **Heroku**: Suitable for quick deployment with free-tier options.
     - **AWS (Amazon Web Services)**: Offers more flexibility, scalability, and custom deployment environments (EC2, S3, RDS).
2. **Security**
   - **HTTPS**: Enforce encrypted data transmission using SSL/TLS certificates.
   - **Authentication**: Implement login systems using Django's authentication framework or token-based systems (e.g., JWT).
   - **Database Protection**: Ensure user data and face encodings are encrypted and securely stored.
   - **Error Handling**: Add comprehensive error handling and logging to monitor the system.

6 Technologies to be used

6.1 Software Platform

a) Front-end - vscode

b) Back-end - vscode

6.2 Hardware Platform

- RAM- 8GB
- OS – windows
- SSD – 256GB
- Editor- VSCODE
- Browser - Brave

6.3 Technologies used

1. Programming Languages: Python, JavaScript
2. Frameworks: Django, React
3. Database: MySQL, SQLite
4. Hardware: facial recognition cameras
5. Testing Tools: PyUnit, Jest

7 Advantages of this Project

1. **Improved Accuracy**

   One of the primary advantages of this facial recognition-based attendance system is its ability to deliver highly accurate attendance records. Unlike traditional methods, such as manual entry or RFID cards, which are prone to human error or manipulation, facial recognition technology ensures that each attendance entry is authentic and error-free.

This leads to more reliable and consistent data, which is critical for maintaining discipline, evaluating student performance, and ensuring institutional accountability.

2. **Reduced Proxy Attendance**

Proxy attendance, where one student marks attendance on behalf of another, is a common issue in many educational institutions. This system effectively addresses and eliminates this problem by using facial recognition to verify each individual's identity. Since the system is capable of detecting and recognizing unique facial features, only the actual student can be marked present, thereby enhancing the integrity of the attendance process.

3. **Increased Efficiency**

Automating the attendance process significantly enhances overall efficiency. Teachers and administrators no longer need to spend valuable time taking roll calls or updating records manually. The system captures attendance quickly and accurately as students enter the classroom, allowing educators to focus more on teaching and less on administrative tasks. This time-saving feature becomes especially valuable in institutions with a large number of students.

4. **Enhanced Security**

The system provides an added layer of security for both data and individuals. Attendance data is stored and transmitted using secure protocols, reducing the risk of tampering or data breaches. Moreover, by ensuring that only authorized individuals can be marked as present, the system contributes to the overall safety of the institution. Facial recognition can also be integrated with access control systems to further secure entry and exit points within the campus.

5. **Real-time Attendance Tracking**

One of the standout features of this project is its ability to track attendance in real time. Administrators can access up-to-date records from a centralized dashboard, allowing

them to monitor student attendance instantly. This capability is especially useful for identifying patterns of absenteeism or unusual attendance behaviour and it enables quick follow-up actions such as notifying parents or counselling students.

6. **Reduced Administrative Burden**

   Maintaining attendance manually can be a time-consuming and repetitive task for school staff. By automating the process, this project significantly reduces the workload of administrative personnel. The system not only captures and records attendance but also generates reports and statistics automatically. This helps in streamlining the administrative workflow and allows staff to allocate their time and efforts to more critical and value-added activities.

7. **Improved Student Engagement**

   With accurate and consistent attendance tracking, institutions can identify students who are frequently absent and intervene early. Addressing absenteeism in its early stages can lead to better academic performance and improved student outcomes. When students are aware that their attendance is being monitored accurately and in real-time, they are more likely to attend classes regularly and remain engaged in their studies.

8. **Scalability**

   The system is designed to be scalable and can easily accommodate a growing number of students, faculty, and administrators. Whether implemented in a small classroom or a large university campus, the system can handle extensive data without compromising performance. Its modular design allows for easy upgrades and expansions, making it a future-ready solution suitable for institutions of various sizes.

8 Assumptions, if any

- None

9 Future Scope and further enhancement of the Project

Future Scope:

The facial recognition-based attendance system holds significant potential for future development, innovation, and integration into broader technological ecosystems. As facial recognition technology continues to evolve, the system can be expanded and enhanced in numerous ways to meet the dynamic needs of educational institutions and other organizations. Some of the major areas for future scope include:

1. **Integration with Other Institutional Systems**:
   One of the most promising areas of expansion is the seamless integration of the attendance system with existing institutional systems such as Student Information Systems (SIS), Learning Management Systems (LMS), and Human Resource Management Systems (HRMS). This integration can automate attendance record synchronization, streamline administrative workflows, and reduce redundancy. For example, linking attendance data with academic performance and behaviour tracking systems can help identify patterns and enable data-driven decision-making.

2. **Incorporation of Artificial Intelligence and Machine Learning for Enhanced Accuracy**:
   AI and ML algorithms can significantly enhance the accuracy and efficiency of facial recognition by continuously learning and adapting to changes in facial features due to aging, changes in hairstyle, lighting variations, and even mask-wearing (post-pandemic considerations). Advanced AI models can detect spoofing attempts, distinguish identical twins, and reduce false positives and negatives, making the system more robust and reliable over time.

3. **Development of a Web-Based Application for Remote Attendance Marking**:
   With the increasing trend of remote learning and work-from-home setups, there is a need for a web-based version of the attendance system that allows individuals to mark their attendance from any location using their device's webcam. This would be particularly useful for hybrid classrooms or remote work environments. The web app can be designed to ensure real-time verification, with features like time-stamping, location tracking (with user consent), and browser-based facial recognition APIs.

4. **Deployment on Cloud-Based Infrastructure**:
   Migrating the system to a cloud platform such as AWS, Microsoft Azure, or Google Cloud would enhance its scalability, availability, and performance. Cloud deployment enables central storage of attendance data, making it accessible from anywhere, while also offering powerful processing capabilities for real-time recognition. Furthermore, it

facilitates better data backup, security compliance, and seamless updates without local system dependency.

Further Enhancement:

In addition to expanding the core functionalities, there are numerous enhancements that can be made to improve user experience, adaptability, and overall effectiveness of the system. These include:

1. **Improved User Interface (UI) and User Experience (UX)**:
   A clean, intuitive, and responsive interface greatly enhances usability. Future versions of the application can incorporate interactive dashboards, personalized views for students and administrators, real-time attendance tracking, graphical reports, and accessibility features for differently-abled users. Mobile-first design principles and multilingual support can also be adopted to cater to a diverse user base.

2. **Automated and Customized Report Generation**:
   The system can be upgraded to automatically generate comprehensive attendance reports at daily, weekly, monthly, or semester-wise intervals. These reports can include insights such as attendance percentage, punctuality statistics, absentee trends, and correlation with academic performance. Administrators and teachers can receive automated email or SMS alerts for low attendance or anomalies in behavior patterns.

3. **Customizable Attendance Policies and Rules**:
   To accommodate varying institutional policies, the system should allow administrators to define custom rules such as grace periods, minimum attendance thresholds, and late-entry penalties. Features such as class-wise, subject-wise, and department-wise configurations will make the system adaptable to diverse academic structures.

4. **Integration with Wearable Devices and IoT**:
   In the future, the system could be enhanced to interact with wearable devices such as smartwatches or smart glasses equipped with cameras and sensors. This integration can enable hands-free attendance marking and help in monitoring real-time location or health conditions of the user in certain environments, such as laboratories or fieldwork.

5. **Enhanced Security Features**:
   As facial recognition systems deal with sensitive biometric data, it is crucial to

continuously upgrade security features to protect against unauthorized access and data breaches. Advanced encryption methods, two-factor authentication (2FA), and blockchain-based record verification can be incorporated. Additionally, features like liveness detection, anti-spoofing mechanisms, and anomaly detection can further fortify the system against fraudulent attendance marking.

6. **Offline Functionality and Synchronization**:
   Future versions of the system can support offline attendance marking, allowing the application to function without an internet connection. Once reconnected, the system can synchronize the data with the central server. This would be particularly beneficial for institutions in remote or low-connectivity areas.

7. **Environmental and Contextual Adaptability**:
   Future enhancements may also include context-aware recognition capabilities, where the system adjusts based on environmental factors such as lighting, weather conditions, and background noise. Incorporating infrared or thermal imaging sensors can allow the system to function even in low-light or night-time conditions.

8. **Multimodal Biometric Authentication**:
   To further improve security and reliability, the system could integrate additional biometric modalities such as fingerprint scanning, voice recognition, or iris scanning. This multimodal approach can serve as a fallback mechanism if facial recognition fails or is compromised.

10 Project Repository Location

S#	Project Artifacts (softcopy)	Location	Verified by Project Guide	Verified by Lab In-Charge
1.	Project Synopsis Report	git@github.com:Soumaykumar25/smart_attendance_system.git	Name and Signature	Name and Signature

S#	Project Artifacts (softcopy)	Location	Verified by Project Guide	Verified by Lab In-Charge
2.	Project Progress updates	git@github.com:Soumaykumar25/smart_attendance_system.git	Name and Signature	Name and Signature
3.	Project Requirement specifications	git@github.com:Soumaykumar25/smart_attendance_system.git	Name and Signature	Name and Signature
4.	Project Report (Final Version)	git@github.com:Soumaykumar25/smart_attendance_system.git	Name and Signature	Name and Signature
5.	Test Repository	git@github.com:Soumaykumar25/smart_attendance_system.git	Name and Signature	Name and Signature
6.	Project Source Code (final version) with executable	git@github.com:Soumaykumar25/smart_attendance_system.git	Name and Signature	Name and Signature
7.	Any other document	N/A	Name and Signature	Name and Signature

11 Definitions, Acronyms, and Abbreviations

Abbreviation	Description
VSCode	Visual Studio Code
OS	Operating System
RAM	Random Access Memory
CPU	Central Processing Unit
SQLite	Structured Query Language Library
HTTPS	Hypertext Transfer Protocol Secure
API	Application Programming Interface

12 Conclusion

The proposed smart attendance system using facial recognition technology aims to provide a secure, efficient, and accurate way of tracking attendance. The system is expected to benefit educational institutions by reducing the risk of proxy attendance, improving attendance tracking, and enhancing overall security.

13 References

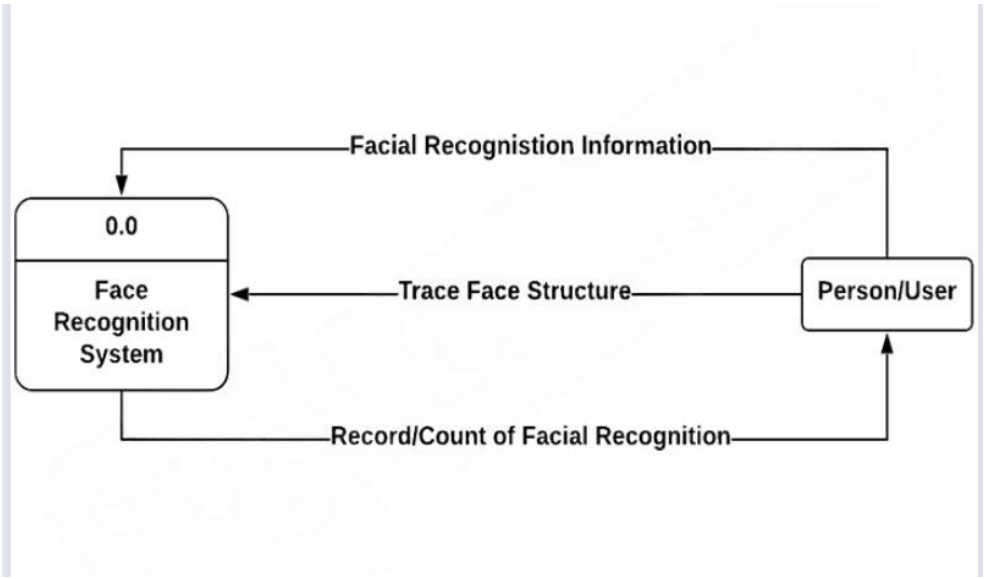
Books:

1. "Facial Recognition: A Comprehensive Review" by A. K. Jain and S. Z. Li (2019)

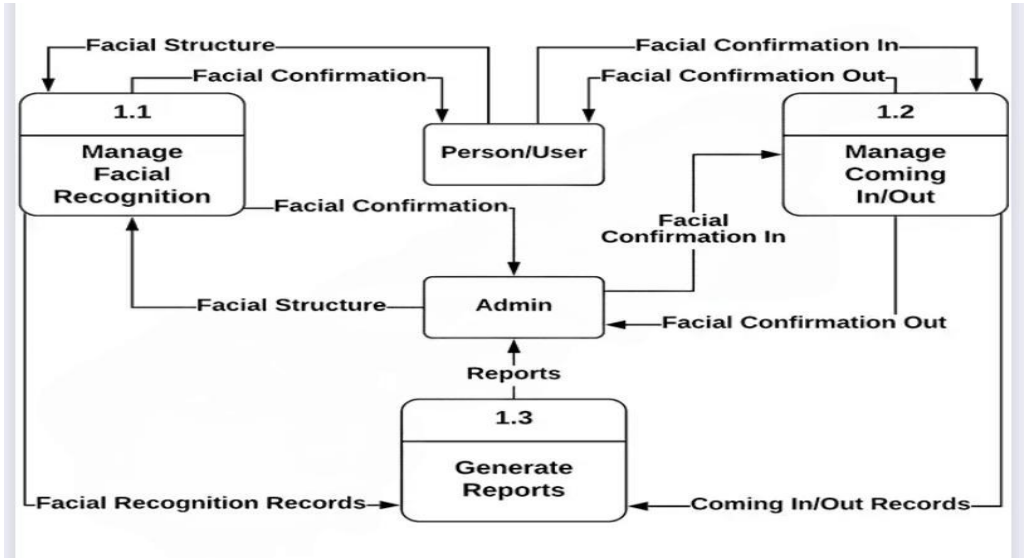
2. "Python Machine Learning" by S. Raschka and V. Mirjalili (2017)

Annexure A
Data Flow Diagram (DFD)
(Mandatory)

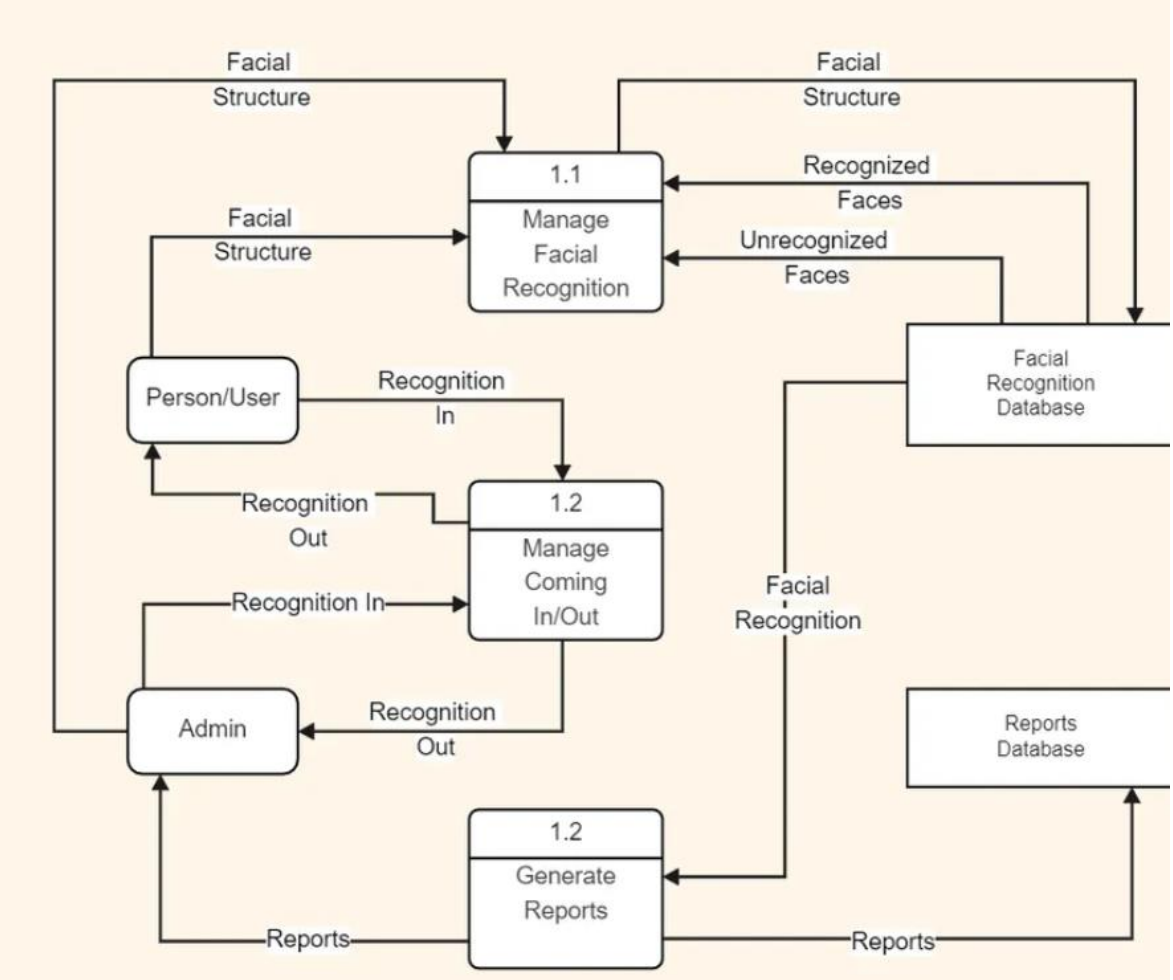
- **LEVEL 0**



- **LEVEL 1**



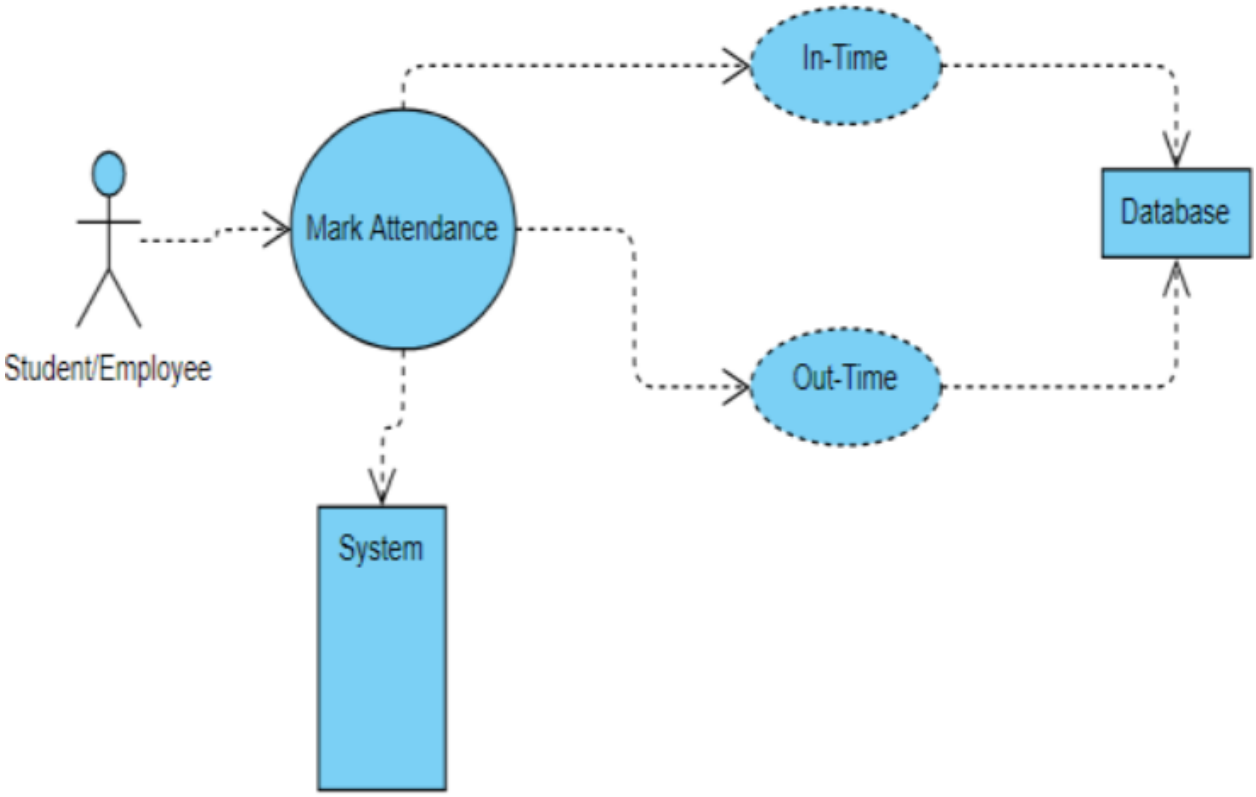
Annexure B
Entity-Relationship Diagram (ERD)
(Mandatory)



Annexure C

Use-Case Diagram (UCD)

(Optional)



Annexure D
Data Dictionary (DD)
(Mandatory)

Example:

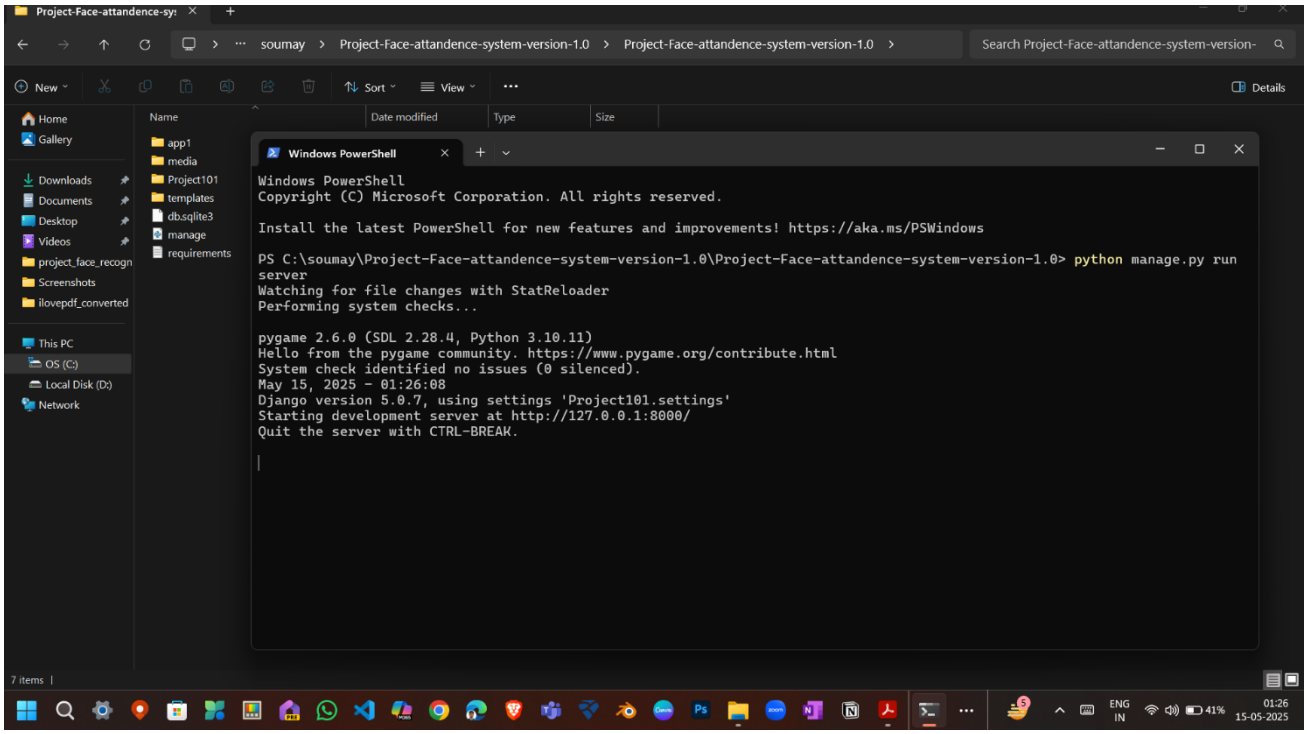
User Table (USR)

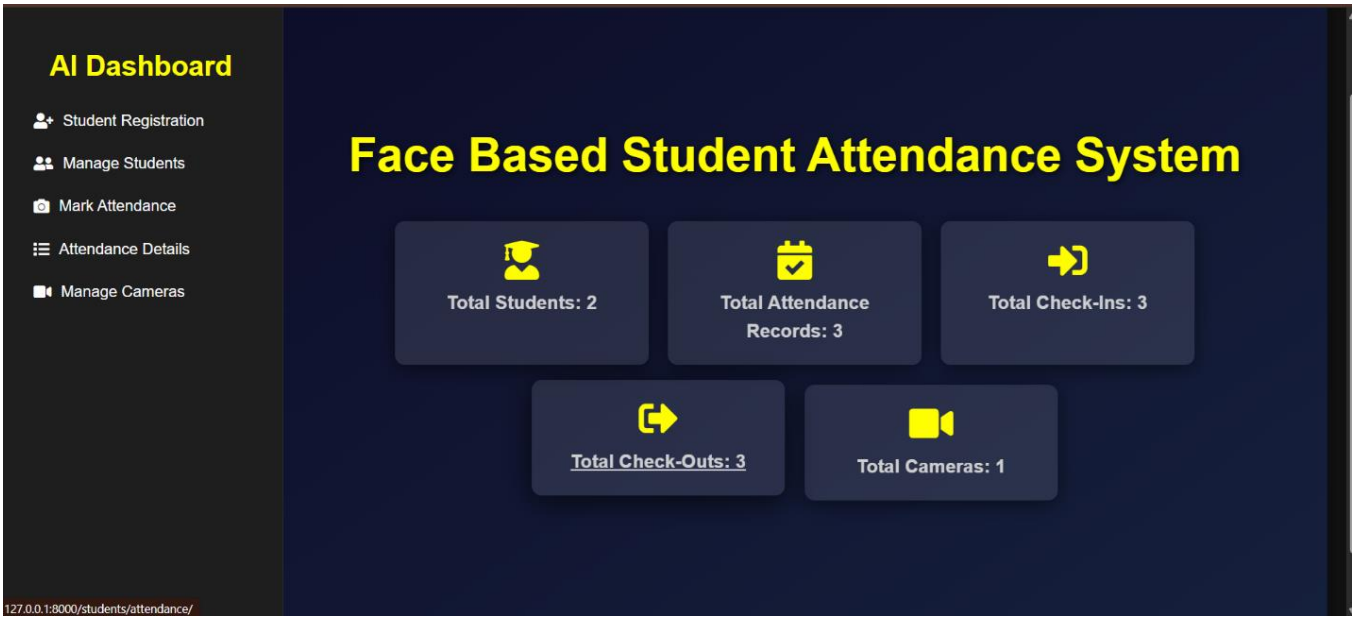
Fields	Data type	Description
Zaid	Text	Admin name
@Zaid9258090608	Text	Admin password
7302367399	Number	Admin Contact
Moradabad	Text	City

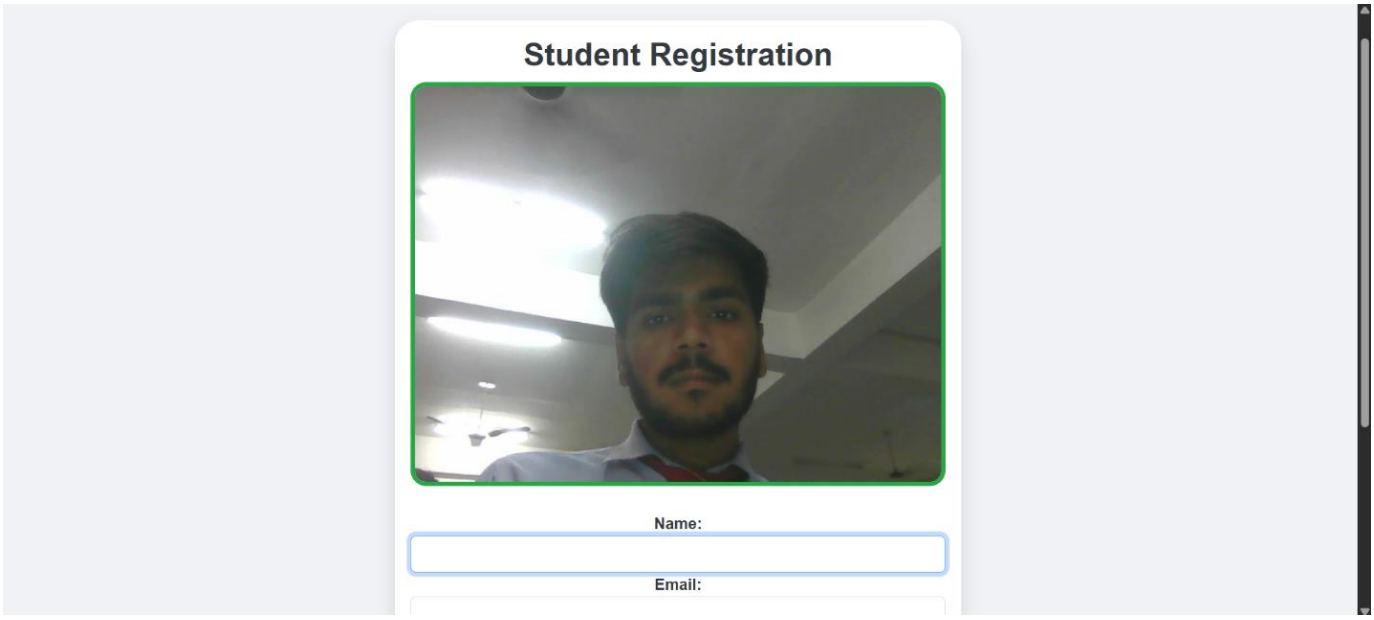
Supplier Table (SUPP)

Fields	Data type	Description
0001	Number	Supplier ID
Soumay kumar	Text	Supplier Name
Moradabad	Text	Supplier Address
9258090608	Number	Supplier Contact

Annexure E
Screen Shots



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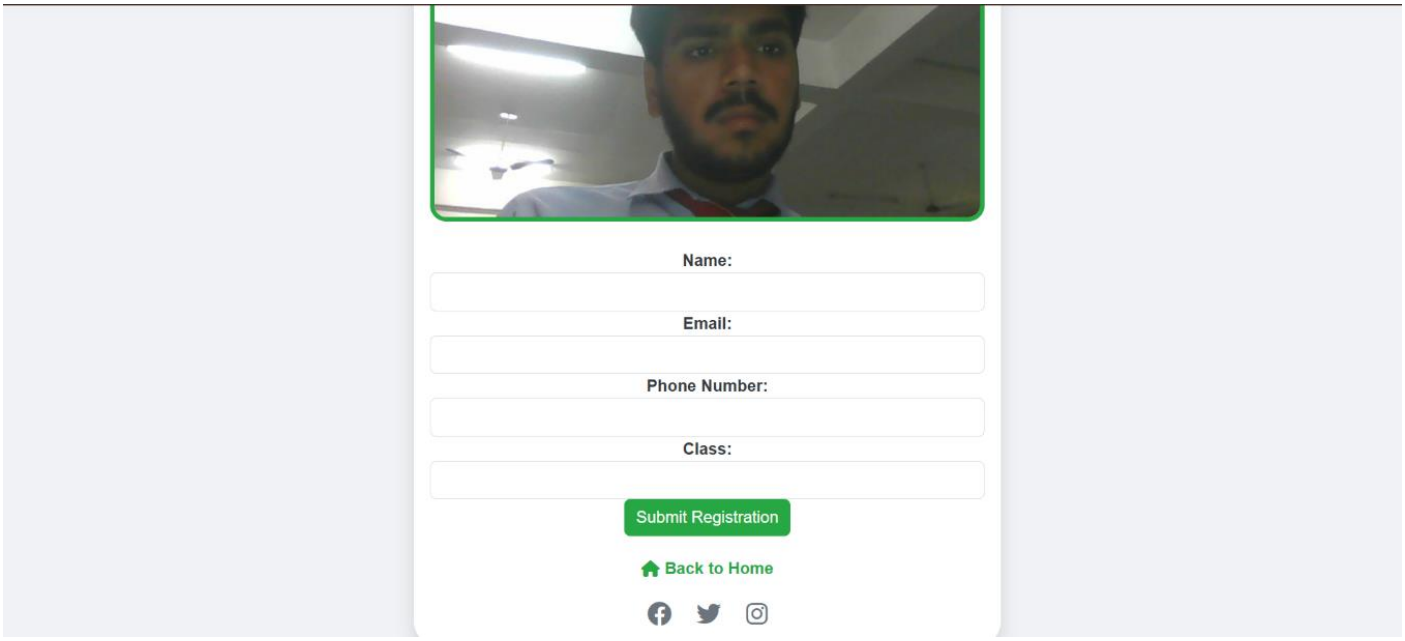
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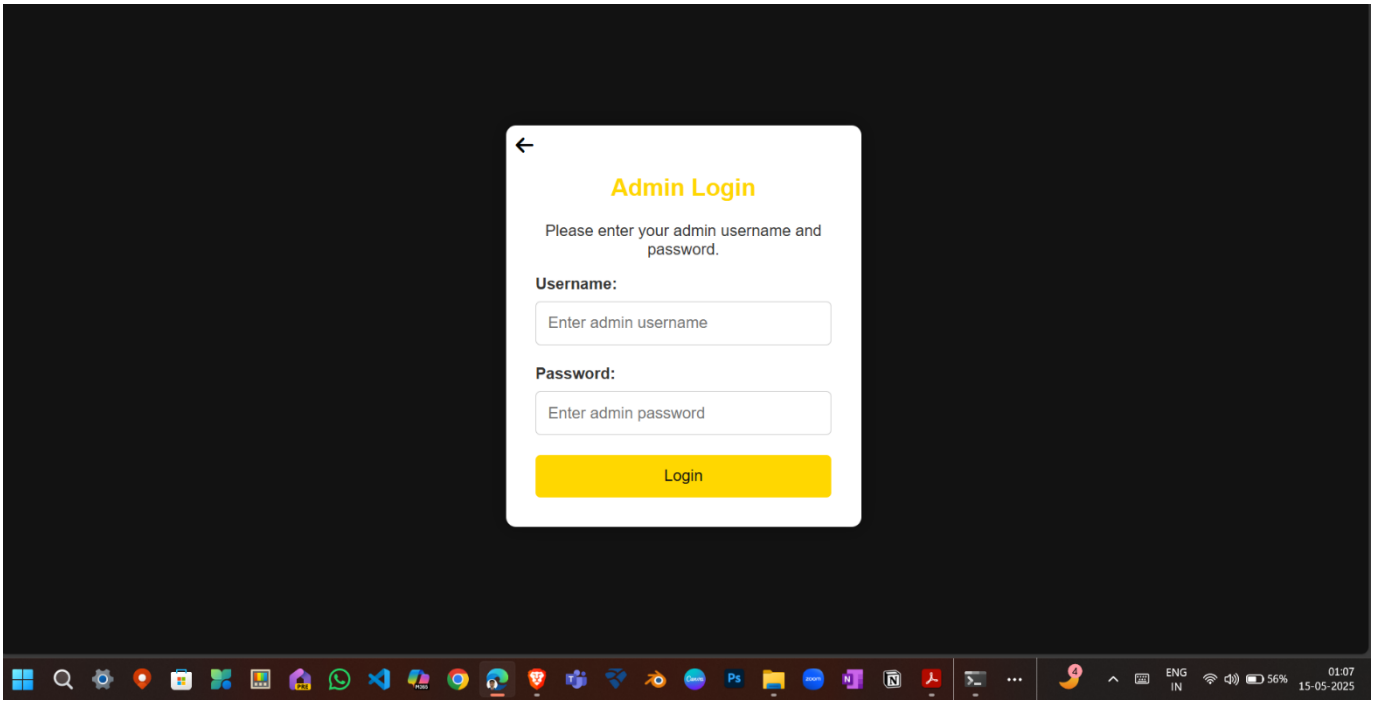
Email:
Phone Number:
Class:
Submit Registration
Back to Home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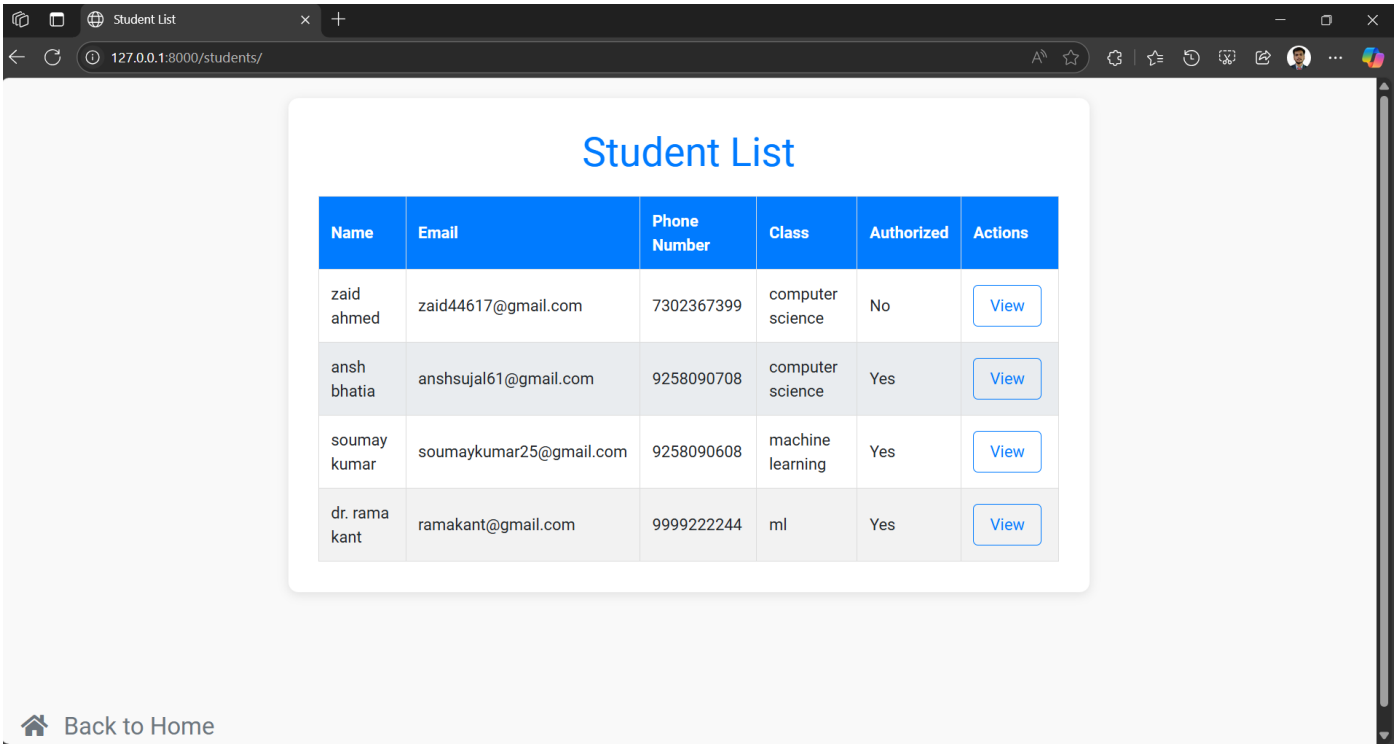
Please enter your admin username and password.
Username:
Enter admin username
Password:
Enter admin password
Login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anshsujal61@gmail.com
9258090708
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soumay kumar
soumaykumar25@gmail.com
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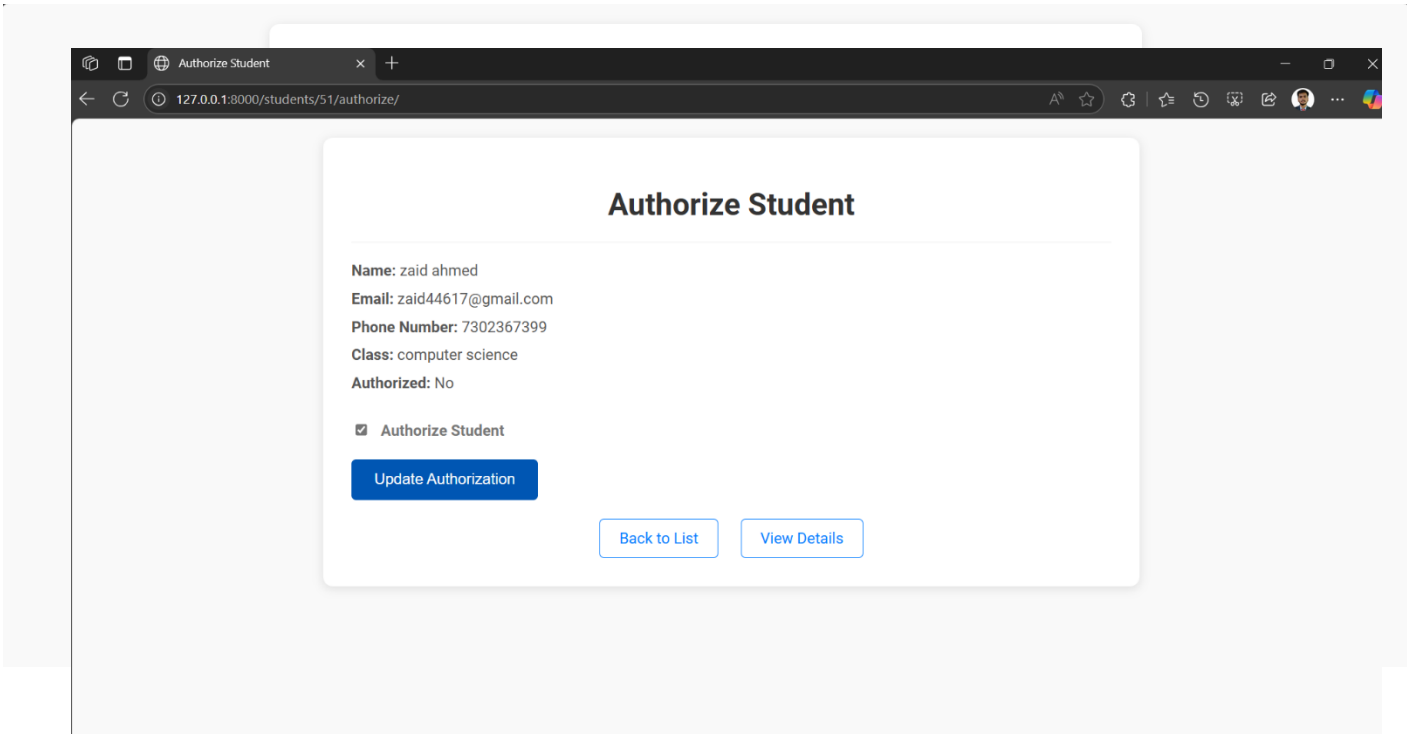
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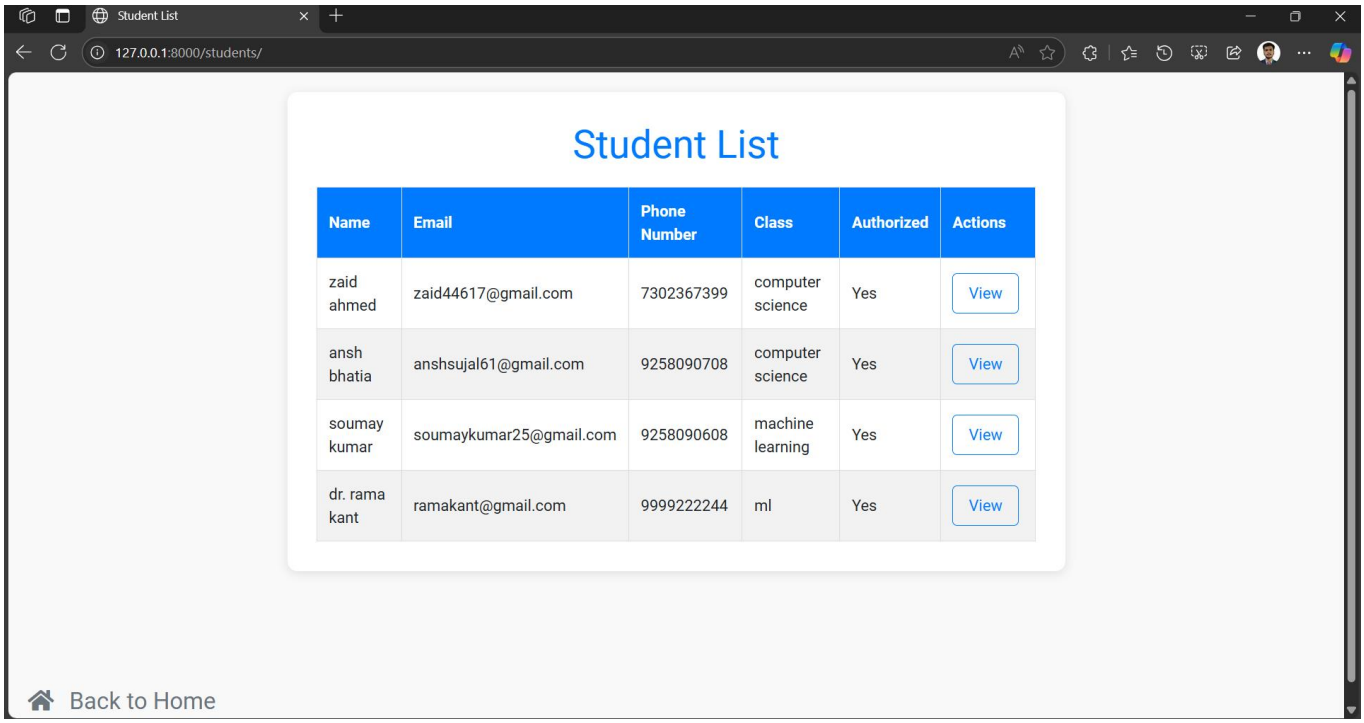
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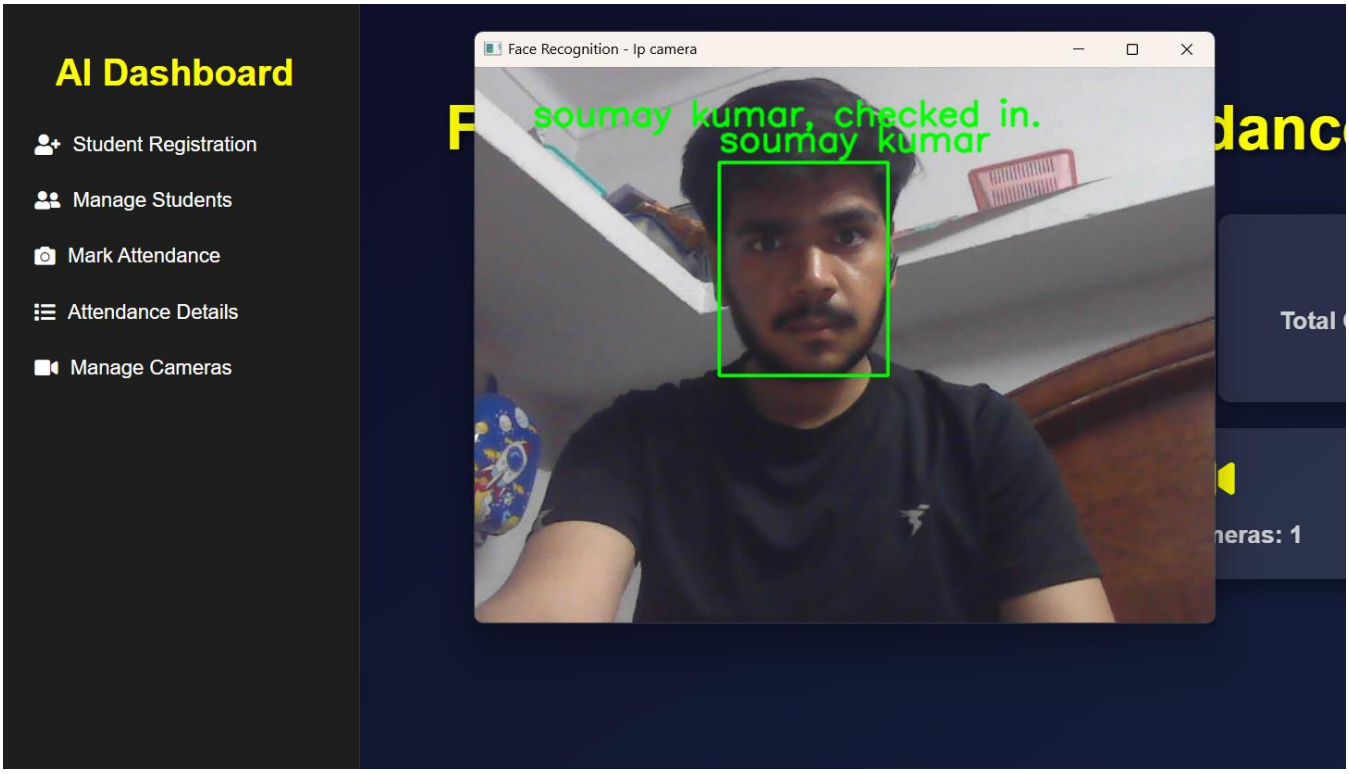
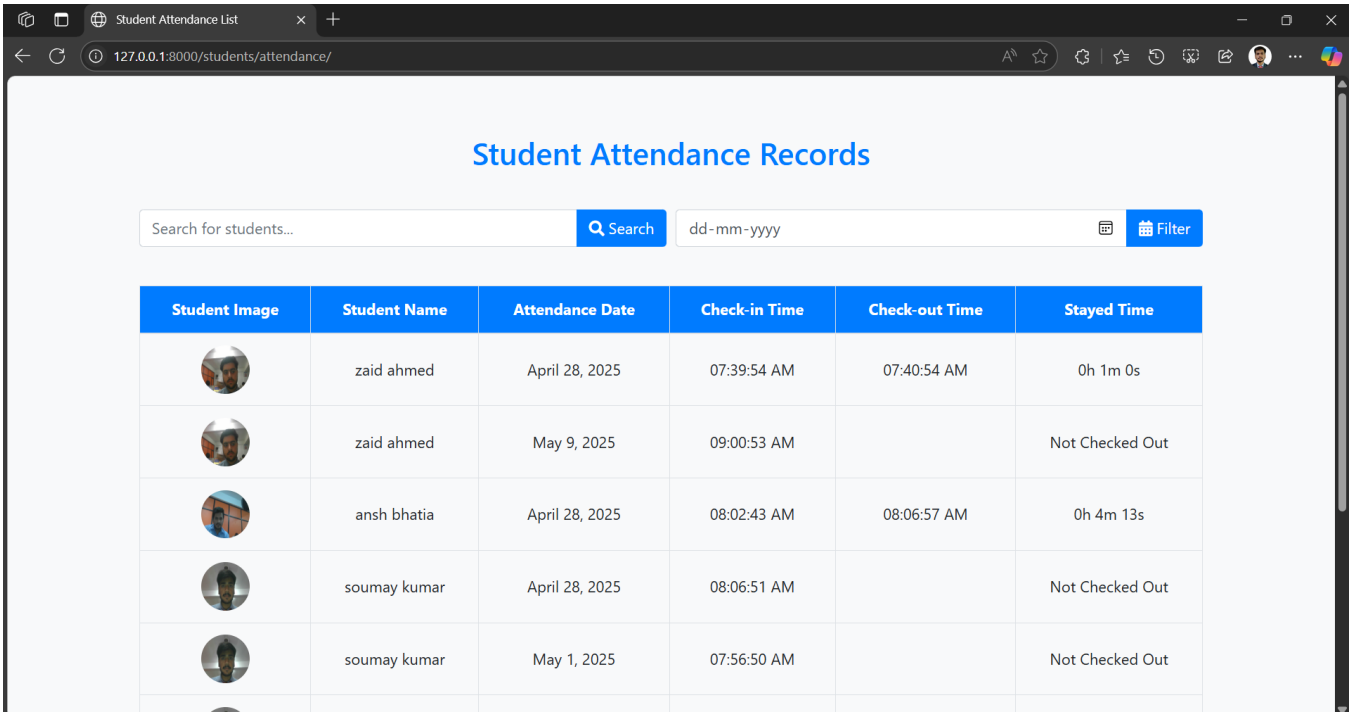
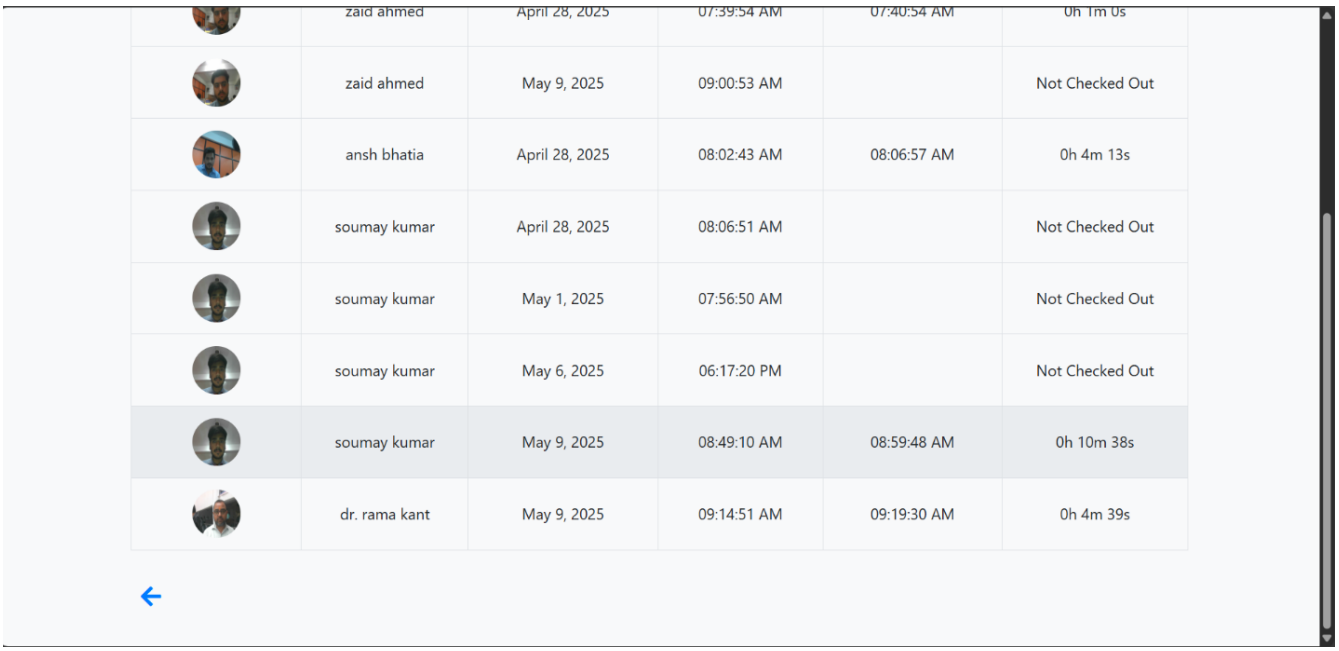
View
Back to Home


AI Dashboard
Student Registration
Manage Students
Mark Attendance
Attendance Details
Manage Cameras
Face Recognition - Ip camera
soumay kumar, checked in.
soumay kumar
Total
neras: 1


Student Attendance List
127.0.0.1:8000/students/attendance/
Student Attendance Records
Search for students...
Search
dd-mm-yyyy
Filter
Student Image
Student Name
Attendance Date
Check-in Time
Check-out Time
Stayed Time
zaid ahmed
April 28, 2025
07:39:54 AM
07:40:54 AM
0h 1m 0s
zaid ahmed
May 9, 2025
09:00:53 AM
Not Checked Out
ansh bhatia
April 28, 2025
08:02:43 AM
08:06:57 AM
0h 4m 13s
soumay kumar
April 28, 2025
08:06:51 AM
Not Checked Out
soumay kumar
May 1, 2025
07:56:50 AM
Not Checked Out



	zaid ahmed	April 28, 2025	07:39:54 AM	07:40:54 AM	0h 1m 0s
	zaid ahmed	May 9, 2025	09:00:53 AM		Not Checked Out
	ansh bhatia	April 28, 2025	08:02:43 AM	08:06:57 AM	0h 4m 13s
	soumay kumar	April 28, 2025	08:06:51 AM		Not Checked Out
	soumay kumar	May 1, 2025	07:56:50 AM		Not Checked Out
	soumay kumar	May 6, 2025	06:17:20 PM		Not Checked Out
	soumay kumar	May 9, 2025	08:49:10 AM	08:59:48 AM	0h 10m 38s
	dr. rama kant	May 9, 2025	09:14:51 AM	09:19:30 AM	0h 4m 39s