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Full Length Article

Student Attendance System Using Face Recognition

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Abstract
Manually recording attendance in educational institutions takes a lot of time and is prone to mistakes. This project showcases a Python-based face recognition-based automated student attendance system. To detect and identify students' faces with high accuracy, the system makes use of the face-recognition library and OpenCV for real- time image capture. The system automatically logs attendance in a CSV/Excel file with the student's name, date, and time after successful identification. In addition to ensuring safe and effective attendance management, the suggested solution increases accuracy and decreases human labor. A database or web-based interface can be added to expand it further for widespread use in smart classrooms. It involves capturing images through web cam then it trains the image and marks the attendance in dashboard.

Keywords: *Python, CSV.*

Introduction

Face recognition has gotten a part of consideration due to its convenience in numerous diverse areas. It includes identifying and recognizing people from facial pictures or recordings. In computer vision and machine learning, face recognition has grown in popularity, and numerous algorithms have been created over time. The main idea is to naturally distinguish or confirm a person based on their facial highlights. Python and OpenCV are popular tools for implementing face recognition algorithms, with many libraries and modules available for use. Using facial recognition technology, "Attendance using Face Recognition" is a system created to make the procedure of recording attendance automatic. A camera is used by the model to capture images of people entering specific locations, their identities are then verified and processed using deep learning algorithms.

The model stores the attendance records in a database to provide real time reports to the administrators. It provides an easy way to keep track of people and manage their attendance. This implementation offers a more efficient and accurate way manage attendance records compared to other traditional methods such as paper-based systems or manual data entry.

Problem Statement

Managing student attendance in educational institutions is often a **time-consuming and error-prone process** when done manually through roll calls or paper registers. Even traditional biometric systems like fingerprint scanners require physical contact, which can cause hygiene concerns and delays when large groups of students are involved. There is a need for a **contactless, efficient, and reliable attendance system** that can automatically identify students and record their presence with minimal human intervention. Face recognition technology, powered by computer vision and machine learning, provides a promising solution. By capturing student images through a webcam and matching them against a pre-trained dataset, the system can **automatically mark attendance in real time**. This reduces manual effort, prevents proxy attendance, and ensures accurate record-keeping.

The proposed mini project aims to design and implement a **Face Recognition-based Student Attendance System** that:

- Detects and recognizes student faces using OpenCV and machine learning algorithms.
- Records attendance automatically in a database or file system.
- Provides a user-friendly interface for administrators/teachers to view and manage attendance records.
- Ensures security and accuracy by handling

unknown or unregistered faces appropriately.

Literature Review

1. Ravishka Fernando et al. (IEEE ICIPRoB 2024) proposed a real-time attendance system that combines Haar Cascade for face detection and Local Binary Pattern Histogram (LBPH) for face recognition. Haar Cascade is used for detecting faces in real time, scanning images and applying a series of classifiers to identify faces quickly. Once detected, LBPH is employed to analyze the texture of the face, creating a unique pattern for each individual, enabling recognition. The system demonstrated over 99% accuracy in controlled conditions, showcasing its robustness. However, its performance dropped when faced with challenges such as poor lighting or occlusions, where parts of the face are obscured, like by a mask or hair. This makes it less effective in environments where lighting is suboptimal or faces are partially hidden. This system is particularly useful in real-time attendance applications where fast and accurate identification is critical.

2. Balakannan et al. (IEEE ICEECT 2024) introduced a hybrid machine learning approach, combining Convolutional Neural Networks (CNNs) for feature extraction with Support Vector Machines (SVM) and K-Nearest Neighbors (KNN) classifiers for face recognition. CNNs are adept at extracting hierarchical features from images, allowing the system to process and analyze facial features efficiently. The extracted features are then classified using either SVM or KNN, comparing them to a known database to identify the individual. The modular design of the pipeline offers flexibility, allowing for easy swapping or upgrading of components. However, the system's performance is hindered by high computational costs, as CNNs require substantial processing power for feature extraction. Additionally, facial occlusions limit its effectiveness in less than ideal conditions. This approach is suitable for applications where customization and flexibility are key, though it may not be ideal for devices with limited computational resources.

3. Kritagya Painuly et al. (IEEE CONIT 2024) focused on utilizing deep CNNs and transfer learning using pre-trained models such as VGG16 and ResNet for face recognition. Transfer learning allows the system to leverage the knowledge from models trained on large datasets, which is particularly useful for tasks like face recognition. Both VGG16 and ResNet are well-established CNN architectures known for their high performance in image classification tasks. The system demonstrated impressive results, performing well even under real-world variations such as different lighting conditions and facial angles. However, these models are computationally intensive and require significant hardware resources, making them less suitable for devices with limited processing capabilities. This approach is ideal for high-end applications where computational power is available and where the need for accuracy under diverse conditions is paramount.

4. D. Balakrishnan et al. (IEEE ICETITE 2024) developed a CNN-based system for face recognition, utilizing FaceNet for generating face embeddings and MTCNN for face detection. FaceNet is known for its ability to convert faces into numerical vectors (embeddings), which can be compared for recognition. MTCNN, a multi-stage face detection method, is used to detect faces and align them for consistent recognition.

Proposed System And Methodology

Proposed Sytem

The proposed system aims to fully automate the process of recording student attendance by utilizing real-time face recognition technology integrated with artificial intelligence. The core idea is to reduce manual intervention while increasing the accuracy and reliability of attendance data. During the registration phase, each student's facial images are captured using a webcam, ensuring multiple angles and lighting conditions to improve recognition reliability. These images are labeled with unique student IDs and stored for training the system.

Once trained, the system activates at the start of a lecture session, using the webcam to scan for student faces. The recognized faces are matched against the trained dataset using a facial recognition algorithm. If a match is confirmed with a confidence score exceeding the defined threshold, the system logs the attendance, including student ID, date, time, and subject. The system also includes an intuitive graphical user interface for ease of use, allowing instructors to start and stop sessions, manually add entries for unrecognized faces, and access attendance logs.The inclusion of a text-to-speech engine enhances user interaction by providing real-time auditory feedback on system operations, such as successful recognition or errors. All attendance data is securely saved in timestamped CSV files or a relational database, ensuring easy retrieval and integration with institutional reporting systems

-Advantages:

-Automates the entire attendance process, reducing the need for manual intervention and associated errors.

-Capturing multiple facial images from different angles and lighting conditions during registration enhances recognition reliability.

-Enables instant face scanning and attendance marking as soon as lecture sessions begin, ensuring up-to-date attendance records.

-The graphical user interface allows easy management of attendance sessions, manual corrections, and access to attendance history, making it convenient for instructors.

-Attendance data is stored securely with timestamps in CSV files or databases, enabling effective data management and seamless integration with institutional reporting systems.

-Automated biometric recognition minimizes fraudulent attendance marking through proxy presence.

-System records student ID, date, time, and subject for comprehensive attendance tracking.

Functional Requirements

1. ***Face Detection & Recognition***

- The system must detect faces in real time using a webcam or camera.
- It must recognize registered student faces by comparing them with the trained dataset.
- It must reject or flag unknown/unregistered faces.

2. ***Student Registration***

- The system must allow administrators to register new students by capturing multiple facial images.
- It must store student details (Name, Roll Number, ID, etc.) along with facial data.
- It must update or delete student records when required.

3. ***Attendance Marking***

- The system must automatically mark attendance when a student's face is recognized.
- It must record the date, time, and student ID in the attendance database/file.
- It must prevent duplicate entries for the same student in a single session.

4. ***Data Management***

- The system must maintain a database (e.g., SQLite/MySQL/CSV) of student records and attendance logs.
- It must allow administrators to view, edit, and manage attendance records.
- It must generate daily/weekly/monthly attendance reports.

5. ***User Interface***

- The system must provide a simple GUI for teachers/admins to:
- Start/stop attendance sessions.
- View attendance records.
- Manage student registration.

6. ***Security & Accuracy***

- The system must ensure only registered faces are accepted for attendance.
- It must handle similar-looking faces with confidence thresholds to avoid misclassification.
- It must store facial data securely to protect student privacy.

7. ***System Operations***

- The system must allow administrators to configure camera settings.
- It must provide error messages for issues like poor lighting, camera failure, or missing datasets.
- It must allow attendance export in formats like CSV or Excel.

Methodology:

Data Collection: Gather a dataset of images or videos of individuals' faces. Ensure that the dataset represents the expected variations in appearance, such as different lighting conditions, angles, facial expressions, and possible occlusions.

Preprocessing: Clean and preprocess the collected data to improve the quality and consistency of the images. Common preprocessing steps include resizing images, converting them to grayscale, and normalizing pixel values.Face Detection: Utilize a face detection algorithm or library (e.g., OpenCV, dlib) to detect and locate faces within each image or video frame. This step helps isolate and extract the facial region for further processing.

Face Alignment: Align the detected faces to a standardized position or pose. This step reduces variations caused by head tilts or rotations, making the subsequent steps more reliable. Techniques such as facial landmarks detection or geometric transformations can be used for face alignment.

Feature Extraction: Extract facial features that capture the unique characteristics of each individual's face. Common techniques include Principal Component Analysis (PCA), Local Binary Patterns (LBP), or Convolutional Neural Networks (CNNs) for deep feature extraction.

Feature Encoding: Convert the extracted features into a compact and meaningful representation. Techniques such as Linear Discriminant Analysis (LDA), Local Binary Patterns Histograms (LBPH), or deep learning-based methods like Siamese or Triplet networks can be used for feature encoding.

Model Training: Utilize the preprocessed and encoded data to train a machine-learning model.

System Design

The system is designed to automate student attendance using face recognition. It integrates **hardware components** (camera, computer, storage) with **software modules** (OpenCV, database, GUI). The design ensures real-time recognition, secure data handling, and easy reporting for teachers.

Architecture Layers

Input Layer

Camera/Webcam captures live video of students.
Images are preprocessed (grayscale conversion, resizing, noise reduction).

Processing Layer

Face Detection Module → Identifies faces in the frame using Haar Cascade.
Face Recognition Module → Matches detected faces with trained dataset using LBPH algorithm.
Attendance Module → Marks attendance if recognition is successful.

Data Management Layer

Attendance records stored in **SQLite/MySQL/CSV** database.
Student details (Name, Roll Number, ID) linked with facial data.

Output Layer

GUI (Tkinter) displays recognition results and attendance status.
Report Generator exports attendance logs to CSV/Excel for analysis.

Workflow

Start Session → Teacher/admin launches the system.
Capture Faces → Camera records student faces.
Preprocess Images → Convert to grayscale, resize.
Detect Faces → Haar Cascade locates faces.
Recognize Faces → LBPH compares with dataset.
Mark Attendance → Database updated with student ID, date, time.
Generate Reports → Attendance logs exported for review.
End Session → Camera released, system stops.

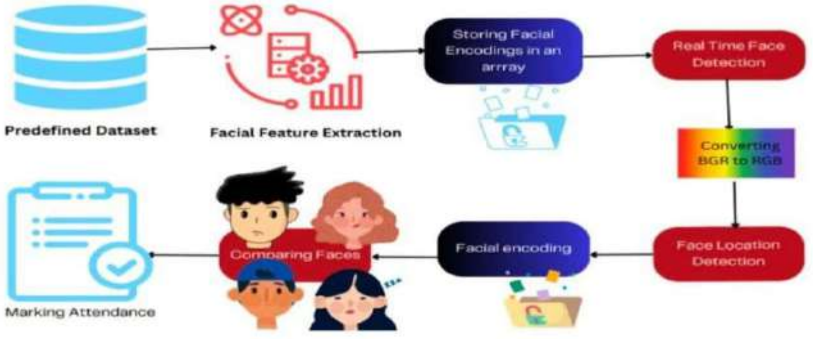


Figure 1. Block diagram describing the design of our algorithm for face recognition

System Architecture

The system architecture outlines a structured workflow for automating student attendance using facial recognition technology. It begins with **Student Registration**, where students provide their name and roll number, and only valid entries are accepted. Next, the **Image Acquisition** module captures facial images using a webcam, associating each image with the student's name. These images are then processed through the **Face Detection** module, which identifies facial regions and stores their coordinates. The system proceeds to **Feature Extraction**, where unique facial features are analyzed and divided into training and testing sets to build a reliable recognition model. Once trained, the **Face Recognition** module compares live images with stored data to identify students and generate attendance records. Finally, the **Admin Activity** module allows administrators to manage the system, view attendance reports, and oversee overall operations. This architecture ensures a seamless interaction between students, faculty, and administrators, combining real-time image processing with secure data management to deliver an efficient and accurate attendance solution.

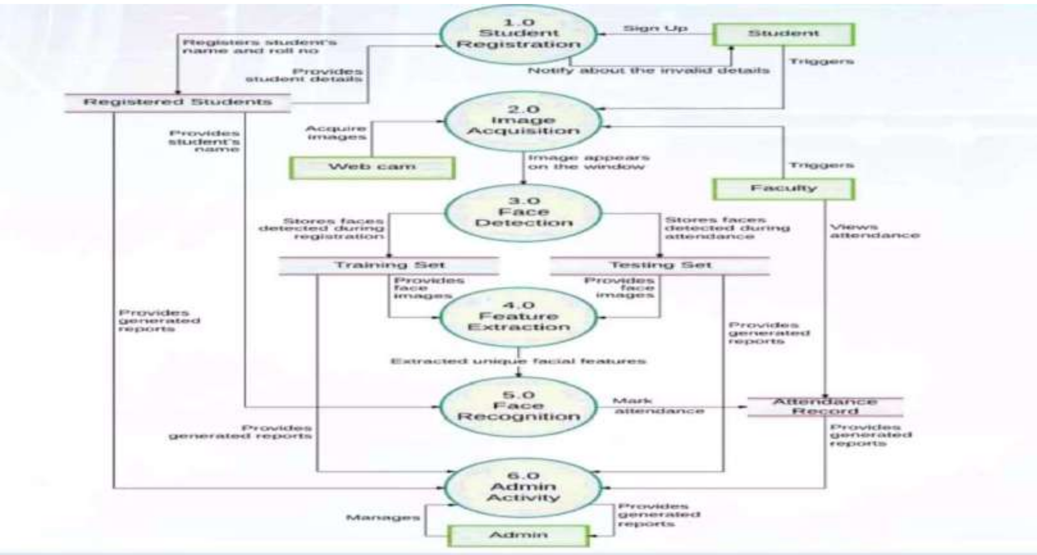


Fig.1: System Architecture

System Testing
System testing ensures the **Face Recognition Attendance System** works correctly and meets requirements. It involves unit testing of modules like face detection, recognition, and database operations, followed by integration testing to verify smooth interaction between components. End-to-end testing validates the complete workflow from student registration to attendance report generation. User acceptance testing confirms usability for teachers and admins, while performance testing checks recognition speed and scalability. Security testing ensures only authorized access to records and protects facial data. Overall, the system testing confirms reliability, accuracy, and readiness for deployment in real classroom environments.

Unit Testing

1. Each module (e.g., face detection, recognition, attendance marking) was tested independently.
2. Verified that functions like image capture, database insertion, and GUI updates work as expected.

Unit testing ensures that each individual module of the **Face Recognition Attendance System** works correctly in isolation. It focuses on verifying small components such as face detection, recognition, database insertion, and GUI updates. For example, the face detection unit is tested to confirm that it identifies faces accurately, while the recognition unit is checked against known datasets to validate correct identification. Database operations are tested to ensure student records and attendance logs are stored and retrieved properly. By testing these units independently, errors can be identified early, improving reliability, reducing debugging time, and ensuring smooth integration later.

Integration Testing

1. Tested the interaction between modules:
   -Camera → Face Detection → Recognition → Attendance Logging.
2. Ensured smooth data flow and correct handoff between components.

Integration testing ensures that the individual modules of the **Face Recognition Attendance System** work together seamlessly. After unit testing verifies each component, integration testing focuses on the interaction between modules such as the camera, face detection, recognition, database, and GUI. For example, the captured image must flow correctly from the webcam to the detection module, then to recognition, and finally update the attendance database. It validates data transfer, module communication, and error handling across the system. By testing these combined processes, integration testing ensures smooth end-to-end functionality, reliable performance, and accurate attendance marking in real classroom scenarios.

Functional Testing

Functional testing verifies that the **Face Recognition Attendance System** performs all required operations as specified in the functional requirements. It focuses on validating the core features such as student registration, image acquisition, face detection, recognition, attendance marking, and report generation. During testing, the registration module was checked to ensure that only valid student details were accepted and stored correctly in the database. The image acquisition module was tested to confirm that the webcam captured and saved facial images with proper identifiers. Face detection was validated to ensure accurate identification of facial regions, while recognition was tested against the trained dataset to confirm correct identification of registered students and rejection of unknown faces. Attendance marking was verified to ensure that records were updated with student ID, date, and time, without duplication. The reporting module was tested to generate accurate daily and monthly attendance logs in CSV/Excel formats. Additionally, the GUI was tested for usability, ensuring that teachers could easily start sessions, view records, and export reports. Overall, functional testing confirmed that the system meets its intended objectives and delivers reliable, user-friendly attendance management.

System Testing

1. End-to-end testing of the complete system:

Student registration → Image acquisition → Recognition → Attendance marking → Report generation.

2. Verified that the system behaves correctly under normal classroom conditions.

System testing validates the complete functionality of the **Face Recognition Attendance System** to ensure it meets all requirements. It begins with **unit testing** of individual modules such as face detection, recognition, database operations, and GUI handling. Once modules are verified, **integration testing** checks smooth interaction between components, ensuring data flows correctly from image capture to attendance marking. **End-to-end testing** simulates real classroom scenarios, confirming that student registration, recognition, and report generation work seamlessly. **User acceptance testing** ensures teachers and admins find the system intuitive and reliable.

Performance testing measures recognition speed, ensuring attendance is marked within 2–3 seconds per student, while **security testing** verifies that only authorized users can access records and that facial data is protected. Overall, system testing confirms accuracy, reliability, usability, and readiness for deployment in real educational environments.

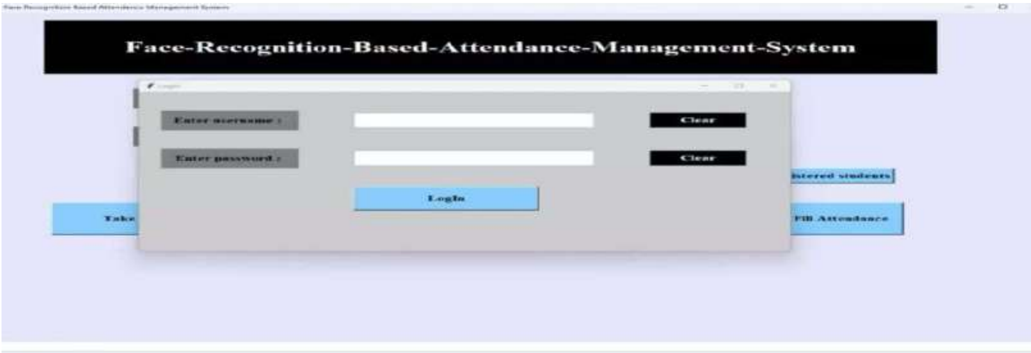
Performance Testing ensures that the **Face Recognition Attendance System** operates efficiently under different conditions. The system was tested for response time, scalability, and accuracy. Face detection and recognition were measured to confirm that attendance is marked within 2–3 seconds per student. Stress testing was performed with multiple students simultaneously to evaluate system stability, while load testing checked database performance when handling large attendance records. The system maintained consistent accuracy and speed, proving its reliability for real classroom environments.

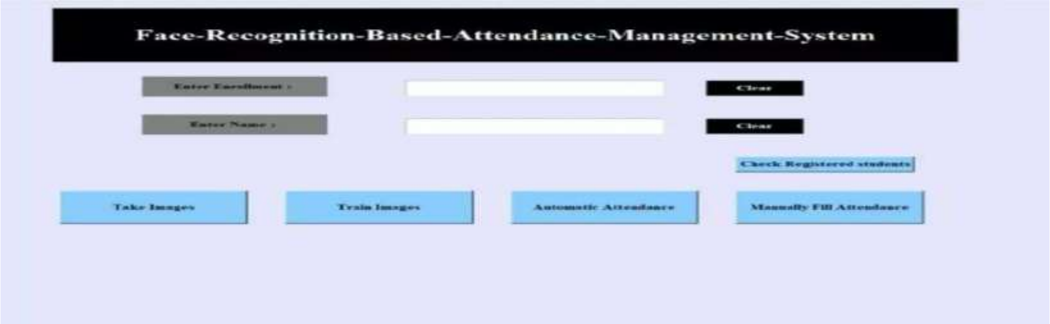
Security Testing validates that the system protects sensitive data and restricts unauthorized access. User authentication was tested to ensure only registered teachers and administrators could access attendance records. Database security was verified by checking that student details and facial images are stored safely, preventing unauthorized retrieval or modification. Role-based access control was implemented to separate admin and faculty privileges. Additionally, attempts to bypass login or inject invalid data were blocked, confirming the robustness of the system against common threats.

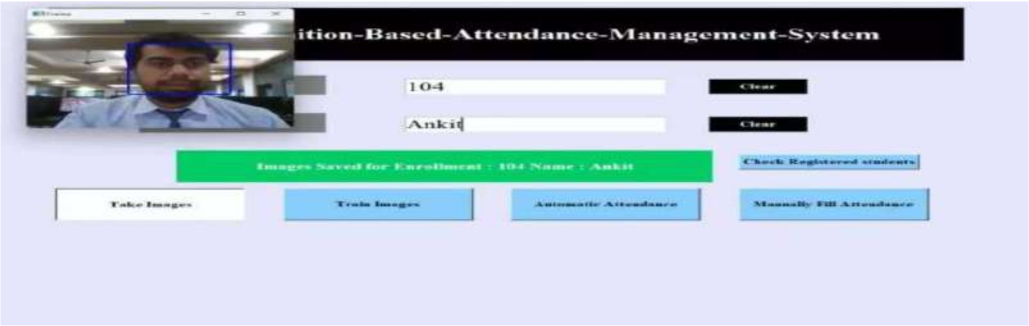
Result And Discussion

The results of an automatic attendance system using machine learning depend on various factors such as the quality and quantity of data used for training the model, the performance of the selected machine learning algorithm, and the accuracy of the data processing and feature extraction techniques used. Generally, an effective automatic attendance system should be able to accurately recognize and identify students in real time, with minimal false positives and negatives. The system should also be able to handle variations in lighting, pose, and other environmental factors that may affect the performance of the system. The accuracy of an automatic attendance system can be measured using metrics such as precision, recall, and F1 score. Precision measures the proportion of correctly identified positive instances (correctly recognized students), and recall measures the proportion of positive instances that are correctly identified .The discussion section of the research paper focuses on interpreting and analysing the results obtained from the automatic attendance system. Researchers may discuss the strengths and limitations of their proposed approach, addressing any challenges encountered during implementation. They may also provide insights into the factors that influenced the system's performance, such as the quality of the training data, pre- processing techniques used, or the choice of machine learning algorithms. Additionally, the researchers may discuss potential areas of improvement or future work to enhance the system's accuracy, efficiency, or robustness.

Results



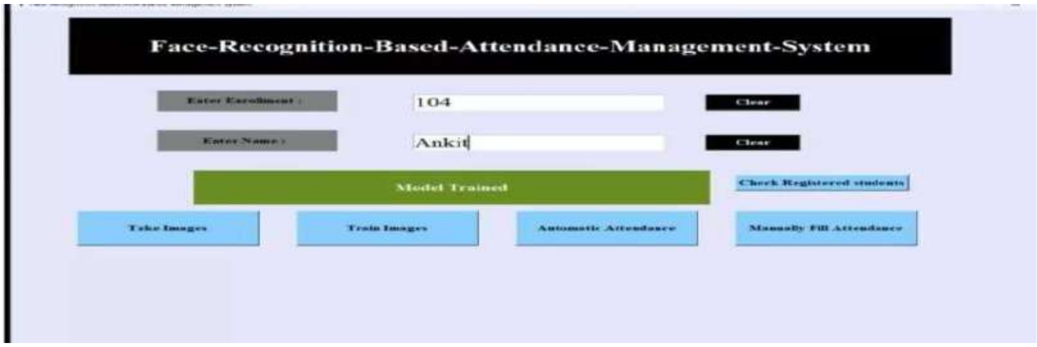




104

Ankit

Images Saved for Enrollment : 104 Name : Ankit



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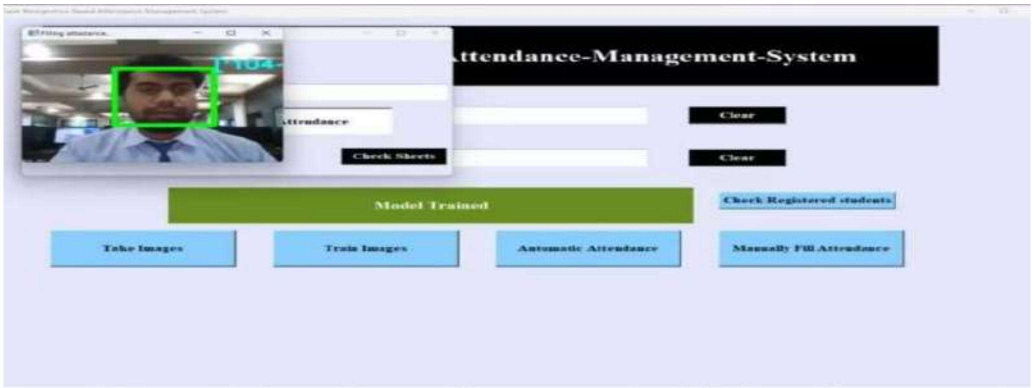
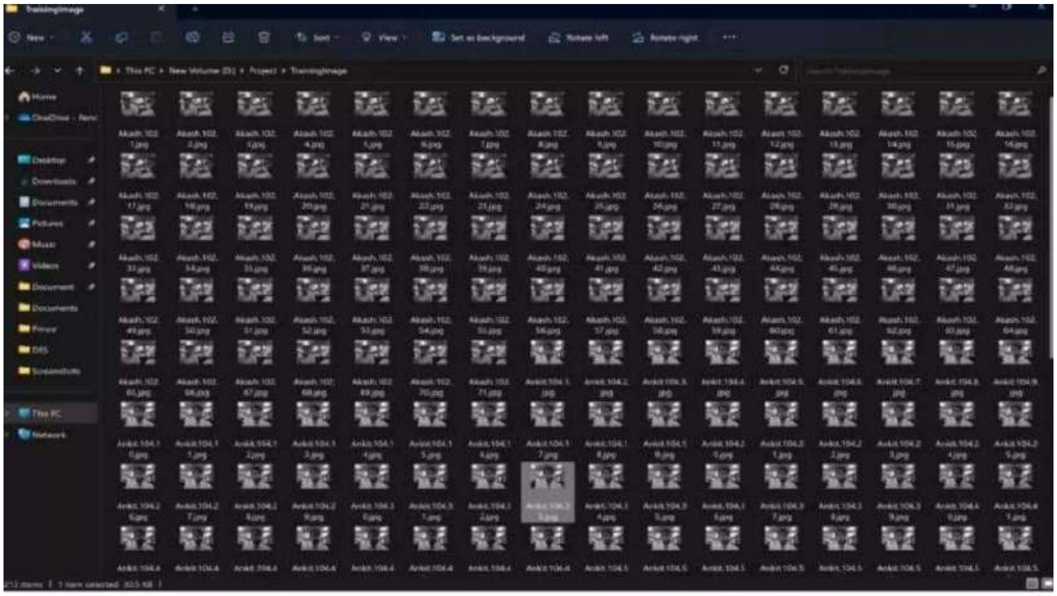
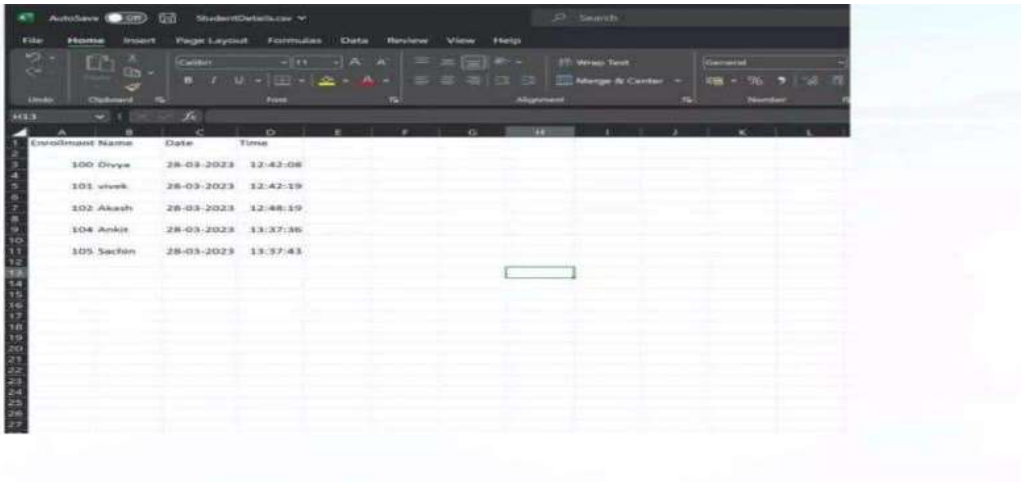
Ankit

Model Trained







Enrollment	Name	Date	Time
100	Divya	28-03-2023	12:42:08
101	vivek	28-03-2023	12:42:19
102	Akash	28-03-2023	12:48:19
104	Ankit	28-03-2023	13:37:36
105	Sachin	28-03-2023	13:37:43

Conclusion And Future Scope

Conclusion

In automatic attendance system using machine learning can provide several benefits in terms of accuracy, efficiency, and convenience. By utilizing advanced computer vision algorithms and machine learning techniques, such a system can automatically detect and recognize faces, and match them with a pre-existing database of student or employee records. This can greatly reduce the time and effort required for manual attendance-taking, and also eliminate errors and discrepancies that can occur in traditional methods. Additionally, such a system can also provide valuable insights and analytics, such as attendance patterns, late arrivals, and early departures, that can help improve overall attendance and productivity. However, it is important to note that such a system requires careful consideration of privacy and security concerns, such as data protection, consent, and transparency. Moreover, there may be limitations and challenges associated with the accuracy and reliability of the system, especially in situations where there are multiple people with similar physical features.

In order to obtain the attendance of individuals and to record their time of entry and exit, the authors proposed the attendance management system based on face recognition technology in the institutions/organizations. The system takes attendance of each student by continuous observation at the entry and exit points. The result of our preliminary experiment shows improved performance in the estimation of the attendance compared to the traditional black and white attendance systems. Current work is focused on the face detection algorithms from images or video frames. In further work, authors intend to improve face recognition effectiveness by using the interaction among our system, the users and the administrators. On the other hand, our system can be used in a completely new dimension of face recognition application, mobile based face recognition, which can be an aid for common people to know about any person being photographed by cell phone camera including proper authorization for accessing a centralized database.

Future Work

Although the **Face Recognition Attendance System** achieves reliable attendance automation, several enhancements can be explored in future development:

- *Improved Accuracy with Deep Learning*
  - Integrate advanced algorithms such as CNNs (Convolutional Neural Networks) for higher recognition accuracy, even in challenging lighting or crowded environments.
- *Mobile Application Integration*
  - Develop a mobile app for teachers and students to access attendance records, notifications, and reports remotely.
- *Cloud-Based Storage*
  - Shift from local databases to cloud platforms for scalability, secure backups, and centralized access across multiple classrooms or institutions.
- *Multi-Factor Authentication*
  - Combine facial recognition with other biometric methods (fingerprint, RFID) to enhance security and reduce false positives.
- *Real-Time Analytics*
  - Provide dashboards with insights such as attendance trends, punctuality statistics, and automated alerts for absenteeism.
- *Edge Computing Deployment*
  - Optimize the system to run on lightweight devices (Raspberry Pi, Jetson Nano) for cost-effective classroom deployment.
- *Integration with Academic Systems*
- Link attendance data with Learning Management Systems (LMS) or ERP platforms for seamless academic record management.

Future work for the **Face Recognition Attendance System** includes enhancing accuracy with deep learning, integrating mobile applications, and adopting cloud-based storage for scalability. Additional improvements may involve multi-factor authentication, real-time analytics, and linking attendance data with academic systems, ensuring greater efficiency, security, and adaptability in educational environments.

References

1. Ravishka Fernando, Hashini Athauda, “Image Processing based Real-Time Online Attendance Monitoring System using Facial Recognition”. 2024 International Conference on Image Processing and Robotics (ICIPRoB), IEEE 2024.
2. S P Balakannan, Kothuri Sravani, Jeyapriya, Sara Fathima, Rosini, “AI Based Attendance System using Machine Learning”. 2024 International Conference on Electrical Electronics and Computing Technologies (ICEECT),IEEE 2024.
3. Kritagya Painuly, Yukti Bisht, Himadri Vaidya, Akanksha Kapruwan, Rupesh Gupta, “Efficient Real-Time Face Recognition-Based Attendance System with DeepLearning Algorithms”. 2024 4th International Conference on Intelligent Technologies (CONIT),IEEE 2024