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Intelligent Student Attendance Monitoring System Using Face Recognition

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Abstract— In today's digital age, a face recognition system plays an important role in almost every field. Face recognition is one of the most commonly used biometric technologies. It can be applied for security, verification, identification, and offers many other benefits. Although its accuracy is comparatively lower than iris and fingerprint recognition, it is widely adopted because it is contactless and non-intrusive. Moreover, face recognition can be effectively utilized for recording attendance in schools, colleges, offices, and other institutions. This system is designed to develop a classroom attendance solution based on face recognition, as traditional manual attendance methods are time-consuming and difficult to manage. There is also a possibility of proxy attendance in manual systems, which increases the necessity for an automated solution. The proposed system operates in four stages: database generation, face detection, face identification, and attendance updating. The database is prepared using students' images collected from the class. Face detection and identification are carried out using the Haar-Cascade classifier and the Local Binary Pattern Histogram (LBPH) algorithm, respectively. Faces are identified from real-time video streaming in the classroom. At the end of the session, the attendance report is sent to the respective faculty member via email.

Keywords— Automated Face; Identification; Image-Based Face Detection,;Haar Feature-Based Cascade Classifier;Local Binary Pattern (LBP);Automated Attendance System

I. INTRODUCTION

The conventional method of marking attendance is a laborious task in many schools and colleges. It also places an additional responsibility on faculty members, who must manually call out students' names, which can take nearly five minutes of the total lecture time. This process is inefficient and time-consuming. Moreover, there is a possibility of proxy attendance. As a result, many institutions have started implementing alternative methods for recording attendance, such as Radio Frequency Identification (RFID), iris scanning, fingerprint authentication, and others. However, these approaches are generally queue-based, which may require more time and are often intrusive in nature. Face recognition has emerged as a significant biometric technique that is easily obtainable and non-intrusive. Systems based on face recognition are comparatively unaffected by different facial expressions. A face recognition system is broadly classified into two types: verification and identification. Face verification involves a one-to-one (1:1) comparison, where a captured face image is matched with a stored template image. In contrast, face identification is a one-to-many (1:N) process, where a query face image is compared with multiple images in the database. The objective of this system is to develop an attendance management system based on face recognition technology. In this approach, an individual's face is used as the basis for marking attendance. Today, face recognition is becoming increasingly popular and is widely applied in various domains. In this paper, we propose a system that detects students' faces from real-time classroom video

streaming, and attendance is recorded if the identified face matches an image stored in the database. This automated system is expected to reduce the time required compared to traditional attendance methods.

II. LITERATURE SURVEY

In [3], the researchers presented an automated attendance framework that combines face recognition with Radio Frequency Identification (RFID) to identify authorized students and record their entry and exit from the classroom. The system preserves an accurate record of every enrolled student. It also stores attendance information for students registered in a specific course and generates required reports whenever necessary. In [4], the authors developed and deployed an attendance monitoring system based on iris biometric technology. Initially, participants were required to enroll their personal details along with their distinct iris template. During attendance recording, the system automatically captured the eye image of each individual, identified the iris pattern, and matched it with the stored database. The designed prototype was implemented as a web-based platform. In [5], the researchers proposed a facial recognition-based attendance solution. Techniques such as Viola-Jones object detection framework and Histogram of Oriented Gradients (HOG), together with the Support Vector Machine (SVM) classifier, were employed to build the system. The study considered several real-time challenges, including variations in scale, lighting conditions, occlusion, and head pose. Performance assessment was carried out using Peak Signal-to-Noise Ratio (PSNR) measurements, and the implementation was completed using a MATLAB graphical interface. In [6], the authors conducted a comparative study to identify the most suitable facial recognition technique between Eigenface and Fisherface, both available in OpenCV 2.4.8. The evaluation was performed using the Receiver Operating Characteristic (ROC) curve. Experimental findings showed that the Eigenface method delivered superior performance compared to Fisherface. The attendance system developed using the Eigenface approach achieved an accuracy ranging from 70% to 90%. In [7], the researchers suggested a classroom attendance approach based on facial recognition by integrating Discrete Wavelet Transform (DWT) and Discrete Cosine Transform (signal processing method"] (DCT) for extracting facial features. These features were then classified using a Radial Basis Function network (RBF) classifier. The proposed technique achieved an overall recognition accuracy of 82%.

III. PROPOSED SYSTEM

In the suggested system, every student in the class must complete the enrollment process by providing the necessary information. After registration, their facial photographs are captured and stored in the database. For each lecture, faces are identified from the live video feed of the classroom. The identified faces are then compared with the images available in the database. If a match is detected, attendance is automatically recorded for the respective student. At the end of every session, a report containing the list of absent students is emailed to the faculty member in charge of the class. The architecture of the proposed system is presented below.

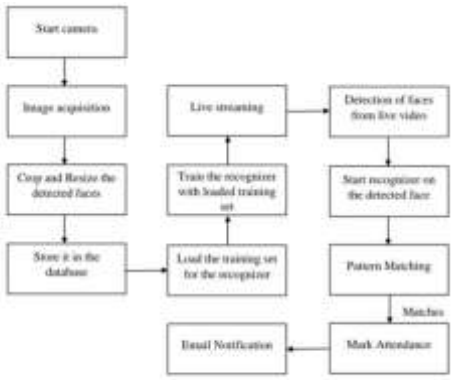


Fig.1. System Architecture

1. Dataset Creation

Photographs of students are obtained using a webcam. Several images of each student are captured with different poses and facial variations. These images are then subjected to preprocessing steps. Initially, the images are cropped to extract the Region of Interest (ROI), which is later utilized in the recognition stage. The cropped images are resized to a fixed pixel resolution. After resizing, they are converted from RGB format to grayscale. Finally, the processed images are saved in a folder under the respective student's name.

2. Face Detection

In this system, face detection is carried out using the Haar Cascade classifier with the help of OpenCV. The Haar Cascade method must first be trained to identify human faces, a step referred to as feature extraction. The training dataset is provided in an XML file named *haarcascade_frontalface_default*.

The detectMultiScale function from OpenCV is employed to draw bounding rectangles around detected faces within an image. This function requires three parameters: **scaleFactor**, **minNeighbors**, and **minSize**. The *scaleFactor* controls the reduction of the image size at each scaling stage. The *minNeighbors* parameter specifies the minimum number of neighboring rectangles needed for a region to be considered a valid face; higher values generally result in fewer but more accurate detections. The *minSize* parameter defines the smallest detectable object size, which is set to (30, 30) by default. In this implementation, the chosen values are 1.3 for scaleFactor and 5 for minNeighbors.

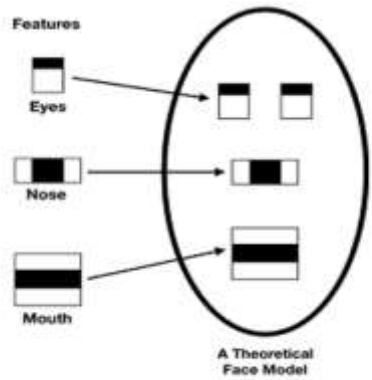


Fig.2. Haar Features

3. Face Recognition

The facial recognition procedure consists of three main stages: preparing the training dataset, training the recognition model, and performing prediction. The dataset contains stored images labeled with unique integer identifiers corresponding to each student. These labeled images are used to train the recognition system.

The algorithm utilized for recognition is Local Binary Patterns Histograms (LBPH). Initially, Local Binary Patterns (LBP) are extracted from the complete facial image. These patterns are then converted into decimal values, and histograms are generated from those values. As a result, each training image is represented by a histogram. During identification, the histogram of the detected face is computed and compared with the stored histograms in the database. The system then returns the label that best matches the detected face, identifying the corresponding student.

4. Attendance Updation

Once the recognition stage is completed, the identified students are marked as present in an Excel record, while the remaining students are recorded as absent. The absentee list is then sent via email to the respective faculty members. Furthermore, an updated monthly attendance report is provided to faculty at the end of each month.

IV. RESULTS AND DISCUSSIONS

Results and Discussion

Intelligent Student Attendance Monitoring System Using Face Recognition

The proposed **Intelligent Student Attendance Monitoring System Using Face Recognition** was implemented to automate the traditional attendance process and improve the efficiency of attendance management in educational institutions. The system was tested in a classroom-like environment using a webcam to evaluate its ability to detect faces, recognize registered students, identify unknown individuals, detect absent students, and prevent fake attendance through spoof detection techniques.


Fig.3. possible photo spoof attempt

During the execution of the system, the webcam continuously captures video frames. Each frame is processed using a **face detection algorithm**, which identifies human faces present in the camera view. After detecting a face, the system performs **face encoding**, where unique facial features are extracted and converted into numerical representations. These encoded features are then compared with the facial data stored in the student database.

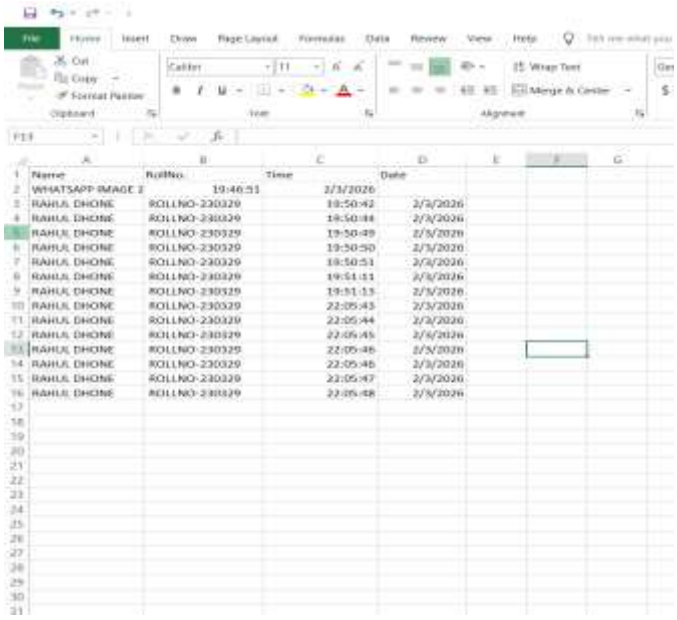
When the detected face matches with a registered student, the system successfully marks the student's attendance in the **Attendance.csv** file. The system records the student's name along with the date and time of detection. This automatic attendance marking

eliminates the need for manual roll calls and reduces errors that commonly occur in traditional attendance systems. The automated approach also saves classroom time and improves overall efficiency.

In cases where the system detects a face that does not match any record in the database, it classifies the individual as an **unknown person**. The system then captures the image of that person and stores it in the **Unknown_Persons** folder. This feature enhances security by allowing administrators to monitor unidentified individuals entering the classroom or restricted areas.

Fig.4. Face Recognition

The system also includes a mechanism to identify **absent students**. After recording the attendance of recognized students, the system compares the attendance file with the list of registered students stored in **students.csv**. Students whose faces are not detected during the attendance session are automatically marked as absent. Based on this information, the system can send **SMS or email notifications to parents**, informing them about their child's absence. This improves communication between parents and the institution while ensuring better attendance tracking.



Name	RollNo.	Time	Date
WHATSAPP IMAGE 2		19:46:51	2/3/2026
RAHUL DHONE	ROLLNO-230329	19:50:42	2/3/2026
RAHUL DHONE	ROLLNO-230329	19:50:44	2/3/2026
RAHUL DHONE	ROLLNO-230329	19:50:49	2/3/2026
RAHUL DHONE	ROLLNO-230329	19:50:50	2/3/2026
RAHUL DHONE	ROLLNO-230329	19:50:51	2/3/2026
RAHUL DHONE	ROLLNO-230329	19:51:11	2/3/2026
RAHUL DHONE	ROLLNO-230329	19:51:13	2/3/2026
RAHUL DHONE	ROLLNO-230329	22:05:43	2/3/2026
RAHUL DHONE	ROLLNO-230329	22:05:44	2/3/2026
RAHUL DHONE	ROLLNO-230329	22:05:45	2/3/2026
RAHUL DHONE	ROLLNO-230329	22:05:46	2/3/2026
RAHUL DHONE	ROLLNO-230329	22:05:46	2/3/2026
RAHUL DHONE	ROLLNO-230329	22:05:47	2/3/2026
RAHUL DHONE	ROLLNO-230329	22:05:48	2/3/2026

To enhance system reliability and prevent fraudulent attendance attempts, a **photo spoof detection module** is integrated into the system. In some cases, students may try to mark attendance by showing printed photographs or images on mobile screens. To prevent this, the system analyzes the **difference between consecutive camera frames**. If the system detects minimal or no movement between frames, it interprets the input as a static image and identifies it as a possible **photo spoof attempt**. In such situations, the system captures a screenshot and stores it in the **Spoof_Attempts** folder for further analysis. The event can also be recorded as **Fake_Attendance** in the system log.

The major observations obtained from the experimental results are summarized below:

- **Automatic Face Detection:** The system accurately detects faces from real-time webcam input.
- **Efficient Student Recognition:** Registered students are successfully identified through facial feature comparison.
- **Automated Attendance Recording:** Attendance is automatically stored in the Attendance.csv file with date and time details.
- **Unknown Person Detection:** The system identifies unregistered individuals and stores their images for monitoring purposes.
- **Absent Student Identification:** The system compares attendance records with the student list to determine absent students.
- **Parent Notification Mechanism:** SMS or email alerts can be generated to inform parents about student absence.
- **Photo Spoof Detection:** Static image attacks are detected, and spoof attempts are recorded to prevent fake attendance.

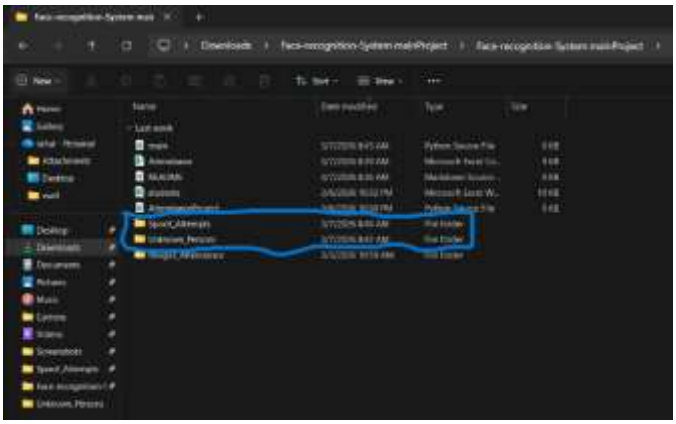
V. CONCLUSION

The **Intelligent Student Attendance Monitoring System Using Face Recognition** provides an efficient, secure, and automated solution for managing student attendance. Traditional attendance methods such as manual roll calls or paper-based registers are time-consuming, prone to human errors, and vulnerable to proxy attendance. By integrating **face recognition technology**, this system eliminates these limitations and ensures accurate and reliable attendance recording.

The system begins with a **webcam capturing real-time frames**, which are processed through **face detection and face encoding techniques**. The captured face is then compared with the stored facial database of registered students. When a match is found, the system automatically records the student's attendance in the **Attendance.csv file**, ensuring a quick and seamless process without any manual intervention. If the system detects a face that does not match any record in the database, it classifies the person as an **unknown individual** and saves the captured image in the **Unknown_Persons folder**.

This feature improves campus security by maintaining a record of unrecognized individuals who appear in front of the camera.

Another important feature of this system is the **spoof detection mechanism**, which helps prevent fraudulent attendance attempts. In many face recognition systems, students may attempt to mark attendance using printed photos or images on mobile screens. To address this problem, the system compares consecutive camera frames and calculates the **frame difference to detect movement**. If the system identifies a static image with minimal movement, it flags it as a **possible photo spoof attempt**. The system then captures a screenshot and stores it in the **Spoof_Attempts folder**, while also marking the attempt in the CSV record as **Fake_Attendance**. This functionality enhances the reliability and trustworthiness of the attendance system.



Overall, the proposed system combines **face recognition, automated attendance logging, unknown person detection, and spoof detection techniques** to create a smart and secure attendance monitoring solution. It reduces administrative workload, saves time during classroom sessions, and increases the accuracy of attendance records. Furthermore, the system strengthens institutional security by monitoring unknown individuals and preventing fake attendance attempts.

In conclusion, the **Intelligent Student Attendance Monitoring System Using Face Recognition** demonstrates how modern computer vision technologies can transform traditional academic processes into **smart, automated, and secure systems**, making it highly suitable for schools, colleges, and educational institutions in the digital era.

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