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Contactless Attendance Management Using AI-Based Face Recognition

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ABSTRACT

The Real-Time Face-Based Attendance System is a creative solution designed for attendance management systems. Conventional methods of attendance tracking, such as manual registers systems, are often prone to errors and fraud. This project addresses the challenges by giving a contactless, automated, and accurate approach to attendance management.The system is developed using Python and Django, an powerful web framework, and integrates it with facial recognition libraries such as OpenCV and FaceNet. It captures live video from a camera, detects faces in real-time, and matches them against a pre-registered database of students. Once the student is authorized , attendance is automatically recorded in the SQLite database. The system is sensitive to lighting conditions and partial facial blurring which impact on system accuracy. Besides all the errors, experimental results indicate that the model is achieving 95% accuracy under controlled conditions which makes the system reliable and easy to use.

I. INTRODUCTION

In today's fast-growing world of technology regular tasks are performed by using modern systems, including attendance marking in schools. Typical methods of marking attendance manually have some fundamental limitations like they fail to capture real-time analysis of data and attendance patterns, and thus administrators cannot maintain the attendance records of students with accuracy and convenience. To solve the problem of the manual attendance system, biometric systems recognition was introduced by providing greater precision and automation. Yet, these also have certain issues, for example, hygiene problems. Students sharing equipment, touching shared surfaces, results for continuous hardware maintenance which pose new risks and logistical challenges**.**

To overcome these constraints, facial recognition technology entered into a technological world which offers a practical and highly secure solution for attendance management. The Face Recognition Student Attendance System uses computer vision and artificial intelligence (AI) to mechanize the attendance process by identifying and recognizing students' faces in realtime. System guarantees accurate attendance marking without physical contact, reducing the possibility of fraud or manipulation while taking care of the health and safety issues. By comparing the facial features with a database of students' profiles, the system identifies students immediately and records their attendance. Face Recognition Student Attendance System fulfils the important demand for secure, efficient, and accurate attendance management in schools. With the latest technology, the system eliminates human error, reduces physical contact, and offers real-time data analysis, an enhancement over the current attendance process. The purpose of this project is to revolutionize attendance monitoring systems, ensuring more security and convenience for both staff and students.

II. LITERATURE REVIEW

Face recognition-based attendance systems are an effective way to track student attendance. Time consumption, fraud vulnerability, and reliance on external equipment are some of the disadvantages of classic manual procedures. In order to get out of these problems, recent research has concentrated on putting automatic attendance systems with facial recognition into place.

Rusdi et al. developed a facial recognition student attendance system based on MATLAB and computer vision to increase efficiency and accuracy. They prioritized automated attendance and acknowledged its importance as a part of the educational system [1]. Chowdhury et al. have proposed that 92% of the students were identified by the automatic attendance system, which was able to detect and recognize many individuals simultaneously in real time. Their study showed how deep learning-based facial recognition may aid with attendance by lowering errors [2]. Jayant et al. use revised face recognition methods for attendance with the modified algorithm for face detection. Attendance data were automatically updated in an Excel file , which led to reduced manual work and increased efficiency of the attendance system [3]. An attendance system was created by Dubey et al. with the aim of reducing proxy attendance using facial recognition on video streaming and saving video clips for future use [4]. Balcoh et al. have focused on some of the most difficult problems, such as severe changes in lighting and rotation of the head, which are much harder to solve [5]. Yang Tao et al. have a lot of perspectives and develop an intelligent system to facilitate automatic class attendance, especially in educational institutions [6]. Lee et al. have used local binary patterns and histogram equalization to enhance facial recognition performance under various lighting conditions in the system [7]. In terms of accuracy and speed, Kadambari et al. have found that deep learning face recognition techniques like Convolutional Neural Networks (CNNs) outperformed more conventional approaches like Histogram of Oriented Gradients (HOG) methods [8]. Akay et al. have evaluated the effectiveness of the HOG and HearCascade methods and discovered that the CNN method performs significantly better for face detection, particularly when it comes to student systems in classrooms [9]. Sawhney et al. used PCA (Principal Component Analysis) and CNN for improved student identification. Their strategy combined real-time facial recognition with an existing student database to minimize errors [10]. Salim et al. developed systems using local binary patterns (LBP) and Raspberry Pi. The system combined restriction of perceived student door-controlled access to enter the class. The student

presence brand of MySQL databases used by the web server was run with 95% accuracy [11]. Using FaceNet and Multitask Cascaded Convolutional Networks (MTCNN), Jose et al. implemented attendance systems on the Jetson TX2. Their system demonstrates the effectiveness of deep learning algorithms, especially when face recognition is done in real-time in multi camera situations [12]. Huang et al. used MTCNN and FaceNet to make an automated attendance system with face recognition features. They use GBDT model (gradient boosting decision tree) to enhance classification and accuracy [13]. Winarno et al. designed the system that combines CNN for feature extraction and PCA for dimension reduction to achieve accuracy between 90% and 98% [14]. Chintalapati et al. use Local Binary Sample Histogram (LBPH) and a support vector machine (SVM) for feature extraction and classification. Their system aims for real time recognition of students in the classroom to reduce fraudulent visitors and proxy attendance [15].

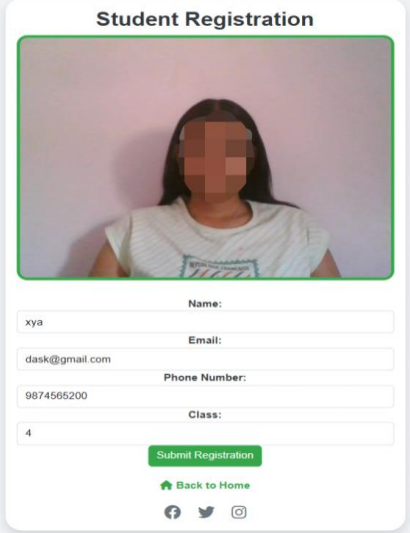
Overall, these studies demonstrate that face recognition technology, CNN-based approaches, significantly improve attendance management by automating the process, reducing errors, and eliminating the need for additional biometric devices. As deep learning and computer vision techniques continue to advance, face recognition systems are expected to become more accurate and widely adopted across educational and corporate sectors.

III. EXPERIMENTATION

Our project aims to automate the attendance process using face recognition technologies which ensures high accuracy, efficiency and security. It reduces manual efforts and proxy attendance.

1. Student Registration

The method uses an image of every pupil at time of registration & saves it to the database. With the help of a pre-trained Face Net model, it processes the image, extracts face traits and links them to the student's unique ID**.**



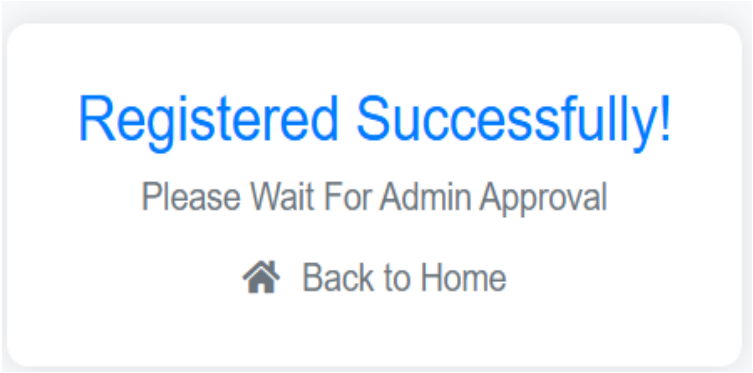


Fig 1- Student Registration Page

2. Authorization Process

The Authorization process system ensures that only students belonging to a specific class are or students who are authorized are allowed to mark attendance. When students check in to the class, the system verifies their identity against stored features. If student details are found in the database and the student is authorized, then attendance is marked automatically.

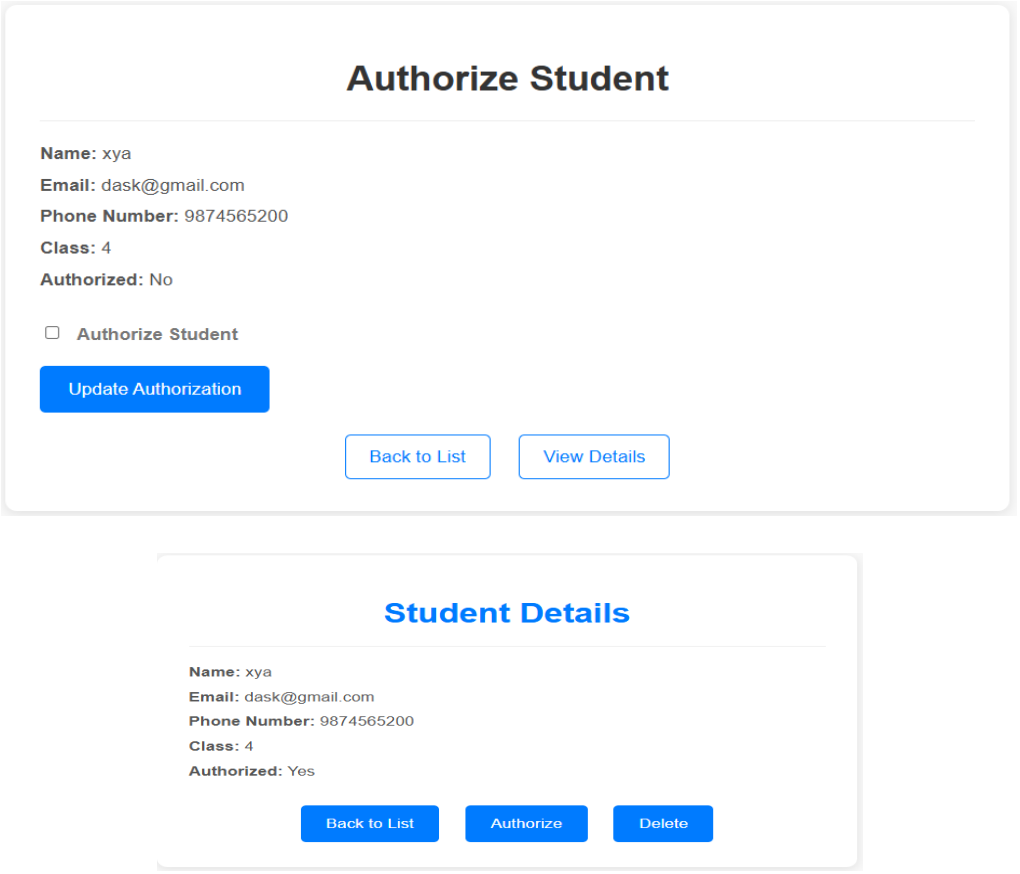


Fig 2- Authorization Page

3. Attendance Marking

Once the authorization is successfully done, the system records the attendance timestamp in the database. Attendance records are available and it allows for real-time tracking and analysis.

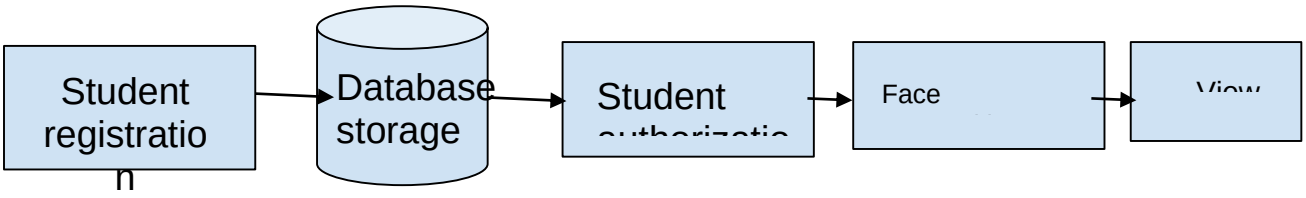


Fig 3- Flow diagram

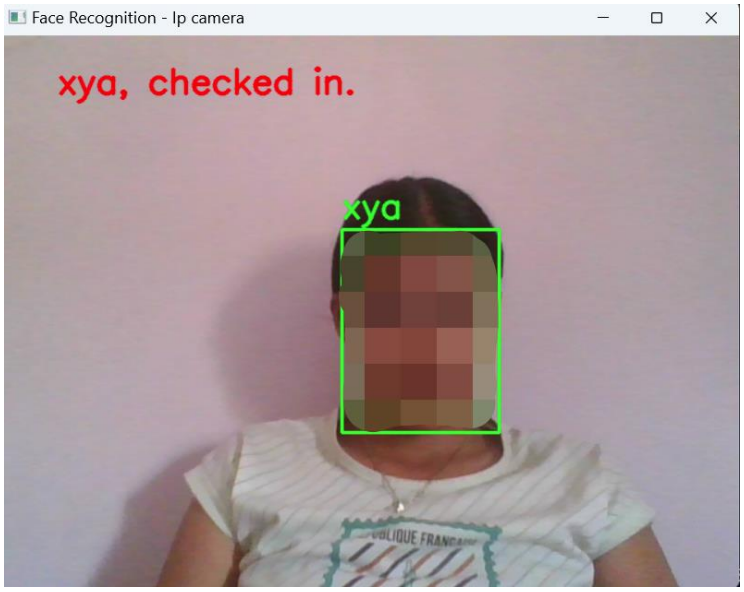


Fig 4- Marking Attendance

4. View Attendance

After successfully marking the attendance, students can view their attendance in real time from the system and they are unable to make changes in the attendance.

Fig 5- Attendance Record

Comparison between existing Researches

Algorithm Used	**Face-Net & OpenCV**	**Local Binary Pattern Histogram (LBPH) & Support Vector Machine** [15]	**CNN-based model** [1]	**Local Binary Pattern Histogram** [4]	**Principal Component** [5]
Recognition Accuracy	95% (with predefined models)	93%-95% (real-time video accuracy)	99% (CNN-based model)	98% (LBP + SVM)	85% (EigenFace method)
Processing Time	1.2 seconds per recognition	Varies based on distance from camera (4ft-7ft gives best results)	Optimized for real-time recognition	Fast (~1 second per recognition)	Slow processing due to image preprocessing steps

VI. RESULT AND DISCUSSION

The system obtained a 95% recognition accuracy with an average processing time of 1.2 seconds for each recognition in real-time. The system was tested under various lighting and obstruction conditions to ensure that it could respond to real-world educational environments. After testing it one observation is noticed that the system also detects and recognizes faces when the photo is displayed on a mobile screen. This behaviour was considered as a limitation which can be resolved in future. Besides this limitation the above fig 5 shows how well the system records attendance of students which reduces the need for manual attendance while maintaining a high accuracy rate. There are some factors which include partial facial blurring and insufficient light are being examined to improve model adjustments in the future. This method ensures that the system is dependable, scalable, and efficient for usage in real academic contexts.

V. CONCLUSION

The Face-Net based Face Recognition Student Attendance system has successfully automated the attendance taking process. It reduces the human errors and proxy attendance occurred during attendance time. The system effectively registers students' records by marking their attendance in real time. It is perfect for educational institutions since it achieves excellent accuracy and quick processing rates by using predefined models like FaceNet and OpenCV's module. Future enhancement could include mobile app integration and multi-angled face recognition for more accuracy.

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