FACETRACE: AI BASED STUDENT PRESENCE IDENTIFICATION SYSTEM

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Abstract: Attendance management is an important activity in schools and colleges because it helps institutions maintain proper academic records and monitor student participation during classes. Attendance tracking is necessary in educational institutions for maintaining student participation records and academic monitoring. Conventional methods such as roll calls, paper registers, RFID cards, and fingerprint devices are still used in many colleges, but these approaches require additional time and may sometimes lead to proxy attendance or recording mistakes. This paper presents FaceTrace, a facial recognition- based attendance system developed for automatic attendance marking. The proposed model uses OpenCV, DeepFace, and FaceNet to recognize students through a webcam feed. A liveness verification step based on head movement is also included to confirm physical presence before attendance is recorded. The system stores attendance information automatically along with timestamps using a Flask- based web application. During testing, the model was able to identify students effectively in real-time classroom conditions while reducing manual attendance handling. During testing, the system was able to record attendance correctly and reduce fake attendance attempts in classroom environments. The developed model can be used in classrooms to simplify attendance handling and reduce dependency on manual recording methods.

Keywords: **Face Recognition, FaceNet, DeepFace, OpenCV, Liveness Detection, Smart Attendance System, Artificial Intelligence, Computer Vision.**

I. INTRODUCTION

Attendance management is an important activity in schools and colleges because it helps faculty maintain participation records and evaluate student involvement during academic sessions. In many classrooms, attendance is still recorded manually using paper registers or roll calls. This process takes classroom time and may sometimes result in errors while maintaining records.

Some institutions use RFID cards or fingerprint devices for attendance monitoring. However, RFID cards can be exchanged between students, and fingerprint scanners require physical contact and dedicated hardware support. These limitations have encouraged the use of automated biometric systems in educational environments.

In recent years, many institutions have started using face recognition systems because they can identify users quickly without physical contact. Facial recognition is considered convenient because it works without physical contact and can operate in real-time environments. Deep learning models such as FaceNet can generate facial feature representations that help identify individuals under different lighting conditions and facial expressions.

Different studies have explored the use of machine learning and image processing for automatic attendance marking. Although many of these systems automated attendance successfully, some were still vulnerable to spoofing attacks involving photographs or prerecorded videos.

To address these issues, the FaceTrace system combines facial recognition with liveness verification techniques for secure attendance marking.

To overcome these challenges, this project proposes FaceTrace, an AI-based student presence identification system using face recognition and liveness detection.
The FaceTrace system integrates OpenCV, DeepFace, and the FaceNet deep learning model for real-time face detection and recognition through webcam streams. The FaceNet model generates facial embeddings for each detected face, and similarity between embeddings is measured using cosine similarity. The cosine similarity between two facial embeddings is calculated using Equation (1).

$$\textbf{Cosine Similarity} = \frac{A.B}{\|A\|B\|} \qquad (1)$$

The system uses liveness verification through head movement analysis to confirm physical presence before marking attendance. Attendance records are automatically stored with timestamps using a Flask-based web application, improving accuracy, reducing manual effort, and enhancing security in smart classroom environments.

II. LITERATURE SURVEY

Sonali Antad and her team proposed a GPS-enabled facial recognition attendance system in 2025 using geofencing and Siamese Neural Networks for authentication. The system reduced proxy attendance and improved attendance reliability and transparency in educational institutions [1].

S.K. Abirami and her team developed an AI-based real- time attendance system in 2022 using OpenCV and TensorFlow for facial recognition and automated attendance management. Their study showed improved recognition efficiency, scalability, and reduced human errors compared to traditional methods [2].

J. Srikanth and his team proposed an AI-based multi-face recognition attendance system in 2024. Their system identified multiple students simultaneously in real-time classroom environments using AI and computer vision techniques. The study showed improved recognition speed and reduced classroom attendance time [3].

Swarnendu Ghosh and his team worked on a fingerprint- based attendance system integrated with Arduino and Bluetooth technology. Unlike facial recognition systems, their approach focused on secure biometric authentication through fingerprint verification. The system automatically recorded attendance and reduced attendance fraud using wireless communication and fingerprint sensors. The researchers concluded that the framework was affordable, portable, and suitable for improving attendance security in classrooms [4].

Virendra Swaroop Sangtani and his team proposed a smart attendance system using face recognition in 2023. Their system captured real-time images through webcams and performed face matching using computer vision algorithms. The framework reduced manual attendance work and improved attendance monitoring efficiency in educational environments [5].

Rama Krishna Peddarapu and his team developed a real- time attendance system in 2023 using OpenCV, Dlib, and CNN techniques for accurate face recognition. Their study showed improved recognition accuracy and reduced attendance errors under varying classroom conditions [6].

Suraj P. Madiwal and his team proposed a centralized smart attendance management system in 2025 using OpenCV, FastAPI, facial encoding techniques, and MongoDB. Their framework supported centralized attendance monitoring across multiple classrooms and campuses. Attendance records were stored automatically using centralized databases to improve scalability and accessibility. Their research showed that centralized monitoring systems improve security, eliminate proxy attendance, and simplify attendance tracking in large institutions [7].

Sarika Zaware and her team introduced a cloud-based attendance system in 2024 using OpenCV and Dlib ResNet models. Their study highlighted that cloud integration improved scalability, remote accessibility, and attendance management efficiency [8].

Arunendra Mani Tripathi and his team proposed a facial recognition attendance system using Principal Component Analysis and Artificial Intelligence techniques. Their implementation extracted facial features and reduced image dimensionality using PCA algorithms for efficient recognition performance. Their results showed that PCA- based recognition systems improve attendance accuracy and reduce attendance manipulation while maintaining reliable performance in classroom environments [9].

Rohit Talele and his team developed an attendance tracking system in 2024 using Haar Cascade and LBPH algorithms for real-time face recognition. Their framework improved recognition accuracy, processing speed, and reduced manual attendance errors [10].
Agustiyar and his team conducted a bibliometric review in 2026 focusing on attendance systems based on facial recognition technologies. Their research analyzed various studies involving Artificial Intelligence, deep learning, computer vision, and biometric authentication methods. The review highlighted rapid growth in automated attendance research and identified future opportunities for improving recognition accuracy, scalability, and attendance security in educational environments [11].

Shubh Agarwal proposed a face recognition attendance system in 2024 using Haar Cascade and LBPH classifiers. The system used image processing and machine learning techniques for automatic attendance generation and achieved good recognition accuracy [12].

Shivam Rawat and his team developed a smart attendance system in 2025 using OpenCV, KNN algorithms, Python, and Flask. Their framework provided real-time recognition, browser-based access, and automated attendance storage with improved accuracy and reduced manual effort [13].
The comparative analysis of previously reviewed face recognition attendance systems is given in Table1

Table 1: Comparative Analysis of Reviewed Face Recognition Attendance Research Papers

S.No	Research Paper	Technique/ Methodology	Recognition Accuracy	Real-Time Support	Anti-Proxy / Security	Database/ Cloud Support	Over all Score
1	Sonali Antad et al. (2025) [1]	Face Recognition + GPS Geofencing + Siamese Neural Network	Very High	High	Very High	Cloud Enabled	10
2	S.K. Abirami et al. (2022) [2]	AI-Based Facial Recognition using TensorFlow & OpenCV	High	High	Medium	Cloud Server	9
3	J. Srikanth et al. (2024) [3]	Multi-Face Recognition using AI Algorithms	Very High	Very High	High	Medium	10
4	Swarnendu Ghosh et al. [4]	Fingerprint-Based Smart Attendance using Arduino	Medium	Medium	High	Low	7
5	Virendra Sangtani et al. (2023) [5]	Face Recognition + Computer Vision Techniques	High	High	Medium	Medium	8

6	Rama Krishna Peddarapu et al. (2023) [6]	OpenCV + Dlib + CNN Real-Time Attendance	Very High	Very High	High	Medium	10
7	Suraj P. Madiwal et al. (2025) [7]	Facial Encoding + OpenCV + FastAPI + MongoDB	Very High	Very High	High	Very High	10
8	Sarika Zaware et al. (2024) [8]	Cloud-Based Face Recognition using Dlib ResNet	High	High	High	Very High	9
9	Arunendra Mani Tripathi et al. [9]	PCA + AI-Based Face Recognition	Medium	Medium	Medium	Low	7
10	Rohit Talele et al. (2024) [10]	Haar Cascade + LBPH Attendance System	High	High	Medium	Medium	8
11	Agustiyar et al. (2026) [11]	Bibliometric Review on Facial Recognition Systems	Medium	Low	Low	Medium	6
12	Shubh Agarwal (2024) [12]	Haar Cascade + LBPH Classifier	High	Medium	Medium	Low	8
13	Shivam Rawat et al. (2025) [13]	OpenCV + KNN + Flask Attendance System	High	High	Medium	Medium	8

III. FINDINGS

The literature survey shows that Artificial Intelligence, Computer Vision, and Deep Learning techniques have improved the efficiency and accuracy of attendance systems [4],[10]. Researchers used methods such as PCA, Haar Cascade, LBPH, CNN, KNN, Dlib ResNet, and Deep Learning algorithms for facial recognition and identity verification [6],[8],[9],[12]. Deep learning-based systems provided better recognition accuracy and real-time performance under different classroom conditions [2],[6].

Many existing systems lacked proper anti-spoofing mechanisms and were vulnerable to fake attendance using photographs or mobile screens [11].
Some systems also improved attendance management through cloud integration, centralized monitoring, and automated attendance storage [7],[8]. Real-time face recognition reduced manual work and improved classroom monitoring efficiency [3],[5]. However, security and fake attendance prevention remained important challenges in many existing systems [11].

The proposed FaceTrace system uses OpenCV, DeepFace, FaceNet, and liveness detection to improve attendance accuracy, security, and automated monitoring in educational institutions [7],[11],[13].
The performance comparison of the reviewed attendance systems is illustrated in Figure 1.

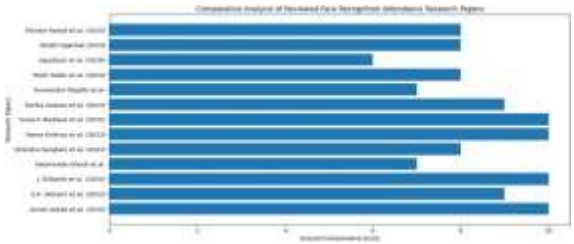

Figure 1: Comparative Analysis of Reviewed Face Recognition Attendance Research Papers.

IV. CONCLUSION

In this study, an AI-based attendance management system named FaceTrace was developed using OpenCV, DeepFace, and the FaceNet deep learning model for real- time facial recognition and automated attendance recording [6],[13]. The proposed framework integrated liveness verification using head movement analysis to reduce spoofing attempts through photographs, mobile screens, and video playback attacks [11]. Attendance records were automatically maintained with timestamps through a Flask-based web application for easier monitoring and management [13].

The FaceTrace system reduced manual effort, minimized proxy attendance, improved recognition accuracy, and enhanced attendance security when compared to traditional attendance methods [1],[5]. Experimental observations showed that combining deep learning-based face recognition with liveness verification provides a reliable, scalable, secure, and efficient attendance management solution suitable for educational institutions and biometric authentication environments [2],[6],[7].

V. REFERENCES

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