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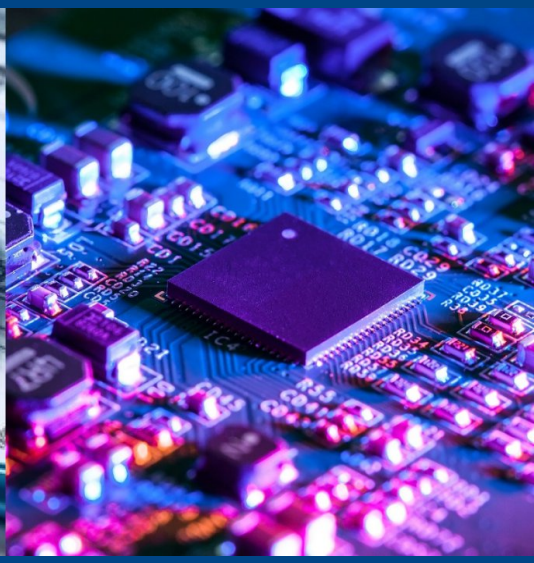

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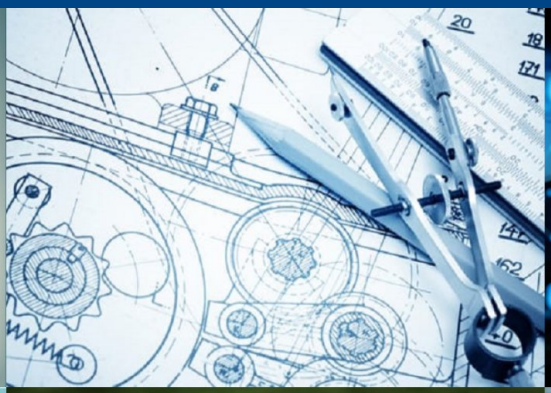

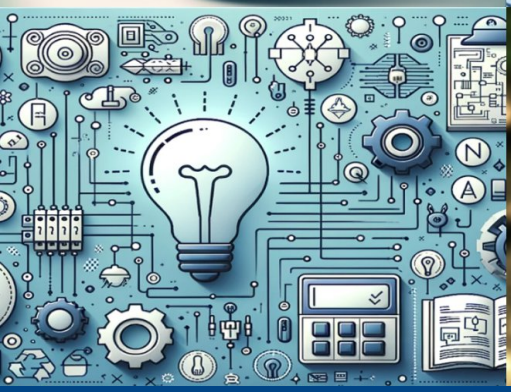

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Automated student attendance monitoring using facial recognition with real-time analytics

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ABSTRACT: This paper presents an Automated Student Attendance Monitoring System that leverages facial recognition technology to eliminate manual attendance marking and mitigate proxy attendance. The proposed system employs Multi-Task Cascaded Convolutional Networks (MTCNN) for robust face detection and FaceNet for generating 128-dimensional facial embeddings, matched against pre-enrolled student profiles using cosine similarity. An attendance event is triggered when the computed similarity distance falls below a defined threshold of 0.6. The system integrates a real- time analytics dashboard that visualises attendance trends, computes student-wise attendance percentages, and generates automated alerts for students whose attendance falls below the 75% institutional threshold. The backend is implemented using the Flask micro-framework, while the frontend is developed with HTML, CSS, and JavaScript. Experimental evaluation in realistic classroom environments confirms that the system operates effectively under standard indoor lighting, significantly reduces administrative workload, and provides accurate, timestamped attendance records with exportable CSV and PDF reports.

KEYWORDS: facial recognition; MTCNN; FaceNet; attendance monitoring; deep learning; analytics dashboard; Flask; cosine similarity.

I. INTRODUCTION

Student attendance is a critical metric in academic institutions, directly influencing academic performance, institutional compliance, and regulatory accreditation. Traditional manual attendance systems are inherently time-consuming, error-prone, and susceptible to proxy attendance — a practice in which one student marks attendance on behalf of another. These limitations impose significant administrative burdens on faculty and undermine the integrity of institutional records.

With advances in computer vision and deep learning, facial recognition has emerged as a reliable, non-intrusive biometric approach for automating attendance management. Convolutional Neural Network (CNN)-based architectures have demonstrated high accuracy in face detection and identification tasks, even under variable real-world conditions. Leveraging these advances, the present work proposes an Automated Student Attendance Monitoring System that integrates MTCNN-based face detection and FaceNet-based face recognition to deliver real-time, accurate, and tamper-resistant attendance recording.

Unlike prior works that address recognition accuracy in isolation, the proposed system additionally incorporates a comprehensive analytics dashboard, threshold-based alert mechanisms, and multi-format report generation within a unified web-based platform.The remainder of this paper is structured as follows: Section 2 reviews related literature; Section 3 identifies the research gap; Section 4 describes the proposed system architecture; Section 5 presents experimental results; Section 6 discusses future enhancements; and Section 7 concludes the paper.

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II. LITERATURE REVIEW

Facial recognition-based attendance systems have attracted considerable research interest in recent years. Santoso et al. [1] developed a decision support system using machine learning models for face recognition-based attendance, demonstrating improved recognition accuracy compared to conventional approaches. Lari et al. [2] proposed an efficient attendance management system for college environments using machine learning and facial recognition, achieving high detection rates under controlled settings.

Afiyanto et al. [3] conducted a reliability assessment of attendance systems under varying lighting conditions, revealing that illumination significantly impacts recognition performance and underscoring the necessity of robust preprocessing and adaptive thresholding in practical deployments. Bangare et al. [4] designed a smart automated attendance system using face recognition, reporting improved accuracy over conventional systems across multiple classroom environments.

Patel et al. [5] proposed enhancing classroom attendance using CCTV-based deep learning face recognition, demonstrating scalable recognition in larger environments. Kadam et al. [6] extended this by presenting a system capable of processing real-time group photographs using machine learning. Yadav [7] emphasised ease of deployment in a web-based system, while Ray [8] incorporated geolocation and real-time action logging to augment recognition with contextual data integrity.

Oshin et al. [9] implemented a class attendance system with an emphasis on deployment simplicity in resource-constrained environments. Agustiyar et al. [10] conducted a bibliometric review of face recognition for attendance systems, identifying emerging research trends including multi-modal biometrics, cloud integration, and liveness detection as critical future directions.

III. RESEARCH GAP

Despite extensive research in facial recognition-based attendance, several critical limitations persist in the existing literature. These gaps motivate the development of the proposed system:

- Most existing systems focus exclusively on face recognition accuracy without providing integrated analytics, visualisation dashboards, or automated reporting features, limiting their operational utility in institutional environments.
- Very few studies evaluate system performance under varying real-world classroom lighting and partial occlusion conditions, leaving practical deployment robustness largely unaddressed.
- Scalability analysis for large student databases and multi-class environments is largely absent from existing proposals, raising concerns about applicability at institutional scale.
- Threshold-based attendance alert mechanisms and automated report generation — essential for institutional compliance — are rarely incorporated into proposed systems.
- No existing single platform unifies real-time face recognition, an analytics dashboard, threshold-based alerting, and multi-format exportable report generation in an end-to- end deployable web solution.

The proposed system directly addresses all of these gaps by delivering a unified, web- based platform that integrates real-time facial recognition, student-wise analytics, automated alert notifications, and report generation with CSV and PDF export capabilities.

IV. PROPOSED SYSTEM

4.1 System architecture

The proposed system follows a modular, three-layer architecture. The Data Acquisition Layer captures classroom images via a connected camera interface. The Recognition Engine detects and identifies faces in real time using MTCNN and FaceNet. The Analytics and Reporting Layer processes attendance records and presents visualisations via a web-based dashboard. A schematic overview of the system architecture is presented in Fig. 1.

Fig. 1. Three-layer system architecture of the proposed automated attendance monitoring platform.

[Fig. 1: System Architecture Diagram — Insert Here]

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4.2 Face detection using MTCNN

The system employs Multi-Task Cascaded Convolutional Networks (MTCNN) for robust face detection under real-world classroom conditions. MTCNN is a lightweight deep learning framework that simultaneously performs face detection and facial landmark localisation through a cascade of three progressively refined convolutional networks: the Proposal Network (P-Net), which rapidly scans the image at multiple scales to generate candidate face regions; the Refinement Network (R-Net), which filters false candidates and refines bounding boxes; and the Output Network (O-Net), which performs final face localisation and five-point landmark detection for accurate facial alignment. This cascaded architecture achieves high detection accuracy while maintaining the computational efficiency required for real-time classroom deployment.

4.3 Face recognition using FaceNet

For face recognition, the system employs FaceNet [11], a deep convolutional neural network trained with a triplet loss function to learn a compact 128-dimensional Euclidean embedding space in which inter-embedding distances directly correspond to face dissimilarity. Each detected and aligned face region is passed through the FaceNet model to produce a 128- dimensional feature vector. The cosine similarity between the extracted embedding and each pre-stored student embedding is computed as:

$$\text{cosine\_similarity}(A, B) = (A \cdot B) / (\|A\| \times \|B\|) \quad (1)$$

where A and B are 128-dimensional embedding vectors, A·B denotes the dot product, and ‖·‖ denotes the L2 norm. An attendance event is triggered when the computed similarity distance between two embeddings falls below a threshold of 0.6, indicating a confirmed identity match. This threshold was empirically determined to balance recognition precision and recall under standard classroom conditions.

4.4 Student enrollment phase

Prior to attendance monitoring, each student undergoes an enrollment phase in which 5–10 face images are captured under varying poses, angles, and lighting conditions to ensure embedding diversity and representational robustness. FaceNet embeddings are extracted from each image and stored in a structured database alongside the student's institutional identifier, enrolled class section, and associated metadata. Multi-sample enrollment improves recognition robustness by providing a richer characterisation of intra-class facial variation. An overview of the enrollment and recognition pipeline is depicted in Fig. 2.

[Fig. 2: Enrollment and Recognition Pipeline — Insert Here]

Fig. 2. Student enrollment and real-time recognition pipeline illustrating MTCNN detection, FaceNet embedding extraction, cosine similarity matching, and attendance recording.

4.5 Real-time analytics dashboard

The analytics module processes stored attendance records to compute: student-wise cumulative attendance percentages; class-wise attendance trends over configurable time intervals; and threshold-based alert flags for students whose attendance falls below the 75% institutional minimum. Attendance data visualisations — including interactive bar charts and trend graphs — are rendered on the web frontend. The backend is implemented using the Flask micro-framework (Python), which exposes RESTful API endpoints to interface with the underlying database. The frontend is developed using HTML5, CSS3, and JavaScript, ensuring platform-independent browser accessibility without additional client-side installation.

4.6 Report generation

The system supports exporting attendance records in both CSV and PDF formats. CSV exports facilitate integration with institutional information management systems and support further statistical analysis, while PDF reports provide formatted, printable records suitable for official compliance and archival purposes. This dual-format export capability enables faculty members and administrators to maintain full compliance with institutional academic requirements without manual data transcription.

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Table 1. Feature comparison of the proposed system with representative existing approaches.

Feature	Santoso [1]	Lari [2]	Kadam [6]	Oshin [9]	Proposed
Real-time recognition	Yes	Yes	Yes	Yes	Yes

Feature	Santoso [1]	Lari [2]	Kadam [6]	Oshin [9]	Proposed
MTCNN + FaceNet	No	No	No	No	Yes
Analytics dashboard	No	No	No	No	Yes
Threshold alert mechanism	No	No	No	No	Yes
CSV / PDF export	No	No	No	No	Yes
Unified web-based platform	No	Yes	No	No	Yes

V. EXPERIMENTAL RESULTS

The system was evaluated in a realistic classroom environment with multiple concurrently present students. A structured assessment was conducted to validate recognition accuracy, attendance recording reliability, dashboard functionality, and alert generation under standard indoor conditions. The following outcomes were observed:

- The system successfully detected and recognised multiple student faces simultaneously from classroom images captured under standard indoor lighting.
- Attendance events were automatically marked with accurate timestamps, eliminating manual recording effort and transcription errors.
- Student-wise attendance percentages were correctly computed and dynamically visualised in the analytics dashboard in near real time.
- Daily attendance reports were generated reliably for each class session, covering all enrolled students with complete metadata.
- Attendance trend visualisations accurately reflected class participation patterns over multi-day observation periods, enabling early identification of at-risk students.
- Alert notifications were triggered correctly for all students whose cumulative attendance fell below the 75% institutional threshold.
- The FaceNet recognition model demonstrated effective performance under standard indoor lighting, with minimal false positives and false negatives observed.
- The end-to-end system significantly reduced administrative workload and improved attendance transparency for both faculty and students.

Overall, the proposed system demonstrated efficient real-time performance suitable for deployment in standard classroom environments. A summary of performance observations is presented in Table 2.

Table 2. Summary of observed system performance metrics during experimental evaluation.

Performance Metric	Observation
Face detection (standard lighting)	Effective — low false positive rate
Attendance timestamp accuracy	Accurate (real-time recording)
Attendance percentage computation	Correct for all enrolled students
Alert generation (sub-75% cases)	Triggered correctly in all cases

Performance Metric	Observation

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Report export (CSV and PDF)	Reliable across all sessions
Dashboard visualisation responsiveness	Responsive and accurate
Administrative workload reduction	Significant

VI. FUTURE ENHANCEMENTS

Several enhancements are planned to extend the capabilities and robustness of the proposed system:

- Integration of liveness detection to prevent spoofing attacks using printed photographs or pre-recorded video streams, thereby strengthening biometric security.
- Cloud-based deployment to support large-scale institutional use across multiple campuses and geographic locations using scalable infrastructure.
- Development of a mobile application interface for remote attendance monitoring, student self-service access, and real-time administrative notifications.
- Multi-camera support to achieve wider spatial coverage in larger lecture theatres and enable simultaneous monitoring across multiple classrooms.
- Incorporation of AI-based anomaly detection algorithms to identify suspicious attendance patterns and provide institutional security insights.

VII. CONCLUSION

This paper presented an Automated Student Attendance Monitoring System that integrates MTCNN-based face detection, FaceNet-based facial recognition, and a comprehensive real- time analytics dashboard within a unified, web-based platform. The system addresses key limitations of existing approaches by combining accurate, real-time recognition with automated reporting, threshold-based attendance alerts, and multi-format data export.The MTCNN cascade enables robust face detection across varying classroom conditions, while FaceNet's 128-dimensional embeddings matched via cosine similarity provide discriminative and computationally efficient identity verification. Experimental evaluation confirms the system's recognition accuracy, recording reliability, and practical utility in classroom environments. The proposed solution substantially reduces administrative burden while improving the transparency, integrity, and auditability of attendance management in academic institutions. Future work will focus on liveness detection, cloud scalability, and mobile integration to further broaden the system's real- world applicability.

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Data availability statement
The datasets generated and analysed during the current study are not publicly available due to institutional privacy constraints governing the use of student biometric data, but are available from the corresponding author on reasonable request and subject to appropriate data sharing agreements.

Author contributions
Kiruthika N: Conceptualisation, supervision, methodology, and review. Abdul Fathir F: System design, backend development, and experimental evaluation. Abdul Rahman S: Frontend development, dashboard implementation, and data curation. Ahamed Nazik R: Face recognition module development, testing, and validation. All authors reviewed and approved the final manuscript.

Conflict of interest statement
The authors declare that there are no conflicts of interest regarding the publication of this paper.

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REFERENCES

[1] J.T. Santoso, D. Manongga, and Hendry, Decision support system in machine learning models for a face recognition-based attendance system, TELKOMNIKA, 23, 371–381 (2025)
[2] A.Z. Lari, F. Khan, A. Ahmad, A.A. Raza, and M. Suaib, An efficient attendance management system for college environments using machine learning and facial recognition technology, Int.
J. Innovative Res. Comput. Sci. Technol., 13, 8–12 (2025)
[3] R. Afiyanto, E.D. Astuti, A.A. Kamal, and N.P.L. Santoso, Reliability assessment of attendance systems based on face recognition under varying lighting conditions, Int. Trans. Artif. Intell., 4, 25–37 (2025)
[4] S.L. Bangare et al., Design of face recognition based effective automated smart attendance system, Indonesian J. Elect. Eng. Comput. Sci., 38, 2020–2030 (2025)
[5] J. Patel, S. Gandhi, V. Katheriya, P. Pataliya, and A. Majumdar, Enhancing classroom attendance systems with face recognition through CCTV using deep learning, Procedia Comput. Sci., 258, 3031–3041 (2025)
[6] G.R. Kadam et al., Facial recognition-based classroom attendance system with real-time group photo processing using machine learning approach, in Proc. ICCSCE 2025, Atlantis Press, 1166– 1177 (2025)
[7] U. Yadav, A web-based facial recognition attendance system, Technical Report (2025)
[8] D. Ray, A face recognition based attendance system with geolocation and real-time action logging, Technical Report (2025)
[9] O. Oshin, J. Amenaghawon, F. Moninuola, and O. Idowu-Bismark, Class attendance system using facial recognition, Ingenierie des Systemes d'Information, 30, 1589 (2025)
[10] A. Agustiyar, R.R. Isnanto, and C.E. Widodo, Face recognition for attendance systems: a bibliometric review of research trends and opportunities, Jurnal Sisfokom, 15, 8–13 (2026)
[11] F. Schroff, D. Kalenichenko, and J. Philbin, FaceNet: A unified embedding for face recognition and clustering, in Proc. IEEE Conf. Comput. Vis. Pattern Recognit. (CVPR), 815–823 (2015)

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