IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940



International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 10, October 2026

DOI: 10.17148/IJARCCE.2026.1510122

AI-Based Smart Classroom Attendance System using Face Recognition with CCTV Camera

Praveen Kallappa Ullagaddi[1], Rahul K G[2], Vikhyath[3], Vishal Paramavva Madar[4], Prof. Pradeep Kumar K G[5]

B.E. Students, Department of Computer Science and Engineering,

Vivekananda College of Engineering & Technology, Puttur, Karnataka, India[1-4]

Professor, Department of Computer Science and Engineering,

Vivekananda College of Engineering & Technology, Puttur, Karnataka, India[5]

Abstract: Manual attendance in classrooms is time-consuming, error-prone and open to proxy marking. This paper presents an AI-based smart attendance system that uses a CCTV camera and face recognition to mark student attendance automatically. Live classroom video is split into frames, faces are detected and converted into numerical face encodings, and the encodings are matched against those of registered students. A recognised student is marked present with date and time, duplicate entries within a session are prevented, and unknown faces are ignored. Records are stored in MongoDB, and a web dashboard supports student registration, live attendance, and Excel report generation. Unit tests of ten core functions all passed. The system offers a contactless, low-cost and scalable alternative to manual roll calls.

Keywords: Face recognition, Smart attendance, CCTV, Computer vision, OpenCV, Artificial intelligence, MongoDB.

I. INTRODUCTION

Attendance records are central to academic discipline, yet most institutions still take them with paper registers or roll calls. This consumes lecture time, invites human error, and allows proxy attendance, which weakens the reliability of the records. Biometric and vision-based techniques can remove these limitations.

Face recognition is well suited to classrooms because it is contactless and needs no action from students. In the proposed system a CCTV camera installed in the classroom captures live video; the software detects faces, compares them with pre-registered student faces, and stores attendance automatically with the date and time. All records are digital, so teachers and administrators can retrieve and export them whenever required.

The main contributions of this work are: (i) an end-to-end pipeline from CCTV video capture to attendance storage, (ii) a duplicate-attendance check per session, (iii) a web interface for registration, live monitoring and report generation, and (iv) a modular design that can use a webcam, an IP camera or an RTSP CCTV stream.

II. LITERATURE REVIEW

Several authors have automated attendance with face recognition. Early systems used classical methods: Viola-Jones with Fisherfaces and GSM alerts [1], LBP-based classification on low-cost Raspberry Pi hardware [2], Haar cascades with a MySQL back end [4], and Haar cascades with LBPH histograms that ran in real time with minimal resources [9]. These work well under controlled lighting but degrade with pose changes, occlusion and low light.

Machine-learning and deep-learning approaches improved robustness. SVM classifiers with OpenCV [6], CNN-based matching [5], ResNet-based recognition with liveness detection [7], FaceNet embeddings [8], ArcFace embeddings [13], attention mechanisms for spectacles and partial occlusion [18], and MTCNN-based hybrid pipelines [19] report higher accuracy and speed. Multi-face detection with YOLO [12] allows many students to be marked at once.

Work on deployment aspects includes CCTV/RTSP-based monitoring [14], a low-cost CCTV setup [21], secure cloud storage of logs [17], proxy-resistant verification [11], notification and reporting support [16], database-backed analytics [10], [22], and surveys comparing face recognition with fingerprint and RFID [15], [23]. Table I summarises representative studies.

 This work is licensed under a Creative Commons Attribution 4.0 International License

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 10, October 2026

DOI: 10.17148/IJARCCE.2026.1510122

TABLE I. SUMMARY OF SELECTED RELATED WORK

Ref.	Method	Notable point
[1]	Viola-Jones + Fisherface	>90% accuracy; SMS alerts
[2]	LBP on Raspberry Pi	95% recognition; low cost
[5]	CNN matching	96% indoors; <2 s per face
[7]	ResNet + liveness	97% accuracy; anti-spoofing
[9]	Haar + LBPH	>30 FPS; light-weight
[12]	YOLO multi-face	40+ faces concurrently
[13]	ArcFace embeddings	98% on benchmarks
[14]	Face recognition + CCTV	93% accuracy; RTSP streams
[21]	Low-cost CCTV setup	92% accuracy; <$100

The gap addressed here is a practical, CCTV-based system that combines recognition, duplicate prevention, a database and a management dashboard in one open-source package.

III. METHODS AND MATERIALS

A. System Overview

The system has two stages: student enrollment and attendance recognition. During enrollment the Student ID/USN, name and class are entered and a facial image is captured. The face is detected and converted into a numerical face encoding, which is stored in the database against the student record. During an attendance session the CCTV stream is divided into frames, and each frame goes through detection, encoding and matching.

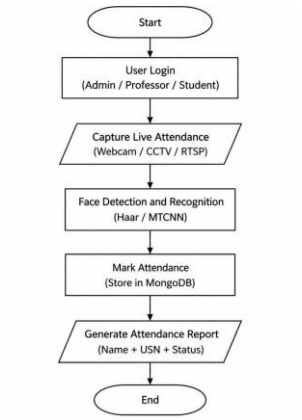


Fig. 1. Flowchart of the smart classroom attendance system.

B. Processing Pipeline

(1) Video capture: frames are read from a webcam, IP camera or RTSP CCTV stream using OpenCV. (2) Face detection: Haar cascade or MTCNN locates face regions in each frame, discarding the background. (3) Face encoding: each face is converted into a numerical feature vector (for example, from eye spacing, nose shape and overall structure). (4) Recognition: the vector is compared with stored encodings using a distance threshold; if no registered student matches, the face is labelled unknown and ignored. (5) Attendance marking: for a recognised student the system checks whether attendance is already recorded in the current session; if not, the Student ID, name, date and time are stored. (6) Reporting: records can be viewed on the dashboard or exported to Excel.

C. Users and Use Cases

Three roles are supported: Admin, Professor and Student (Fig. 2). The Admin manages students and timetable, configures settings, takes attendance and generates reports; the Professor takes attendance and generates reports; the Student can view attendance reports.

 This work is licensed under a Creative Commons Attribution 4.0 International License

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 10, October 2026

DOI: 10.17148/IJARCCE.2026.1510122

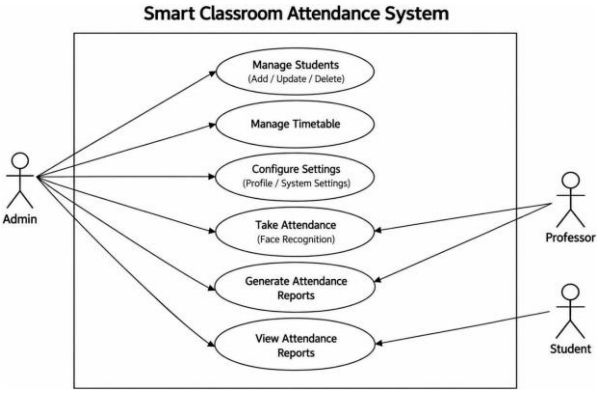


Fig. 2. Use case diagram.

D. Hardware and Software

Hardware: a classroom CCTV camera (IP camera needs a network link), and a computer for processing with sufficient storage for encodings and records. Software: Python, OpenCV for video and image processing, the face_recognition library with NumPy for encodings, MongoDB for student and attendance data, VS Code/PyCharm for development, on Windows or Linux. The camera should be placed so that students' faces are captured with enough clarity.

E. Requirements

Functional: real-time capture, simultaneous multi-face handling, automatic marking with date and time, secure storage, and report generation. Non-functional: accuracy, real-time performance, reliability, usability for non-technical staff, scalability as the database grows, and maintainability.

IV. IMPLEMENTATION

The application connects the recognition module to the database so that a recognised student's record is retrieved and attendance is stored automatically. Recognition threshold, camera resolution, frame-processing rate and the duplicate check are configurable, and were calibrated by testing so that attendance is recorded only for valid matches.

The web interface consists of a dashboard, live attendance, student management, student registration, analytics and report pages. The dashboard (Fig. 3) shows total students, present and absent counts and attendance rate, with a seven-day overview chart. The live attendance page (Fig. 4) shows the camera feed, the recognition result and current-session counts, with controls to start and stop the camera. The report page (Fig. 5) exports attendance records, with student name, USN, date, time and status, from MongoDB to an Excel file.

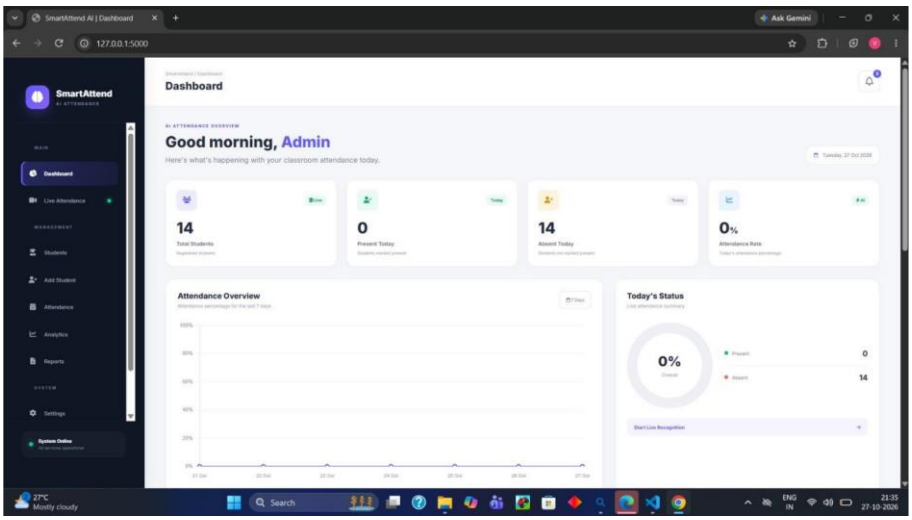


Fig. 3. Dashboard of the SmartAttend application.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 10, October 2026

DOI: 10.17148/IJARCCE.2026.1510122

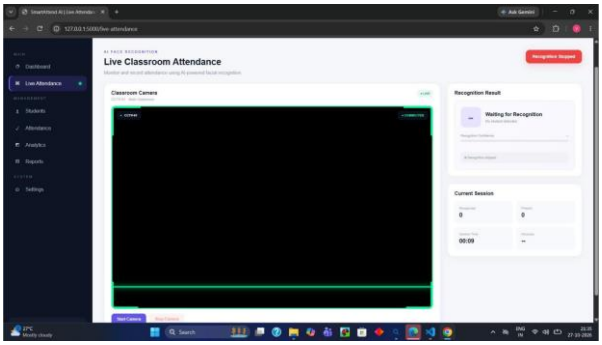


Fig. 4. Live classroom attendance module.

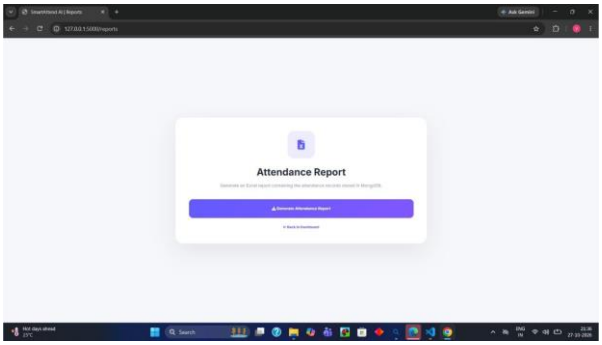


Fig. 5. Attendance report generation page.

V. RESULTS AND DISCUSSION

The system was tested at unit, integration, functional, system and acceptance levels. Unit tests exercised each module separately; the results are in Table II. All ten test cases passed, including rejection of unknown faces and prevention of duplicate entries.

TABLE II. UNIT TEST CASES AND RESULTS

ID	Test case	Expected outcome	Result
1	Student registration	Details accepted and stored	Pass
2	Face capture	Valid face image captured	Pass
3	Face detection	Face detected in input image	Pass
4	Face encoding	Valid encoding generated	Pass
5	Face matching	Registered face matches	Pass
6	Student identification	Correct ID and name found	Pass
7	Unknown face handling	Not assigned to a student	Pass
8	Attendance marking	Recognised student marked present	Pass
9	Duplicate check	No second entry in a session	Pass
10	Database storage	Attendance stored correctly	Pass

 This work is licensed under a Creative Commons Attribution 4.0 International License



International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 10, October 2026
DOI: 10.17148/IJARCCE.2026.1510122

Integration and system tests confirmed correct data flow from CCTV capture through detection, recognition, attendance and database storage. System tests covered a single student, multiple students, different positions and orientations, varied lighting, registered and unregistered faces, repeated appearances, and temporary camera or network faults. Acceptance testing verified correct stored records, dashboard counts, and Excel reports whose names, USNs, dates, times and statuses matched the database.

Limitations: recognition accuracy depends on camera quality, placement, lighting and face angle, and large-scale accuracy figures have not yet been measured on a full class. Face recognition alone does not completely prevent proxy attendance, since a photograph or video could be shown to the camera; anti-spoofing is therefore needed.

VI. CONCLUSION AND FUTURE WORK

An AI-based smart attendance system using face recognition and a CCTV camera was developed. It automates enrollment, detection, encoding, recognition and attendance recording, avoids duplicate entries, stores records in a database and exports reports, reducing manual effort and classroom time.

Future work includes multiple cameras for larger rooms, stronger deep-learning models for pose and low-light robustness, anti-spoofing/liveness detection, cloud storage and analytics, a mobile app with notifications, role-based access control, automatic attendance-percentage calculation, a student portal, and integration with college management systems.

REFERENCES

[1]. S. John, A. Joseph, and R. Mathew, “Face Recognition Attendance System with GSM Notification,” Int. J. Eng. Res. Technol. (IJERT), vol. 8, no. 5, pp. 112–116, May 2019.
[2]. P. P. M. S. Thilakarathna, D. Perera, and K. Silva, “Automated Smart Attendance System Using Face Recognition,” Int. J. Comput. Appl., vol. 177, no. 12, pp. 20–25, Feb. 2020.
[3]. G. Rao, S. Kulkarni, and P. Sharma, “Automated Attendance System Using Facial Recognition Technology,” Int. J. Adv. Comput. Sci. Appl. (IJACSA), vol. 11, no. 4, pp. 310–315, Apr. 2020.
[4]. R. Kumar, V. Singh, and M. Patel, “Smart Classroom Attendance System Based on Face Recognition,” Int. J. Sci. Res. Comput. Sci. Eng. Inf. Technol., vol. 6, no. 3, pp. 45–50, Jun. 2020.
[5]. P. Sharma, A. Verma, and S. Gupta, “Real-Time Face Recognition Attendance System for Educational Institutions,” Int. J. Innov. Technol. Explor. Eng. (IJITEE), vol. 9, no. 7, pp. 1012–1018, May 2020.
[6]. H. Singh, R. Kaur, and D. Sharma, “Face Recognition-Based Attendance System Using OpenCV and Machine Learning,” Int. J. Eng. Adv. Technol. (IJEAT), vol. 9, no. 5, pp. 2250–2255, Jun. 2020.
[7]. K. Patel, S. Mehta, and R. Shah, “Deep Learning-Based Attendance System Using Facial Images,” Int. J. Comput. Vision Robot., vol. 10, no. 2, pp. 150–158, Aug. 2021.
[8]. M. Ahmed, T. Khan, and A. Ali, “AI-Based Attendance System Using Live Camera Input,” Int. J. Adv. Res. Artif. Intell., vol. 10, no. 1, pp. 55–61, Jan. 2021.
[9]. S. Verma, P. Yadav, and R. Mishra, “Smart Attendance System Using Haar Cascade and LBPH,” Int. J. Comput. Sci. Mob. Comput., vol. 9, no. 6, pp. 80–86, Jun. 2020.
[10]. Nair, P. Menon, and S. Krishnan, “Automated Attendance Model Using Facial Recognition and Database Integration,” Int. J. Eng. Sci. Comput., vol. 10, no. 8, pp. 26789–26795, Aug. 2020.
[11]. V. Reddy, K. Rao, and P. Kumar, “Proxy-Resistant Attendance System Using Face Recognition,” Int. J. Emerg. Technol. Comput. Sci. Electron., vol. 12, no. 4, pp. 98–104, Sep. 2021.
[12]. F. Khan, A. Siddiqui, and M. Rahman, “Real-Time Attendance Monitoring System Based on Multi-Face Detection,” Int. J. Comput. Appl., vol. 176, no. 22, pp. 10–16, Mar. 2021.
[13]. S. Das, R. Paul, and T. Ghosh, “Attendance System Using Deep Learning and Face Embeddings,” Int. J. Adv. Comput. Sci. Appl. (IJACSA), vol. 12, no. 5, pp. 220–227, May 2021.
[14]. H. Ibrahim, M. Yusuf, and A. Kareem, “Classroom Attendance Solution Using Face Recognition and CCTV Input,” Int. J. Image Graph. Signal Process., vol. 13, no. 3, pp. 45–52, Jun. 2021.
[15]. R. Chandra, S. Naik, and P. Joshi, “Review of Biometric Attendance Techniques for Smart Classrooms,” Int. J. Comput. Eng. Technol. (IJCET), vol. 11, no. 7, pp. 70–78, Jul. 2020.
[16]. J. Jose, M. Thomas, and A. Francis, “Face Recognition Attendance System with Notification Support,” Int. J. Innov. Res. Sci. Eng. Technol. (IJIRSET), vol. 10, no. 9, pp. 9450–9457, Sep. 2021.
[17]. S. Ali, N. Hussain, and T. Mahmood, “Secure Attendance System Using Facial Biometrics and Cloud Storage,” Int. J. Cloud Comput. Serv. Archit., vol. 11, no. 2, pp. 15–22, Apr. 2021.

 This work is licensed under a Creative Commons Attribution 4.0 International License



International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 10, October 2026
DOI: 10.17148/IJARCCE.2026.1510122

[18]. D. Roy, P. Sen, and A. Dutta, "Attendance System Using Deep Face Recognition for Classroom Automation," Int. J. Mach. Learn. Comput., vol. 11, no. 6, pp. 510–517, Dec. 2021.
[19]. B. Thomas, R. George, and S. Mathew, "Hybrid Face Detection and Recognition Model for Smart Classrooms," Int. J. Adv. Trends Comput. Sci. Eng., vol. 10, no. 4, pp. 2750–2756, Aug. 2021.
[20]. Mehta, R. Jain, and P. Agarwal, "Face Recognition-Based Student Attendance System Using Machine Learning Classifiers," Int. J. Comput. Appl. Technol. Res., vol. 10, no. 5, pp. 120–126, May 2021.
[21]. R. Gupta, V. Sharma, and K. Mishra, "Low-Cost Automated Attendance System Using CCTV Camera and Facial Recognition Software," Int. J. Eng. Res. Technol. (IJERT), vol. 10, no. 7, pp. 300–306, Jul. 2021.
[22]. J. Lee, H. Kim, and S. Park, "Attendance Monitoring System Integrating Face Recognition with Student Database," Int. J. Smart Home, vol. 15, no. 3, pp. 33–40, Mar. 2021.
[23]. M. Hasan, A. Rahman, and S. Karim, "Artificial Intelligence Applications in Attendance Management Systems: A Review," Int. J. Artif. Intell. Appl. (IJAIA), vol. 12, no. 4, pp. 55–67, Jul. 2021.
[24]. P. Johnson, R. Walker, and M. Hall, "Real-Time Class Attendance System Using Deep Learning-Based Face Recognition," Int. J. Comput. Vision Pattern Recognit., vol. 5, no. 2, pp. 88–96, Feb. 2022.
[25]. L. Fernandes, K. Dsouza, and R. Pinto, "Automated Student Attendance Solution Using Face Detection and Recognition Pipelines," Int. J. Innov. Sci. Res. Technol. (IJISRT), vol. 7, no. 1, pp. 400–408, Jan. 2022.

 This work is licensed under a Creative Commons Attribution 4.0 International License