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Smart Classroom Management Software for Enhanced Learning Environments.

Ms. Sakshi Umakant Chaudhari[1], Asst. Prof. Sapana A. Fegade[2]

Research Scholar, Department of Computer Applications, Shramsadhana College of Engineering & Technology Jalgaon.MH, India[1]

Asst. Professor, Department of Computer Applications, Shramsadhana College of Engineering & Technology Jalgaon.MH, India[2]

Abstract: Smart classroom technology is increasingly used to support teaching, attendance, communication, and classroom resources. However, many institutions still manage these activities through separate tools or manual procedures. This paper proposes Smart Classroom Management Software (SCMS) as a centralized platform for administrators, teachers, and students. The system combines attendance, timetable management, learning resources, announcements, student information, and basic analytics. Optional AI and IoT features can support attendance and classroom monitoring, while teacher verification and privacy controls remain important. Recent 2025–2026 research shows growing use of computer vision, IoT, AI-based behaviour analysis, and smart classroom interoperability. Based on this literature, the proposed system focuses on practical integration rather than a single feature. A design-oriented mixed-method approach is proposed, using questionnaires, interviews, task-based testing, and measures such as attendance accuracy, task completion time, usability, and response time. The paper presents a research-ready model and evaluation plan and does not invent experimental results that have not yet been collected.

Keywords: Smart classroom, classroom management software, artificial intelligence, Internet of Things, attendance, learning analytics, classroom monitoring, privacy, learning environment

INTRODUCTION

Smart classroom technology is becoming an important part of modern education. Traditional classroom activities such as attendance, timetable management, sharing learning materials, announcements, and maintaining student records are often managed separately. This can increase the workload of teachers and make classroom information difficult to manage.

A smart classroom provides a technology-based environment where software and connected devices can support regular teaching and learning activities. Smart Classroom Management Software (SCMS) can combine different classroom functions into one platform. It can help teachers manage attendance, schedules, learning resources, announcements, student information, and basic academic records.

Attendance management is an important classroom activity. Manual attendance requires regular effort from teachers and may interrupt the teaching process. With the support of artificial intelligence and computer vision, attendance can be assisted automatically. IoT devices can also provide additional information about classroom conditions when required.

The proposed Smart Classroom Management Software focuses on providing a centralized platform for classroom management. The system provides different access for administrators, teachers, and students according to their roles. It aims to reduce routine work, improve access to classroom information, and support teachers in managing classroom activities more effectively.

This paper presents the design, methodology, and evaluation plan of the proposed SCMS. The system is designed to support teachers rather than replace their decisions, especially when automated features such as attendance are used.

The main objective of this study is to design a centralized Smart Classroom Management Software that simplifies classroom management through a single platform. The proposed system aims to improve attendance management, timetable and resource handling, communication, and access to student information while providing optional support for AI- and IoT-based classroom functions.

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REVIEW OF LITERATURE

The development of smart classroom systems has received increasing attention with the use of artificial intelligence (AI), Internet of Things (IoT), computer vision, and data-based technologies in education. Recent studies have focused on improving classroom management, attendance monitoring, student engagement, classroom environment monitoring, and interoperability between educational systems. The following studies provide the background for the proposed Smart Classroom Management Software.

Firodiya et al. [1] (IEEE, 2025) presented a study on Smart Classroom Management Software for enhanced learning environments. The study discussed the use of AI, machine learning, and IoT for smart classroom activities, including attendance and timetable-related functions. The work is closely related to the proposed system because it considers classroom management through technology. The present work focuses on a centralized role-based platform in which common classroom activities are integrated and automated attendance remains under teacher verification.

Fütterer et al. [2] (2025) presented a systematic review of artificial intelligence in classroom management. The study examined educational purposes, technical implementations, and ethical considerations. The review showed that AI can be used for activities related to student attention, behaviour, and engagement. It also highlighted concerns related to responsible use of AI in education. These findings are relevant to the proposed system because AI features should support teachers without removing human control.

Murudi et al. [3] (IEEE, 2026) proposed an IoT-enabled Smart Classroom Management System using Raspberry Pi. The system used camera-based techniques for classroom attendance. Their work shows that low-cost hardware can be used for smart classroom applications. However, camera-based attendance can be affected by classroom conditions. The proposed system therefore uses automated attendance as a proposed feature that can be checked by the teacher.

Figueroa et al. [4] (2026) proposed a smart classroom ontology to improve interoperability in learning environments. Their work considered different classroom components, including people, resources, sensors, and learning systems. Interoperability is important when multiple technologies are used in one classroom platform. The proposed SCMS therefore follows a modular design that can support additional AI and IoT components.

Llurba et al. [5] (2026) reviewed the applications and dimensions of AI in smart classrooms. Their study considered technological, pedagogical, and environmental aspects and discussed the role of teachers. The study indicates that AI can support several classroom activities, but teachers continue to play an important role. This supports the teacher-in-the-loop design used in the proposed SCMS.

Abozeid et al. [6] (2026) investigated intelligent recognition of student behaviour in smart learning environments. Their work demonstrates the potential of AI and computer vision for understanding classroom behaviour. However, automated recognition can be sensitive because incorrect interpretation may affect students. Therefore, advanced recognition is considered optional in the proposed system.

Firdaus et al. [7] (2026) developed a Smart Classroom Monitoring System using IoT and AI for improving space utilization in higher education. The system considered classroom occupancy and environmental information. Their study shows that IoT and AI can support classroom monitoring and resource management. The proposed SCMS considers similar technologies as optional extensions to the core classroom management functions.

Hossain et al. [8] (2026) reviewed AI and IoT applications for classroom interactivity and student engagement. Their study indicates that connected technologies can support more interactive educational environments. This supports the idea of extending classroom management software beyond administrative tasks while maintaining a simple core platform. Nguyen et al. [9] (IEEE, 2021) proposed an automated classroom attendance system using AI and IoT technology. Their work demonstrates the use of technology for reducing manual attendance work. Attendance automation is also considered in the proposed SCMS. However, the proposed system includes a teacher review stage before attendance is finally stored. Kaur and Bhatia [10] (IEEE, 2024) presented a review and research agenda for smart classrooms. Their work provides a broader view of smart classroom technologies and identifies the need for continued research in this area. The study supports the development of systems that combine technology with practical classroom requirements.

Batista et al. [11] (2022) investigated the deployment of low-cost sensors for context-aware smart classrooms. Their work shows that sensors can be used to collect information about classroom conditions. Such sensors can be integrated into future versions of SCMS for occupancy and environmental monitoring.

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Tagliabue et al. [12] (2021) studied data-driven indoor air-quality prediction in educational facilities using an IoT network. Their research demonstrates how IoT data can support environmental monitoring in educational spaces. Although environmental monitoring is not part of the core SCMS, it can be considered a future extension.

From the reviewed studies, it can be seen that AI, IoT, computer vision, and sensors have been applied to different smart classroom activities. However, many systems concentrate on individual functions such as attendance, behaviour recognition, environmental monitoring, or space utilization. The proposed SCMS brings common classroom management functions together in one platform and allows advanced technologies to be integrated as optional modules. Teacher verification is also included to provide human control over automated attendance.

METHODOLOGY

This section outlines the operational framework, architecture, and procedural design of the proposed SCMS.

Research Design

The study follows a design-oriented mixed-methods research approach. The design-oriented component is used to define the proposed software architecture, modules, data flow, and interaction between users and system components. The mixed-method component is included in the planned evaluation because both quantitative and qualitative information are required to understand system performance and usability.

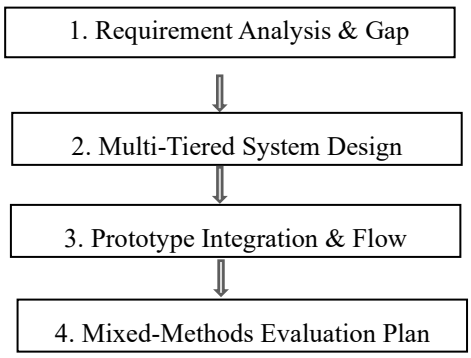

Figure 1: Research Design

Data Collection Methods

The proposed evaluation will use both primary and secondary data.

Primary Data:

Primary data for the proposed study may be collected directly from students and faculty members through questionnaires and semi-structured interviews. The data may focus on system usability, speed, accuracy, ease of learning, and common problems faced while using classroom management systems. Task completion records, system performance logs, and teacher-verified attendance records may also be used to evaluate the proposed SCMS. This data will help assess the usability, functionality, and practical effectiveness of the system.

Secondary Data:

Secondary data for the proposed study may be collected from published research papers, existing classroom schedules, relevant benchmark datasets, system documentation, and existing institutional procedures. Recent studies published between 2021 and 2026 will be reviewed to understand existing smart classroom management systems, AI and IoT applications, automated attendance methods, and related technologies. This information will support the design and development of the proposed Smart Classroom Management Software.

Research Tools, Instruments, and Architecture

The proposed SCMS is designed using a computer or laptop, webcam, and optional IoT sensors as hardware components. Python is considered the main programming language, while HTML, CSS, JavaScript, and a suitable web framework are considered for the web interface. OpenCV and compatible face-recognition libraries can be used for the optional AI-based attendance feature. The system can use MySQL, PostgreSQL, MongoDB, or SQLite for database management and a REST API for communication between the front end, backend, and database. Role-Based Access Control (RBAC) is used to manage access according to user roles. For evaluation, questionnaires, interviews, system logs, task completion time, response-time measurements, and accuracy metrics are considered. The system architecture connects the user interface, application backend, REST API, and database, with optional AI and IoT components integrated into the system.

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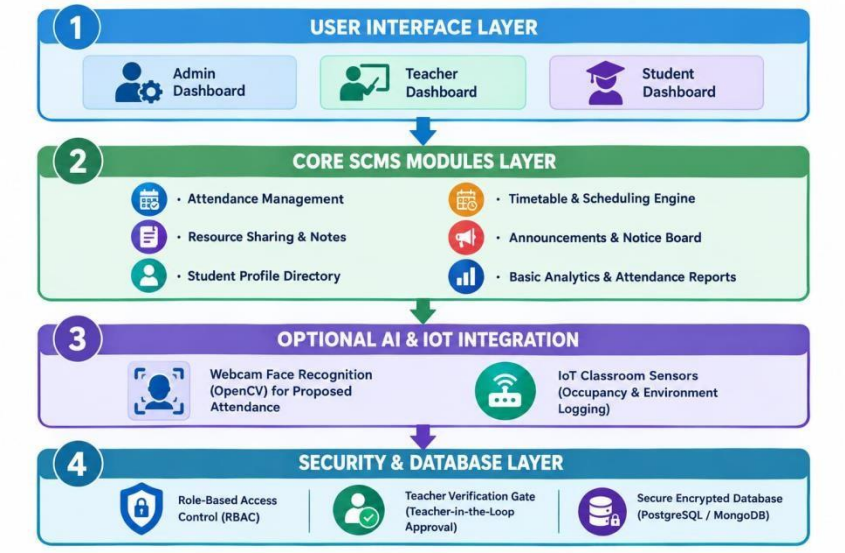

Figure 2: System Architecture of the Proposed SCMS

Sampling Procedure

The proposed evaluation will use purposive sampling. Approximately 50 students and 5 faculty members may be selected from two classroom environments for future prototype evaluation. The participants will be used to assess software usability, functionality, and detection performance under different classroom conditions.

Data Analysis & System Workflow

Quantitative evaluation relies on standard confusion matrix metrics (Accuracy, Precision, Recall) for computer vision tasks, alongside task completion time analysis. Qualitative feedback is transcribed and categorized using thematic analysis.

The execution logic follows a strict Teacher-in-the-Loop sequence: Login → Role Verification → Dashboard Initialization → Automated Capture (Optional) → Proposed Attendance Draft → Teacher Review/Edit → Final Manual Approval → Database Commitment → Student Portal Update.

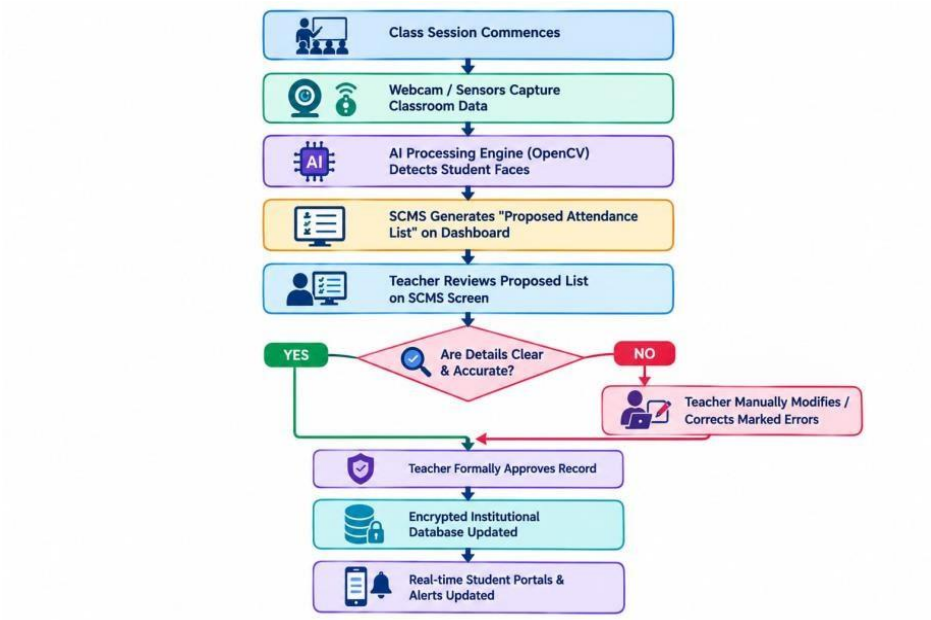

Figure 3: Teacher-in-the-Loop Attendance Workflow

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RESULTS

The proposed system has not yet undergone a completed controlled experiment; therefore, this paper does not report measured numerical results. Instead, the following evaluation framework identifies the measures that will be used to assess the system after prototype implementation.

Measure	Evaluation Method	Expected Result
Attendance accuracy	Compare system output with teacher-verified records	Fewer recording errors
Administrative time	Measure selected tasks before and after SCMS use	Reduced routine workload
Usability	5-point questionnaire and interviews	Positive user feedback
Response time	Measure common dashboard/database operations	Acceptable classroom response
Information access	Task test for finding materials and announcements	Faster access

Table 1: Proposed Evaluation Framework for SCMSs

The evaluation framework indicates that the proposed SCMS will be assessed from both system performance and user experience perspectives. Attendance accuracy and response time will provide quantitative information about system performance, while task completion time and usability feedback will help understand the practical benefits of the system. The results obtained from future prototype testing will be used to determine whether SCMS can effectively support routine classroom management activities.

DISCUSSION

The proposed Smart Classroom Management Software provides a centralized approach to managing common classroom activities. By combining attendance, timetable management, learning resources, announcements, and student information in one platform, the system can make classroom management more organized and convenient for teachers and students.

The use of optional AI and IoT features can further improve the system by supporting automated attendance and collecting classroom information. However, these features may face challenges such as incorrect recognition, environmental conditions, and privacy concerns. Therefore, keeping the teacher involved in reviewing and approving automated attendance is important.

The proposed system also emphasizes role-based access and secure data management. Different dashboards for administrators, teachers, and students can help ensure that users access only the information relevant to their roles.

Overall, SCMS provides a practical foundation for improving classroom management, while future evaluation with real users is needed to measure its actual effectiveness.

CONCLUSION

This paper presented a proposed Smart Classroom Management Software for improving classroom management through a centralized platform. The system combines attendance, timetable management, resource sharing, announcements, student information, and basic analytics.

The literature review shows that AI, IoT, computer vision, and sensor technologies are being increasingly used in smart educational environments. Existing studies have demonstrated applications in automated attendance, student behaviour recognition, classroom monitoring, environmental sensing, and interoperability.

The proposed SCMS brings these ideas into a modular classroom management framework. AI and IoT are considered optional components so that the core system can remain simple and practical. The teacher-in-the-loop attendance process also provides human verification before automated attendance information is stored as a final record.

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The system has not yet undergone complete prototype evaluation because prototype evaluation is planned for future work. Future work will include prototype implementation, testing with students and faculty members, and evaluation using accuracy, precision, recall, task completion time, usability, and response time.

REFERENCES

[1]. Firodiya, S., Saikar, S., Dhuke, A., & Rupnawar, V., "Smart Classroom Management Software for EnhancedLearning Environments", 2025 2nd International Conference on Integration of Computational Intelligent System (ICICIS), 2025.
[2]. Fütterer, T., et al., "Artificial intelligence in classroom management: A systematic review on educational purposes, technical implementations, and ethical considerations", Computers and Education: Artificial Intelligence, vol. 9, 100483, 2025.
[3]. Murudi, S., et al., "IoT enabled Smart Classroom Management System using Raspberry Pi", 4th International Conference on Knowledge Engineering and Communication Systems (ICKECS), 2026.
[4]. Figueroa, E., et al., "Smart classroom ontology: enhancing interoperability in learning environments", Knowledge and Information Systems, vol. 68, Article 75, 2026.
[5]. Llurba, C., et al., "Artificial Intelligence in Smart Classrooms: A Systematic Literature Review of Applications, Dimensions, and Teacher Roles", Encyclopedia, vol. 6, no. 6, 138, 2026.
[6]. Abozeid, A., Alrashdi, I., & Al-Makhlasawy, R. M., "Intelligent recognition of students' behavior for smart learning environments", Scientific Reports, vol. 16, 5674, 2026.
[7]. Firdaus, I., et al., "Smart Classroom Monitoring System Using IoT and AI to Improve Space Utilization in Higher Education", Journal of Advances in Information Systems and Technology, vol. 7, no. 2, pp. 238–252, 2026.
[8]. Hossain, M. S., et al., "AI and IoT in Education: Enhancing Classroom Interactivity and Student Engagement", Asia Pacific Journal of Educators and Education, vol. 41, no. 1, pp. 11–39, 2026.
[9]. Nguyen, D. D., et al., "Automated attendance system in the classroom using artificial intelligence and internet of things technology", 2021 8th NAFOSTED Conference on Information and Computer Science (NICS), pp. 531–536, 2021.
[10]. Kaur, A., & Bhatia, M., "Smart classroom: A review and research agenda", IEEE Transactions on Engineering Management, vol. 71, pp. 2430–2446, 2024.
[11]. Batista, E., et al., "On the deployment of low-cost sensors to enable context-aware smart classrooms", Lecture Notes in Electrical Engineering, vol. 1036, pp. 333–338, 2022.
[12]. Tagliabue, L. C., et al., "Data driven indoor air quality prediction in educational facilities based on IoT network", Energy and Buildings, vol. 236, 110782, 2021.

