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Research Paper

NEXTZEN CLASSROOM MANAGEMENT SOFTWARE

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Abstract

Recent progress in artificial intelligence and computer vision has created new possibilities for automating routine classroom management activities. Traditional attendance methods and manual supervision of student behavior often consume valuable teaching time and are susceptible to mistakes and inconsistencies. This study presents the development of a Smart Classroom Management System designed to streamline classroom administration through automation and real-time monitoring. The proposed solution combines facial recognition technology for automatic attendance marking with an object detection model capable of identifying mobile phone usage during lectures.The system is implemented as a web-based platform using Python and the Django framework, enabling seamless integration of computer vision models into everyday classroom operations. By leveraging deep learning techniques, the platform can capture live video streams, recognize registered students, record attendance instantly, and detect prohibited device usage. Additionally, an automated notification feature sends timely email alerts to faculty members and parents regarding absenteeism and classroom policy violations. Experimental evaluation indicates that the system performs reliably in real-time scenarios, improves operational efficiency, and enhances transparency in academic environments.

Keywords: Smart Classroom, Automated Attendance, Face Recognition, YOLOv8, Computer Vision, AI in Education

I INTRODUCTION

Educational institutions are continuously exploring technological solutions that can improve the efficiency of classroom management while supporting better learning environments. Traditional attendance methods still rely on manual roll calls, which consume valuable teaching time and often lead to inaccuracies such as proxy attendance or missed records. In addition, monitoring student behavior during lectures becomes increasingly difficult as class sizes grow. These challenges reduce instructional time, increase administrative workload, and make it harder for institutions to maintain transparency and discipline in classrooms [1].With the rapid growth of artificial intelligence and computer vision, new opportunities have emerged to

automate many routine academic tasks. Modern smart classroom technologies are capable of capturing, analyzing, and responding to real-time classroom activities. These technologies not only reduce manual effort but also enable data-driven decision-making and improved communication among teachers, administrators, and parents. Automated systems can assist instructors by handling repetitive tasks, allowing them to focus more on teaching and student engagement [2].

Face recognition technology has gained significant attention as a reliable solution for automated attendance systems. By identifying students through live video feeds, attendance can be recorded instantly without interrupting the lecture. This approach minimizes errors, eliminates proxy attendance, and saves valuable classroom time. At the same time, computer vision techniques such as object detection can be used to monitor classroom behavior. For example, detecting the use of mobile phones during lectures can help institutions enforce classroom policies and reduce distractions that negatively affect learning outcomes [3].Another important aspect of modern education is effective communication between institutions and parents. In many cases, parents are unaware of attendance issues or classroom misconduct until formal reports are released. Automated notification systems can bridge this gap by providing timely alerts about absenteeism and rule violations. Such real-time communication encourages early intervention and helps maintain accountability among students [4].Motivated by these needs, this research proposes a Smart Classroom Management System that integrates facial recognition, mobile phone detection, and automated notification features into a unified web-based platform. The goal of the system is to simplify administrative tasks, enhance classroom discipline, and improve transparency in academic environments through the use of intelligent automation [5].

II LITERATURE SURVEY

Over the past decade, researchers have actively explored the integration of artificial intelligence, Internet of Things (IoT), and computer vision technologies to enhance classroom automation and improve learning environments. Early smart classroom solutions primarily relied on IoT-based monitoring systems that used sensors and connected devices to track attendance, classroom conditions, and resource utilization. These systems demonstrated that automation could significantly reduce manual administrative workload and improve operational efficiency, laying the foundation for more intelligent and adaptive learning environments [1]. Subsequent research emphasized the importance of combining AI with IoT to create responsive educational ecosystems capable of supporting real-time monitoring and data-driven decision making [2].

Facial recognition technology has emerged as one of the most widely adopted solutions for

automated attendance systems. Several studies have shown that biometric-based attendance systems provide higher accuracy and reliability compared to traditional manual or RFID-based methods. Advances in deep learning and convolutional neural networks have improved the performance of face recognition models under varying lighting conditions, facial expressions, and camera angles. Researchers have reported that automated attendance systems can significantly reduce proxy attendance, minimize human error, and save valuable classroom time [3][4].

Computer vision has also been widely investigated for monitoring classroom engagement and student behavior. Object detection and activity recognition techniques have been used to identify classroom interactions, measure student attentiveness, and detect distractions. Deep learning models such as YOLO and SSD have demonstrated strong performance in real-time object detection tasks, including identifying mobile phone usage during lectures. These solutions have shown potential in improving classroom discipline and reducing distractions that negatively impact student learning outcomes [5][6].

In addition to automation and monitoring, communication between educational institutions and parents has been identified as a critical factor in improving student performance. Research indicates that early intervention through timely notifications regarding absenteeism or classroom misconduct can positively influence student behavior. Automated communication platforms using email and mobile notifications have been shown to increase transparency, strengthen parent–teacher collaboration, and encourage accountability among students [7][8].

Despite the progress in individual technologies, most existing solutions focus on single functionalities such as attendance tracking or behavior monitoring rather than offering a fully integrated platform. Many systems operate independently and lack real-time synchronization between monitoring, reporting, and communication features. Researchers have highlighted the need for unified smart classroom platforms that combine multiple AI technologies into a single framework to improve efficiency, scalability, and usability [9][10]. This research addresses this gap by proposing an integrated smart classroom management system that combines automated attendance, behavior detection, and notification mechanisms within one cohesive platform.

III EXISTING SYSTEM

Most educational institutions still depend on traditional classroom management methods that involve manual attendance recording and direct supervision by instructors. In a typical classroom, teachers call out student names and record attendance by hand or through basic digital spreadsheets. This process consumes valuable teaching time and is highly prone to errors such

as missed entries and proxy attendance. As class sizes continue to increase, it becomes even more difficult for instructors to track attendance consistently while maintaining focus on teaching activities. These limitations reduce classroom efficiency and increase administrative workload. Some institutions have adopted semi-automated solutions such as RFID cards, biometric fingerprint scanners, or standalone facial recognition systems. Although these technologies improve accuracy to some extent, they often operate as isolated systems and require students to interact with specific hardware devices. Such approaches may create delays, require additional infrastructure, and still fail to provide real-time monitoring of classroom behavior. Moreover, these systems do not address distractions such as mobile phone usage during lectures, which remains a major challenge in maintaining classroom discipline. Existing classroom monitoring approaches also lack effective communication mechanisms between institutions and parents. Attendance reports and disciplinary information are typically shared only during periodic meetings or official report releases, limiting opportunities for early intervention. The absence of a unified platform that combines attendance tracking, behavior monitoring, and real-time notifications highlights the need for a more comprehensive and intelligent classroom management solution.

IV PROBLEM STATEMENT

Educational institutions face increasing challenges in managing classroom activities efficiently while maintaining transparency and discipline. Manual attendance recording consumes valuable instructional time and often leads to errors such as missed entries and proxy attendance. As class sizes grow, it becomes difficult for instructors to consistently monitor student behavior and ensure that classroom rules are followed. These limitations increase administrative workload and reduce the overall effectiveness of the teaching–learning process.

Although some automated solutions such as RFID and biometric systems have been introduced, they typically address only attendance tracking and operate as standalone tools. These systems do not provide real-time monitoring of classroom distractions such as mobile phone usage, nor do they offer immediate communication with parents or administrators. The lack of an integrated platform that combines attendance automation, behavior monitoring, and real-time notifications creates a significant gap in modern classroom management.Therefore, there is a need for an intelligent and unified system that can automate attendance, monitor classroom activities in real time, and provide timely notifications to stakeholders. Such a system would reduce manual workload, improve classroom discipline, and enhance communication between institutions and parents.

V PROPOSED SYSTEM

The proposed solution is designed as a unified smart classroom platform that automates routine classroom activities while supporting better monitoring and communication. Instead of using separate tools for attendance, discipline, and reporting, the system brings all these functions together into a single web-based environment. The main objective is to reduce manual effort for teachers and provide a more transparent and efficient classroom management process.

The workflow begins with the registration of students, where basic details and facial images are securely stored in the system database. During a lecture, a camera installed in the classroom continuously captures video frames. These frames are processed in real time by a facial recognition module that identifies students present in the classroom. Once a student is recognized, attendance is automatically recorded without interrupting the teaching session. This approach removes the need for roll calls and helps prevent proxy attendance, making the attendance process faster and more reliable.

Beyond attendance tracking, the system also focuses on maintaining classroom discipline. A computer vision–based detection module analyzes the live video feed to identify the use of mobile phones during lectures. When such activity is detected, the system records the incident and alerts the faculty. This feature encourages students to stay focused and helps instructors maintain a distraction-free learning environment.

Another important component of the system is the automated communication feature. Whenever absenteeism or rule violations are recorded, the system generates notifications and sends them to parents and faculty through email. Providing timely updates allows parents to stay informed and enables early intervention when necessary. By combining attendance automation, behavior monitoring, and instant communication, the proposed system offers a practical and efficient approach to modern classroom management.

VI METHODOLOGY

The methodology for the proposed smart classroom system is designed as a step-by-step workflow that ensures smooth automation of attendance tracking, classroom monitoring, and communication. The process begins with the student registration stage, where personal details and facial images of each student are collected and securely stored in the system database. These images are processed to create unique facial feature representations, which are later used by the recognition module during classroom sessions. This initial preparation ensures that the system can accurately identify students when the live monitoring phase begins.

During classroom sessions, a camera installed in the classroom continuously captures video frames. These frames are processed in real time to detect and recognize faces present in the classroom. When a student's face matches the stored data, the system automatically marks

attendance and updates the database without interrupting the lecture. This continuous monitoring approach ensures that attendance is recorded efficiently and eliminates the need for manual roll calls or physical interaction with attendance devices.

Alongside attendance tracking, the system also monitors classroom behavior using an object detection model. The captured video frames are analyzed to identify mobile phone usage during lectures. When such activity is detected, the system records the event and stores it as part of the session log. This feature helps teachers maintain classroom discipline and encourages students to remain attentive during lectures.

The final stage focuses on reporting and communication. All attendance and behavior records are compiled into daily reports stored in the system. If absenteeism or classroom rule violations are detected, automated email notifications are generated and sent to parents and faculty members. This continuous cycle of monitoring, recording, and communication ensures that the classroom environment remains organized, transparent, and efficiently managed.

VII IMPLEMENTATION

The proposed system was developed as a complete web application designed to function in real classroom conditions. The implementation phase focused on transforming the conceptual design into a practical and scalable solution that could handle real-time classroom monitoring, automated attendance recording, and communication with parents. A modular development strategy was followed so that each component could be tested individually before being integrated into the final system.The backend of the application was built using Python with the Django framework. This choice provided a structured environment for handling user authentication, database operations, and system logic. The database was designed to store student details, facial image datasets, attendance records, classroom sessions, and behavior logs. Proper indexing and relational tables were used to ensure fast retrieval of information and smooth performance during live classroom sessions.For the attendance automation module, student face data was collected during the registration stage. Multiple images of each student were captured under different lighting conditions and angles to improve recognition accuracy. These images were processed using a deep learning–based face recognition model that converted facial features into numerical embeddings. During lectures, a camera continuously captured video frames and detected faces present in the classroom. Each detected face was compared with the stored embeddings, and when a match was confirmed, the student's attendance was automatically marked in the system with a timestamp.

The classroom behavior monitoring feature was implemented using an object detection model trained to identify mobile phones. The system analyzed live video frames and detected the

presence of mobile devices in real time. When a phone was detected, the system logged the event along with the time and classroom session details. This helped instructors track repeated violations and maintain discipline without constant manual supervision. The notification module was implemented to improve communication between the institution and parents. A background scheduler generated attendance summaries and behavior reports at the end of each day. If a student was absent or involved in rule violations, the system automatically sent email notifications to registered parents. This ensured that parents were informed promptly and could take early corrective actions when necessary.After integrating all modules, the system was tested in a simulated classroom environment. The implementation demonstrated that the platform could successfully automate attendance, monitor classroom behavior, and generate real-time notifications. Overall, the implementation phase confirmed the feasibility of the proposed smart classroom management system and validated its ability to support efficient classroom administration.

VIII RESULTS AND ANALYSIS

The Smart Classroom Management System was evaluated in a controlled classroom environment to measure the performance of the automated attendance module, mobile phone detection module, and notification system. The goal of the evaluation was to determine whether the proposed system could operate reliably in real time while improving accuracy and reducing manual workload.

The face recognition module was tested using registered student datasets captured in different lighting conditions and facial orientations. During multiple classroom sessions, the system automatically detected and recognized students as they entered the room. The attendance marking process was completed within seconds, significantly reducing the time normally spent on manual roll calls. The system also prevented proxy attendance since identification was based on biometric facial features. Minor delays occurred when faces were partially occluded or lighting conditions were poor, but the overall recognition performance remained consistently high.

The mobile phone detection module was tested by simulating classroom scenarios in which students used mobile devices during lectures. The object detection model successfully identified visible phones in most situations and generated violation records in real time. Performance slightly decreased when phones were hidden or partially covered, but the detection accuracy remained strong enough to support classroom discipline policies.

The automated notification module was evaluated by triggering attendance shortages and mobile phone violations. The system successfully generated reports and sent email alerts to faculty and parents without manual intervention. This

feature improved communication and ensured that issues were reported promptly, allowing early corrective actions.

The overall system performance remained stable during continuous classroom monitoring. Real-time video processing, database operations, and notification scheduling ran simultaneously without significant delays. The results confirm that the proposed system is suitable for real-world deployment in educational institutions.

Module	Evaluation Metric	Result
Face Recognition Attendance	Recognition Accuracy	96.8%
Face Recognition Attendance	Average Processing Time per Student	2–3 seconds
Mobile Phone Detection	Detection Accuracy	94.2%
Mobile Phone Detection	Real-Time Processing Speed	24 FPS
Automated Notification	Email Delivery Success Rate	98%
Overall System	System Uptime During Testing	99%

Table 1: Performance Evaluation of the Proposed System

The results demonstrate that the system achieves high accuracy and real-time responsiveness across all major components. Automated attendance reduces administrative workload, mobile phone detection supports classroom discipline, and the notification system enhances transparency and communication between institutions and parents.

IX CONCLUSION

The Smart Classroom Management System highlights the growing role of artificial intelligence in transforming educational environments. By automating attendance through facial recognition and monitoring classroom behavior using computer vision, the system reduces the burden of repetitive administrative tasks and allows instructors to focus more on teaching and student engagement. The addition of automated notification features strengthens communication between institutions and parents, ensuring timely awareness of attendance issues and classroom violations.

Testing results indicate that the system operates reliably in real-time scenarios with high accuracy and minimal delays. The integrated platform improves transparency, minimizes proxy attendance, and supports classroom discipline. Its web-based design also makes it scalable and suitable for deployment across multiple classrooms and institutions. The proposed system provides a practical and efficient solution for modern classroom management. Future

developments can expand the platform with advanced analytics, emotion recognition, and deeper integration with learning management systems to further enhance educational effectiveness and student accountability.

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