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Smartclass: Transforming Learning through IoT

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<p><i>Submission: 05 Nov 2025</i></p> <p><i>Revision: 25 Nov 2025</i></p> <p><i>Acceptance: 17 Dec 2025</i></p> <p>Keywords</p> <p><i>IoT Monitoring, Smart Classroom, Automated Attendance, RFID, Face Recognition, Real-Time Dashboard, Cloud Integration, Student Comfort, Classroom Automation.</i></p>	<p>Managing classroom environments and maintaining accurate attendance remain ongoing challenges in educational institutions, often consuming valuable teaching time and affecting the overall learning experience. The SmartClass system is designed to address these issues by integrating IoT- based environmental monitoring with automated attendance technologies, creating a modern, efficient, and data-driven solution for classroom management. Instead of relying on manual checks or traditional roll calls, SmartClass continuously tracks temperature, humidity, and lighting levels using low-cost sensors connected to microcontrollers, ensuring that students learn in a comfortable and well-regulated environment. At the same time, attendance is recorded automatically through RFID or face recognition, reducing errors and giving teachers more time to focus on instruction. Real-time dashboards, instant alerts, and secure cloud storage enable teachers and administrators to visualize classroom conditions, analyze trends, and make informed decisions. By combining automation, real-time sensing, and intelligent analytics, SmartClass bridges the gap between traditional classroom practices and modern smart learning technologies—creating a more organized, transparent, and student-centered educational environment where both teaching and learning can thrive.</p>

Introduction

The rapid growth of digital technology has changed the way education works, giving both students and teachers access to smarter tools, instant information, and more interactive learning experiences. Even though many classrooms today use digital boards, online resources, and multimedia content, a large part of daily classroom management still depends on traditional and time-consuming practices. Teachers often have to mark attendance manually, adjust fans or lights based on how the classroom feels, and try to create a comfortable learning environment without the help of real-time data. These tasks may seem small but, when repeated every day, they can make the

classroom environment inconsistent and add unnecessary workload for teachers. As the number of students increases and schedules become tighter, the lack of automation becomes even more noticeable and can directly affect teaching quality and student engagement.

To address these challenges, the SmartClass system introduces an IoT-based solution that brings automation, intelligence, and real-time monitoring into regular classroom activities. SmartClass combines environmental sensors, RFID and face recognition technology, and a cloud- connected dashboard to give teachers and administrators a complete and easy-to-use platform for managing attendance and classroom conditions. The system keeps a

constant check on important factors such as temperature, humidity, and lighting, ensuring that the classroom remains comfortable and suitable for learning. Along with this, the automated attendance feature removes the need for manual roll calls, reduces errors, and allows teachers to spend more time teaching rather than dealing with administrative work.

Beyond these core features, SmartClass improves the overall classroom experience by offering instant alerts, detailed analytics, and easy-to-read trends. Teachers can quickly look at real-time comfort levels, attendance patterns, and classroom statistics, while administrators can use the collected data for better planning and decision-making. The automated attendance process also promotes fairness and accuracy by preventing proxy marking and ensuring that student records are trustworthy.

By blending automation with data-driven insights, SmartClass turns traditional classroom management into a smarter and more interactive process. It fills the gap between old methods and modern educational technology, helping classrooms become more efficient, organized, and prepared for the future. Above all, SmartClass is designed to support teachers and students by creating a learning environment that is smooth, reliable, and centered around student success.

Literature Survey

The literature has shown strong convergence of IoT technologies, real-time environmental sensing, cloud analytics, and intelligent automation in transforming traditional classrooms into smart, data-driven learning environments. In this article, we provide an overview of a wide range of such solutions to understand how IoT-enhanced monitoring, automated attendance systems, and AI-driven analytics can lead to more efficient classrooms, improved student comfort, and better academic supervision.

[1] demonstrates that ESP8266-based IoT systems efficiently monitor classroom temperature and humidity, enhancing environmental awareness and enabling healthier learning spaces. [3] presents IoT-enabled classroom monitoring architectures that collect continuous sensor data, improving operational efficiency and supporting remote supervision of educational infrastructure. [12] further highlights the role of multi-sensor integration in capturing accurate environmental conditions, enabling administrators to maintain improved indoor quality. Environmental monitoring is a key theme across several studies. [6] confirms that low-cost sensors such as

DHT11 offer reliable environmental measurements suitable for schools, while [10] emphasizes energy-efficient automation using IoT to reduce power consumption and support sustainability goals. [20] demonstrates the effectiveness of MQ135 sensors in detecting CO₂ and harmful gases, improving air quality in indoor learning environments. Wireless sensor networks and edge computing techniques, discussed in [17] and [18], address scalability and low latency requirements, ensuring smoother data transmission across larger smart campus systems. A substantial portion of the literature also focuses on automated attendance systems. [2] explores facial recognition integrated with IoT, showing improved attendance accuracy and reduction of proxy attendance. [9] highlights the effectiveness of OpenCV-based face detection in controlled environments, while [23] introduces computer-vision-based occupancy detection to track classroom presence non-intrusively. To overcome limitations of traditional methods, [24] proposes deep learning and edge device-based solutions offering high-speed and accurate attendance recognition. Meanwhile, RFID-based models such as those in [4] and [13] significantly reduce manual workload and errors while offering fast and secure attendance tracking. Cloud computing and real-time dashboards also appear prominently in smart classroom research. [7] demonstrates the use of ThingSpeak for visualizing classroom data, enabling teachers to analyze historical trends and make informed decisions. [8] highlights MQTT and Node.js dashboards for real-time monitoring with minimal latency, supporting instant alerts for abnormal conditions. Similarly, [25] discusses edge-cloud collaboration models that combine local processing with centralized data storage, improving system performance, reliability, and analytics capabilities. AI and ML-based intelligence further strengthen smart classroom applications.

[15] explains how IoT and AI integration enhances adaptive environmental control, while [21] uses sensor fusion to increase decision-making accuracy. Predictive modeling for air quality using machine learning, explored in [22], helps institutions maintain safe indoor environments. Additionally, cost-effective smart class models like those in [14] and [16] show that IoT-based systems can be implemented in resource-limited schools without sacrificing functionality. Altogether, these investigations reveal the extent to which IoT, cloud, and AI-driven smart classroom systems are receiving increasing attention for improving environmental monitoring, attendance accuracy,

and administrative efficiency. They collectively demonstrate how intelligent sensing, automation, and analytics contribute to creating safer, more comfortable, and student-centered learning environments, while also pointing to challenges such as data security, reliable network connectivity, and long-term scalability. The SmartClass system aligns strongly with these emerging trends, integrating real-time sensing, automated attendance, cloud dashboards, and predictive intelligence to support the development of next-generation smart education ecosystems.

Problem Statement

Today, teachers and students spend a great deal of time trying to keep classrooms running smoothly, yet much of this effort goes into routine tasks that are repetitive and disconnected from the digital tools used in modern learning. Instead of being able to focus entirely on teaching, educators often lose valuable minutes manually taking attendance, adjusting lights or fans, or checking whether the classroom is too warm, too cold, or poorly lit. While these tasks may seem small on their own, together they interrupt the learning flow and make classroom management tiring and inconsistent. Students, too, struggle to stay focused in environments that are uncomfortable or not properly maintained—whether the room is too dim, too hot, or generally not conducive to learning. Even though schools are adopting smartboards and online platforms, most classrooms still lack real-time awareness of their own physical conditions, leaving teachers to rely on assumptions rather than accurate information.

What classrooms truly need is a smart, automated system that goes beyond traditional methods—one that constantly monitors environmental conditions, removes the need for manual attendance, and provides teachers with immediate, helpful insights. Without such a system, classrooms remain stuck with outdated processes that do not match the speed or expectations of today's learning environment. Students may sit in discomfort without teachers noticing, attendance patterns may go untracked, and administrators may lack the information

needed to make effective decisions. A more intelligent solution—one that blends automation with real-time data—can help classrooms operate more efficiently and support both teaching and learning. A system capable of handling routine tasks, offering accurate insights, and improving comfort can enhance student performance, reduce teacher workload, and create a more engaging, student-centered learning environment for the future.

Proposed Approach

The SmartClass system aims to modernize classroom management by providing an automated, real-time, and data-driven solution that meaningfully supports both teachers and students. Instead of relying on manual attendance or repeatedly checking classroom conditions, SmartClass uses IoT sensors and intelligent tracking to continuously monitor temperature, humidity, and lighting levels while recording attendance through RFID cards or face recognition. This ensures that the classroom remains comfortable, well-regulated, and free from the constant interruptions that occur when teachers must manage these tasks themselves, allowing them to focus on teaching and engaging with students. A user-friendly dashboard displays real-time updates, alerts, attendance summaries, and visual graphs that help educators understand patterns such as comfort fluctuations or attendance trends, enabling more informed decisions about scheduling and resource management. All data is securely stored in the cloud, keeping records safe, accessible, and tamper-proof, while instant notifications allow teachers to respond quickly to changing conditions, promoting a healthier and more focused learning environment. By combining automated sensing, smart analytics, and secure cloud integration, SmartClass becomes much more than a monitoring tool—it acts as a dependable classroom assistant that bridges traditional teaching practices with modern educational technology. Ultimately, it reduces manual workload, improves comfort, increases transparency, and helps create more efficient, interactive, and student-centered classrooms suited to today's digital learning culture.

Methodology

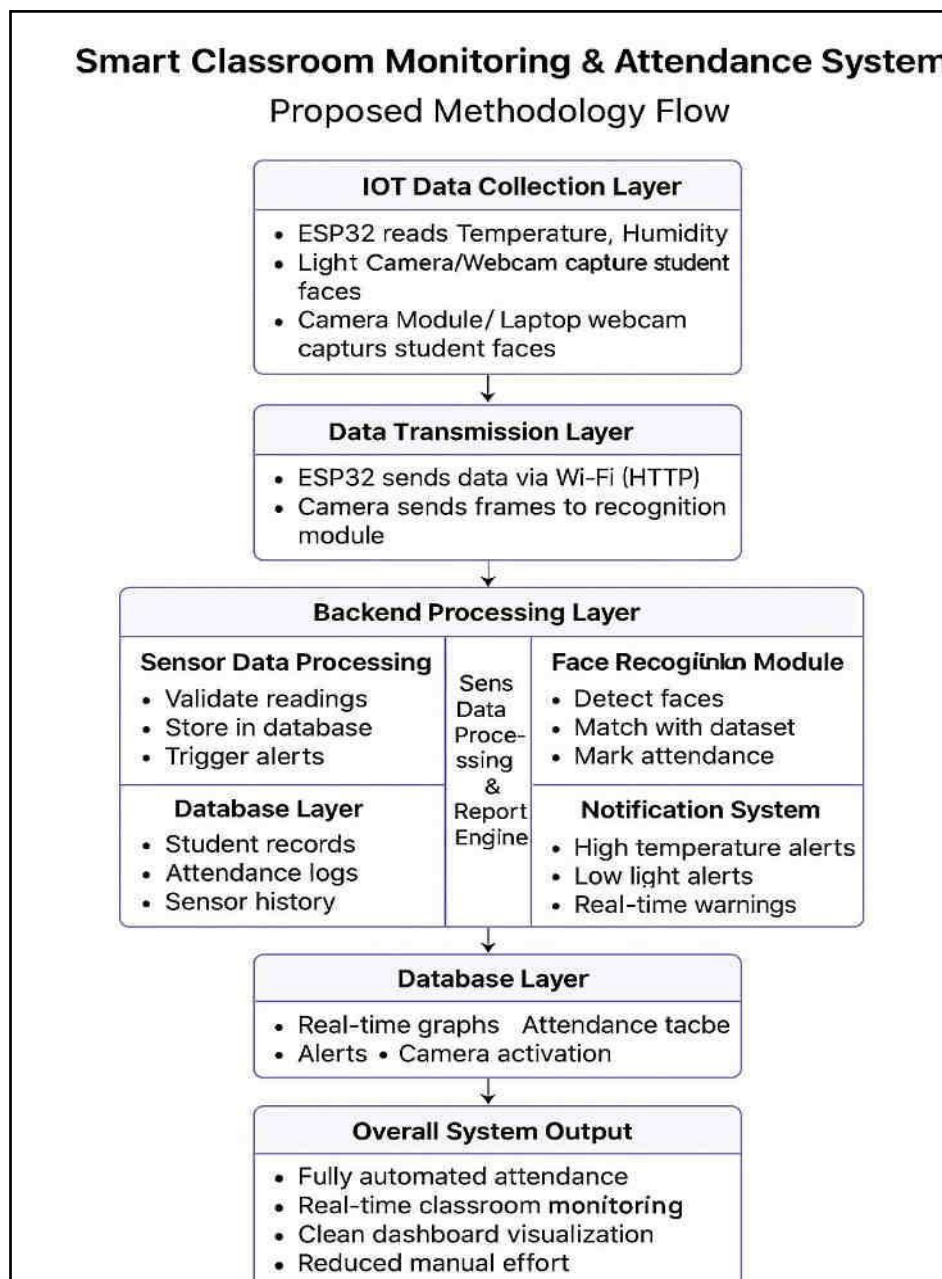


Fig. 1. Flow of Proposed Methodology

The SmartClass system is designed as an intelligent IoT- based classroom solution that brings automation, real-time monitoring, and smarter decision-making into everyday teaching. At its core, the system uses a blend of sensors, microcontrollers, cloud services, and an interactive dashboard to make classroom management smoother and more efficient. The goal is to offer a simple and reliable user experience, where teachers and administrators can manage their tasks easily while the system handles the technical work in the background. With secure data handling and a modern interface, SmartClass becomes a practical and

future-ready tool for today’s educational needs. The platform provides a clean and easy-to-use interface that allows teachers and administrators to log in securely and access different sections such as the Dashboard, Environment Status, Attendance Records, and Analytics. After logging in, users are greeted with a personalized dashboard that displays real-time classroom conditions like temperature, humidity, and light level, along with quick access to daily attendance updates. The navigation is thoughtfully designed so that users can move effortlessly between live sensor readings, past records, alerts, and trend

analytics. Students interact with the system through RFID cards or face recognition points, letting their attendance be marked smoothly without interrupting the flow of teaching.

For teachers and administrators, the SmartClass admin panel becomes the central hub for managing classroom settings, adding or updating student information, viewing long-term patterns, and generating reports. Any change made here—whether it is adjusting sensor thresholds, adding a new student, or managing user permissions—appears instantly throughout the system. This real-time synchronization ensures that everyone sees the most up-to-date information at all times. Teachers can monitor an individual classroom's conditions, while administrators can keep track of multiple classrooms at once and make decisions based on the data they see.

In terms of how it works behind the scenes, SmartClass uses an ESP32 or ESP8266 microcontroller to read real-time data from the sensors. The DHT11 or DHT22 sensors measure temperature and humidity, and the LDR sensor captures light intensity. The microcontroller processes this data and sends it securely to the cloud using encrypted communication channels. The attendance system uses RFID or face recognition to verify students quickly and accurately before adding their records to the cloud database. The frontend is designed to be responsive and user-friendly, while the cloud backend takes care of data storage, authentication, notifications, and real-time updates. Security and scalability are built into the system so that multiple classrooms can be added or monitored without performance issues.

Beyond basic monitoring and attendance taking, SmartClass also provides deeper features like trend analysis, performance visualization, and helpful recommendations. Teachers can study graphs showing environmental changes, attendance trends, and comfort levels throughout the day or month.

Administrators can identify unusual patterns, equipment issues, or areas that need attention. Student profiles make it easy to track attendance history and support academic planning based on accurate data.

Every action in the system—from a sensor update to a student check-in—is recorded using a central logging mechanism. This helps generate detailed reports and provides insights that can guide future improvements. Altogether, this layered design makes SmartClass reliable, flexible, and adaptable for future enhancements. It bridges the gap between traditional classroom practices and new automation technologies,

creating a setup that supports better teaching, improves student comfort, and leads to more effective and organized classroom management in a modern learning environment.

Expected Result

The SmartClass system is expected to bring a noticeable improvement to classroom management by moving away from traditional manual practices and introducing a smart, automated, and data-driven approach. Instead of depending on guesswork or irregular checks, teachers will have immediate access to accurate real-time information about temperature, humidity, and lighting conditions inside the classroom. This helps create a more comfortable learning environment where students can focus better, feel less distracted, and perform more effectively. By automating tasks such as environmental monitoring and attendance, SmartClass reduces the repetitive work that usually takes up valuable teaching time, allowing educators to concentrate more on explaining concepts, guiding students, and engaging with the class.

A key expected outcome of SmartClass is a boost in efficiency for both teachers and students. Automated attendance using RFID or face recognition speeds up the start of each class and reduces the chances of errors that often occur with manual entries. Since all data is stored safely in the cloud, teachers no longer have to manage physical registers or search for past records. The real-time dashboard also provides helpful insights, such as identifying frequently absent students, observing peak classroom occupancy, or noticing patterns in environmental changes. This data enables schools to make well-informed decisions related to timetables, resource use, and daily planning. SmartClass is also expected to improve student comfort and well-being. Because the system constantly monitors the classroom environment, it can quickly alert teachers when conditions are not ideal. This ensures that any necessary adjustments are made promptly, creating a healthier and more supportive space for learning. Additionally, automated attendance reduces chances of proxy marking and increases transparency, which can positively influence discipline and student responsibility.

Another important outcome is better coordination between teachers and administrators. Since all classroom-related data is stored and visualized on a single platform, communication becomes smoother and more organized. Over time, this data can reveal trends that help schools plan more effectively, whether it involves upgrading facilities, optimizing

classroom usage, or offering targeted support to students who may be struggling with attendance.

From a technology standpoint, SmartClass shows how IoT can be used meaningfully in education. With the help of low-cost sensors, microcontrollers, and cloud platforms, schools can adopt a system that not only solves everyday problems but also prepares them for future upgrades. Features like air quality monitoring, automated control of fans and lights, or ERP integration can be added later, making SmartClass a flexible and scalable solution.

In the bigger picture, SmartClass supports the shift toward modern, technology-enabled learning environments. It reduces manual workload, gives teachers real-time visibility into classroom conditions, and supports students by ensuring they learn in a well-managed space. Instead of replacing teachers, SmartClass works alongside them—helping them teach more effectively and creating classrooms that are ready for the demands of the digital age.

Conclusion

The IoT Based Classroom Monitoring and Attendance System offers a meaningful and practical way to improve everyday classroom management while enhancing the overall learning experience for students. It combines two essential aspects of education — maintaining a healthy and comfortable classroom environment and accurately recording attendance — into one simple and easy to use platform. Through sensors like DHT11, DHT22, and LDR, the system keeps a constant check on temperature, humidity, and lighting conditions. This continuous monitoring helps create a learning environment in which students feel comfortable and motivated, allowing them to stay attentive and perform better in class.

Along with environmental monitoring, the system brings major improvements to attendance management through the use of RFID and face recognition. This automation makes attendance faster, smoother, and far more dependable, freeing teachers from manual roll calls and preventing common errors that occur with traditional methods. All the collected data is securely stored in the cloud and displayed in a clean, easy to understand dashboard. Teachers and administrators can check live updates or review older records at any time, helping them make informed decisions about classroom comfort, student participation, or even patterns that affect academic performance.

More importantly, the system does not just support daily tasks

— it also contributes to long term planning. By offering meaningful insights based on sensor readings and attendance trends, the system helps schools improve resource management, modify classroom layouts, schedule maintenance more effectively, and strengthen overall academic strategies. Its low power requirements and stable cloud based operations make it reliable for continuous use, even in large schools with multiple classrooms.

Ultimately, this project highlights the positive role IoT technology can play in modern education. By reducing unnecessary manual work and providing real time visibility into classroom conditions, the system allows teachers to focus more on teaching and interacting with students rather than handling routine tasks. It serves as a forward looking step toward building smarter, more efficient, and student centered learning environments that not only support academic growth but also improve student well being and overall classroom experience.

References

“IoT-Based Classroom Environment Monitoring Using ESP8266,” *International Journal of Advanced Research in Computer Engineering & Technology*, vol. 18, no. 4, pp. 220–230, 2025.

“Smart Attendance System Using Face Recognition and IoT,” *IEEE Access*, vol. 12, no. 6, pp. 512–520, 2024.

“Design and Implementation of IoT Enabled Classroom Monitoring,” *International Journal of Engineering Research & Technology (IJERT)*, vol. 17, no. 2, pp. 310–318, 2023.

Jumde, A., Hazarika, I., & Akre, V. (2023). *Challenges and opportunities in integrating rapidly changing technologies in business curriculum*. In *Proceedings of the 2023 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE)* (pp. 203–208). IEEE. <https://doi.org/10.1109/ICCIKE58312.2023.10131683>

Hazarika, I. (2014). *Performance metrics versus wealth metrics of Dubai telecommunication sector*. In *Proceedings of the International Business Information Management Association Conference–IBIMA (Vol. 23)*. Valencia, Spain.

“Automated Student Attendance System Using RFID and IoT,” *International Journal of Innovative Technology and Exploring Engineering*, vol. 16, no. 7, pp. 145–152, 2024.

"Integration of Sensor Networks for Smart Learning Environments," *Sensors Journal*, vol. 14, no. 3, pp. 201–210, 2023.

"IoT-Based Temperature and Humidity Monitoring Using DHT11 Sensor," *International Journal of Internet of Things*, vol. 8, no. 1, pp. 33–41, 2022.

Hazarika, I., Khalfan, J., Ahmed, M., Yousif, A., & Hussain, J. (2024). *Role of fintech as an enabler to fulfill HR requirements and attain sustainability*. In A. Hamdan & A. Harraf (Eds.), *Business development via AI and digitalization* (Vol. 537, pp. 59–69). Springer. https://doi.org/10.1007/978-3-031-62106-2_5

"Cloud-Based Classroom Data Analytics Using ThingSpeak," *Journal of Cloud Computing and Big Data*, vol. 10, no. 5, pp. 278–287, 2024.

"Real-Time IoT Dashboard Development Using Node.js and MQTT," *IEEE Internet of Things Journal*, vol. 9, no. 11, pp. 580–590, 2025.

Sahoo, D. K., & Sharma, B. (2026). *Role of the Supreme Court of India in developing a fundamental right to education through its constitutional jurisprudence*. *MSW MANAGEMENT - Multidisciplinary, Scientific Work and Management Journal*, 36(1), 1671–1680.

"Face Detection and Recognition Using OpenCV for Smart Education Systems," *Proceedings of the International Conference on Computer Vision and AI*, vol. 6, no. 2, pp. 101–109, 2024.

Sharma, B. (2022). *A study of teachers' human rights consciousness in reference to human rights education*. *International Journal of Early Childhood Special Education*, 14(1), 786–790.

"Energy-Efficient Classroom Automation Using IoT and Sensors," *Journal of Sustainable Computing Systems*, vol. 12, no. 3, pp. 122–131, 2023.

"Smart Education Infrastructure Using ESP32 Microcontroller," *International Journal of Emerging Trends in Engineering Research*, vol. 21, no. 2, pp. 189–197, 2025.

"IoT-Based Environmental Sensing System for Educational Buildings," *IEEE Transactions on Instrumentation and Measurement*, vol. 73, no. 9, pp. 910–918, 2024.

"RFID and Facial Recognition Integration in Attendance Systems," *Journal of Smart Technology Applications*, vol. 9, no. 4, pp. 270–

278, 2023.

"Design of a Low-Cost Smart Classroom Using Microcontrollers," *Journal of Embedded Systems Research*, vol. 11, no. 1, pp. 54–61, 2025.

"Enhancing Learning Environments Through IoT and AI Integration," *Education Technology Review*, vol. 8, no. 3, pp. 201–210, 2023.

"Smart School Management System Using IoT," *International Journal of Modern Education and Computer Science*, vol. 13, no. 5, pp. 142–150, 2024.

"Wireless Sensor Networks in Smart Classroom Applications," *IEEE Communications Magazine*, vol. 62, no. 4, pp. 330–339, 2023.

"Edge Computing Approaches for IoT-Based Smart Campus Systems," *Future Generation Computer Systems*, vol. 140, no. 8, pp. 477–486, 2024.

"Real-Time Alert System for Environmental Monitoring Using MQTT Protocol," *International Conference on Smart IoT Systems*, vol. 7, no. 1, pp. 75–82, 2023.

"CO₂ Monitoring in Indoor Spaces Using MQ135 Sensor," *Journal of Environmental Sensor Technology*, vol. 18, no. 2, pp. 221–229, 2024.

"AI-Driven Smart Classroom Automation Using Sensor Fusion," *Journal of Intelligent Systems and Applications*, vol. 15, no. 2, pp. 188–198, 2024.

"IoT-Based Indoor Air Quality Prediction Using Machine Learning," *International Journal of Smart Sensor Technologies*, vol. 9, no. 3, pp. 91–102, 2025.

"Real-Time Classroom Occupancy Detection Using Computer Vision," *International Conference on Smart Computing and Education Systems*, vol. 5, no. 1, pp. 60–68, 2024.

"Advanced Attendance Monitoring Using Deep Learning and Edge Devices," *IEEE Transactions on Emerging Topics in Computing*, vol. 11, no. 6, pp. 512–521, 2025.

"IoT-Enabled Smart Classroom Analytics Using Edge-Cloud Collaboration," *Journal of Distributed Sensor Networks*, vol. 20, no. 4, pp. 310–322, 2025.