

A Comprehensive Review of Smart Attendance Systems for Secure and Anti-Proxy Attendance

Sarvesh Warjurkar¹, Shruti Bagmare², Kumud Parate³, Sapna Sakya⁴, Mehwish Sheikh⁵, Benazeer

Husain⁶

Department of Computer Science and Engineering

G.H.Raisoni College of Engineering and Management Nagpur, 440016 India

Abstract—Automated attendance management is receiving a lot of attention as educational institutes are trying to improve efficiency, accuracy and security of traditional attendance practices. But, a major obstacle is the prohibition of proxy attendance, as the present systems largely depend on individual authentication or verification methods that only handle specific aspects of attendance security. This review discusses six existing works of smart attendance system based on QR code, Face recognition, Bluetooth Low Energy (BLE), Acoustic signal authentication and their combinations. The selected studies are compared based on their authentication mechanisms, contribution, advantages and reported limitations. The review finds that QR-code-based systems are simple and efficient for attendance recording, but are vulnerable to code sharing; facial-recognition approaches improve identity verification but may be affected by lighting, pose and occlusion; BLE-based approaches provide proximity information but rely on compatible devices and platform permissions; and acoustic authentication can reduce fraudulent attendance caused by authentication-information sharing but does not individually establish biometric identity or physical presence. The comparative analysis shows that there is a large research gap: most existing approaches do not provide a comprehensive verification of students' identity, physical presence, session authenticity and liveness in a unified attendance framework. Therefore, the review emphasises on the importance of multi-layer antiproxy attendance mechanisms with supporting authentication and verification techniques. The results provide foundation for future work toward more secure, reliable and practical smart attendance systems that may reduce proxy attendance in educational environments.

Keywords—Attendance Management, Proxy Attendance, QR Code, Face Recognition, Bluetooth Low Energy, Acoustic Authentication, Smart Attendance System.

INTRODUCTION

Monitoring attendance is a key activity in educational institutions, considering that student attendance is widely used to assess participation and academic engagement. Traditional methods of attendance, especially manual recording, consume a lot of time and can lead to errors while collecting attendance and managing records. Therefore, the development of automated attendance management system has been accelerated by the availability of mobile devices, artificial intelligence, biometric technologies and wireless communication.

A number of technologies have been investigated to enhance the efficiency and reliability of attendance verification. QR-code-based systems offer a convenient method where attendance details can be produced, scanned, verified and recorded electronically. But the QR-based attendance system is still susceptible to misuse and proxy attendance when the authentication information is shared with the other person. This

study reviewed literature that includes QR-based approaches aimed to facilitate attendance management and recognizes proxy attendance as an important limitation.

Facial recognition is also widely studied as a mechanism for automated attendance identity verification. These systems scan the individual's face, extract the relevant features of the face, compare with the registered information and mark attendance after successful verification. This method can improve identity verification and minimize manual intervention. However, environmental and image-related factors may have an impact on facial recognition-based attendance systems. According to the reviewed studies, obstacles that can impact recognition performance include occlusion, poor lighting, and facial posture.

Attendance verification can also be done using proximity-based approaches. The Smart attendance system presented in this paper is based on Bluetooth low energy (BLE), where the devices of the participants advertise their presence and a coordinator device detect the nearby devices for real-time attendance registration. The study confirmed the feasibility of proximity detection with BLE, but also revealed platform-specific BLE limitations, permission dependencies and back-end constraints.

Another approach investigated in the literature reviewed is the authentication of acoustic signals. The acoustic attendance system is based on a majority-based authentication mechanism where the attendance is checked based on the reception of a continuous acoustic signal. The approach was specifically designed to address fraudulent attendance due to the sharing of authentication codes. But acoustic based authentication also has challenges of signal reception and practical classroom conditions.

The presented methods represent significant improvements in the field of automated attendance management. The reviewed studies indicate that no authentication method perfectly satisfies all the needs of attendance verification. QR-code approaches are simple but can be abused. Identity verification through facial recognition is improving, but can be influenced by environmental factors. BLE can provide proximity information, but is dependent on device and platform capabilities. Acoustic authentication offers an alternative to prevent authentication-code sharing, but comes with its own deployment considerations.

Therefore, this review examined six existing studies on smart attendance systems, discussing their technologies, contributions, advantages, and limitations. The aim is to identify common research gaps and to understand how different verification mechanisms may result in more reliable and secure attendance management.

REVIEW METHODOLOGY

This review is carried out by reviewing six research papers on smart and automated attendance systems. The selected studies were selected as they investigate technologies associated with secure attendance verification and proxy-attendance prevention such as QR codes, facial recognition, Bluetooth Low Energy (BLE) and acoustic signal authentication.

The papers were analyzed according to four main aspects; (1) technology or authentication method used, (2) main contribution of the proposed system, (3) advantages or performance reported, and (4) limitations or challenges highlighted in the study. The focus was on the verification of attendance and the possibility of cheating or proxy attendance for each of the technologies.

The six studies were categorized by their primary technological approaches to the analysis. QR-code based approaches were reviewed to understand the convenience and security issues; facial-recognition based approaches were reviewed in terms of identity verification and environmental constraints; We have studied BLE-based attendance as a proximity-verification approach. We have investigated acoustic signal authentication as a measure to mitigate fraudulent attendance due to sharing of authentication codes. The reviewed studies also included combinations of QR codes and facial recognition, so the potential benefits and limitations of multi-factor verification could be considered.

Findings of the selected studies were then compared to identify common strengths, limitations and research gaps. This comparative approach allows the review to move beyond summarizing individual papers to determine how different technologies address different aspects of attendance verification. For example, the literature reports QR-code misuse as a security issue, facial recognition as a challenge in terms of environmental conditions, and device and permission dependencies in case of BLE-based attendance.

Thus, the comprehensive review aims to grasp the current state of smart attendance technologies and to identify the areas where the existing approaches can be improved. As the current study is based on the selected six research papers, this methodology is proposed as a literature-review approach rather than a formal systematic review protocol.

BODY OF THE REVIEW

Yeonwoo Sea et al[1]. "Acoustic Signal Based Smart Attendance System for Preventing Fraudulent Attendance" The paper was published in IEEE Access 2026. The proposed system is an acoustic signal based approach that guarantees secured attendance and avoid fraudulent or proxy attendance. The approach is related to improve the security of attendance process. However, it has a disadvantage that it does not allow to check the presence of students in the classroom properly. This means that while fraudulent attendance can be reduced, the system does not authenticate the student's physical presence at the required place.

Hong-Danh Thai et al[2]. proposed "Enhanced Efficiency in SMEs Attendance Monitoring: Low-Cost Artificial Intelligence Facial Recognition Mobile Application". The study was published in IEEE Access in 2024. The system proposed uses AI based facial recognition for attendance monitoring and supports real time attendance recording. The facial recognition provides a great way to identify the students and also reduces the need of the manual attendance. However, the accuracy of facial recognition can be affected by poor lighting conditions which may reduce the reliability of the system in certain environments.

Vladimir Pleština et al[3]. developed "Smart attendance: A BLE-Based Mobile Application for Real-Time Session Attendance Tracking". It was published in the IEEE Journal of Radio Frequency Identification in 2026. The proposed system uses Bluetooth Low Energy (BLE) technology for automatic attendance system. BLE offers low latency and power efficient communication suitable for real time attendance monitoring. But the system needs BLE-enabled devices, which limits its use in environments that do not have compatible BLE devices or configurations.

Simran B. Wanjare et al. [4] proposed "Contactless Smart Attendance System Using Facial Recognition and QR Code". This study was published in International Journal of Engineering and Advanced Technology (IJEAT) in 2024. It is a combination of QR Code and Facial Recognition system to allow contactless attendance and enhance attendance accuracy. You're adding another layer of identity verification, compared to a QR-only attendance system, by using facial recognition. However, the system is still open to QR-code abuse that may allow students to share the QR code and lead to proxy attendance.

Akeeb Patel et al[5]. proposed "Smart Attendance System Using Face Detection and Recognition". The system uses YOLOv8 and FaceNet for face detection and recognition and provides real-time attendance feature. Such technologies help in automating the process of student identification and attendance. The system can give better attendance management than traditional manual ways. But the accuracy of the system may decrease in low light condition which is an important limitation in implementing face based attendance system in different classroom environments.

Achal Nikhade et al[6]. have proposed "SMART ATTENDANCE SYSTEM: An Advanced Attendance System Using QR Code". System uses QR Code technology for automatic registration of attendance. The simplicity, ease and cost effectiveness of QR based attendance makes it a viable option for educational institutions. But, the major limitation of the system is that attendance through proxy is possible as the QR code can be shared with other students. The system, therefore, does not adequately verify identity and physical presence.

RESEARCH GAPS

The review of selected studies shows that the existing smart attendance systems have improved the efficiency of attendance recording by bringing in different technologies for authentication and verification. However, the approaches reviewed still have limitations to reliably confirm the student's identity, physical presence and authenticity of the attendance attempt.

QR-code-based systems enable simple and rapid attendance recording, but they might be vulnerable to QR-code or authentication-information sharing. This means that, if a student is not present, their attendance can be taken by another student. Thus, QR-code authentication alone might not be sufficient to prevent proxy attendance.

Facial recognition-based systems offer biometric identity verification and can help to determine whether the registered student is the person trying to mark the attendance. However, their performance can be impaired by environmental and facial conditions such as poor lighting, different viewing angles and partial occlusion.

Attendance systems based on BLE offer proximity-based verification by detecting the devices of the participants around. However, their working depends on the availability of BLE-

enabled devices, permissions and platform-specific support which can affect practical deployment.

Authentication by acoustic signals attempts to minimize the fraudulent attendance due to sharing of authentication information. However, the successful reception of an acoustic signal does not in itself verify the student's identity or physical presence by any other biometric or location based mechanism. There are also practical challenges of the approach like signal reception, interference and class room conditions.

The combination of QR-code and facial-recognition reviewed in this paper shows how it is possible to integrate different authentication mechanisms to improve attendance verification. But the deficiencies that come with each individual technology like QR abuse and the environmental impact of facial recognition, for example, might still be present.

The main research gap based on the comparison of six studies is that the existing approaches generally focus on particular aspects of attendance verification and do not comprehensively verify the student's identity, physical presence, and authenticity of the attendance attempt at the same time.

QR codes mainly provide convenient authentication but can be abused; facial recognition provides identity verification but may be affected by environmental conditions; BLE provides proximity information but depends on device capabilities and platform support; and acoustic authentication helps mitigate authentication-information sharing but does not provide biometric or location-based confirmation of physical presence by itself.

Therefore, there is a need for further research on multi-layer attendance verification approaches that can combine complementary mechanisms to verify:

- Identify the student → Face/biometric authentication
- Is the student physically present? → Location/proximity validation
- Is attendance session legitimate? Dynamic authentication method
- Is the individual actually present and not faking the system? Liveness/security validation

This research gap lays the groundwork for the future development of more comprehensive anti-proxy attendance systems that can incorporate multiple verification mechanisms while taking into account security, reliability, usability, environmental conditions, and device compatibility.

CONCLUSION AND FUTURE PERSPECTIVES

Six studies review shows different technologies have been used for improving efficiency, automation and security of attendance management systems. QR-code-based methods are simple and fast to implement for recording attendance, but still susceptible to QR-code abuse and proxy attendance. Facial-recognition systems provide biometric verification of identity. But the technology can be thrown off by environmental conditions such as poor lighting, facial pose, and occlusion. BLE-based methods provide proximity-based verification, but require compatible devices, permissions, and platform support. Acoustic signal-based authentication can help reduce fraudulent attendance caused by sharing of authentication information. However, acoustic signal-

based authentication cannot independently verify the identity or physical presence of the student, and may be affected by the signal and classroom conditions.

Further, the reviewed studies suggest that the integration of multiple technologies might enhance attendance verification. However, the approaches presented in this paper do not provide a complete solution for identity verification, physical presence verification, authentication security and protection against spoofing all together. This demonstrates that attendance verification is a domain where multiple complementary mechanisms can be further investigated.

Hence, future work should focus on multi-layer attendance verification approaches combining multiple authentication and verification mechanisms. Such systems may seek to incorporate biometric identity verification, dynamic authentication, location or proximity verification, and liveness detection to enhance protection against proxy attendance . Additionally, future work is recommended to evaluate these approaches under different environmental conditions and consider device compatibility, privacy, security, usability, scalability and computational requirements.

Finally, the reviewed literature paves the way for designing more holistic anti-proxy attendance systems that can verify not only that an attendance request is sent, but also that the request is associated with the correct student and a true physical presence.

References

- [1] Sea, Y., Park, J., Ha, Y., Lee, S., & Lee, J. (2026). Acoustic signal-based smart attendance system for preventing fraudulent. *IEEE Access*.
<https://doi.org/10.1109/ACCESS.2026.3680256A> ([doi.org](https://doi.org/10.1109/ACCESS.2026.3680256A) in [Bing](https://www.bing.com))
- [2] Thai, H.-D., Seo, Y.-S., & Huh, J.-H. (2024). Enhanced efficiency in SMEs attendance monitoring: Low-cost artificial intelligence facial recognition mobile application. *IEEE Access*, 12.
<https://doi.org/10.1109/ACCESS.2024.3504858>
- [3] Pleština, V., Munivrana, L., & Gotovac, S. (2026). Smart attendance: A BLE-based mobile application for real-time session attendance tracking. *IEEE Journal of Radio Frequency Identification*.
<https://doi.org/10.1109/JRFID.2026.3680246>
- [4] Wanjare, S. B., Mahajan, J. R., & Gadekar, S. S. (2024). Contactless smart attendance system using facial recognition and QR code. *International Journal of Engineering and Advanced Technology (IJEAT)*, 13(6).
<https://doi.org/10.35940/IJEAT.F4516.13060824>
- [5] Patel, A., Sonawane, D., Kale, P., Sheikh, R., & Pathan, A. (2025). Smart attendance system using face detection and recognition. *International Journal of Current Science (IJCS PUB)*, 15(4). <https://www.ijcs pub.org/>
- [6] Nikhade, A., Rathod, B., & Ghanmule, S. (2025). *SMART ATTENDANCE SYSTEM: An advanced attendance system using QR code*. Department of Information Technology, KDK College of Engineering, Nagpur.