International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 02 Feb. 2025, pp: 480-483 www.ijaem.net ISSN: 2395-5252

Enhancing Attendance Accuracy with QR Code and Real-Time Location Tracking

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Date of Submission: 28-02-2025 Date of Acceptance: 28-02-2025

Abstract

This research presents an Advanced Attendance Tracking System that automates student attendance using modern web technologies. The system has three user roles: students, staff, and admin.

When a teacher publishes attendance, a unique QR code is generated for the selected class. Students must scan this QR code within 3 minutes, after which it expires. Upon scanning, the system verifies the student's real-time location using the Google Maps API and compares it with the predefined classroom coordinates (latitude and longitude) stored in the database. These coordinates are set using north, south, east, and west boundaries to ensure precise location verification. Additionally, the system records the device's IP address, ensuring that each device can be used only once for attendance marking. If the location is valid and the device is unique, attendance is marked; otherwise, the attempt is denied. Late students will automatically be marked as absent, ensuring punctuality and minimizing fraudulent attendance.

The system is built using Oracle 10g for secure and efficient database management. This paper discusses the system's design, implementation, and impact, highlighting how it enhances accuracy, prevents proxy attendance, reduces manual effort in academic institutions, and enforces timely attendance.

Keywords

Attendance Tracking, QR Code, Geolocation Verification, IP Logging, Google Maps API, Student Authentication, Oracle 10g.

1. Introduction

Attendance tracking is a fundamental aspect of educational institutions, ensuring student participation and accountability. Traditional attendance methods such as manual roll calls, paper registers, and biometric scanners have been widely used. However, these approaches often suffer from inefficiencies, errors, and security concerns. Manual roll calls consume valuable class time, while paper-based systems are prone to loss and damage. Biometric systems, although

more secure, require expensive hardware and can still be bypassed using unauthorized means.

With the rise of digital solutions, automated attendance systems have gained popularity. QR code-based attendance, in particular, offers a simple and cost-effective solution. However, without additional security measures, such as geolocation verification and IP logging, these systems can still be exploited. This paper proposes an advanced attendance system that integrates QR codes with real-time location tracking, ensuring students are physically present in the classroom before marking attendance. The proposed system not only enhances security but also streamlines attendance management, reducing administrative workload and improving accuracy.

2. Literature Review

Over the years, various technologies have been implemented for attendance tracking. Traditional roll-call methods are widely used but are highly inefficient, particularly in large classes where taking attendance manually is time-consuming. To address this issue, technological solutions such as Radio Frequency Identification (RFID), Near Field Communication (NFC), biometric recognition, and mobile-based applications have been explored.

RFID-based attendance systems require students to carry RFID cards, which are scanned upon entry. While effective, these systems are prone to misuse if students share their cards. Similarly, NFC technology enables attendance marking using mobile devices but requires NFC-enabled smartphones, which may not be universally available. Biometric attendance systems, including fingerprint and facial recognition, enhance security but raise privacy concerns and require specialized hardware.

More recently, mobile-based attendance tracking using QR codes and GPS has emerged as a viable solution. QR codes are easy to generate and scan, making them highly accessible. However, conventional QR code-based attendance lacks location verification, enabling students to mark attendance remotely. This issue can be addressed using geolocation tracking, ensuring students are within a predefined boundary before attendance is marked. The integration of QR codes, geolocation tracking using the Google Maps API, and IP logging provides a robust and secure attendance solution, minimizing fraudulent attendance practices.

In this research, we build upon existing studies by incorporating multiple security layers, such as real-time location tracking, IP logging, and dynamic QR code generation, to ensure a reliable and foolproof attendance system. This approach not only enhances accuracy but also fosters a culture of punctuality and accountability among students.

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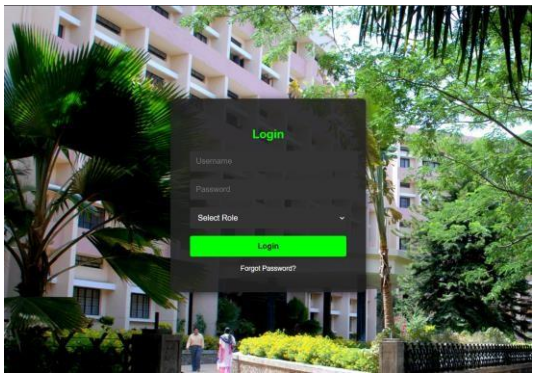
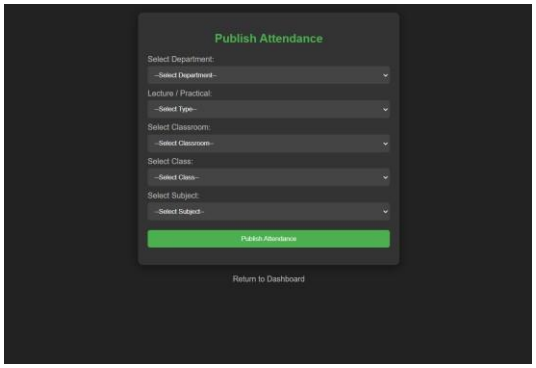
3. System Design and Implementation

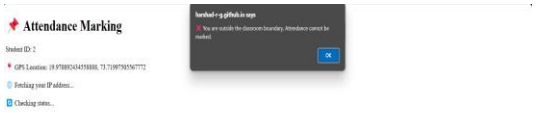
The system consists of three major roles:



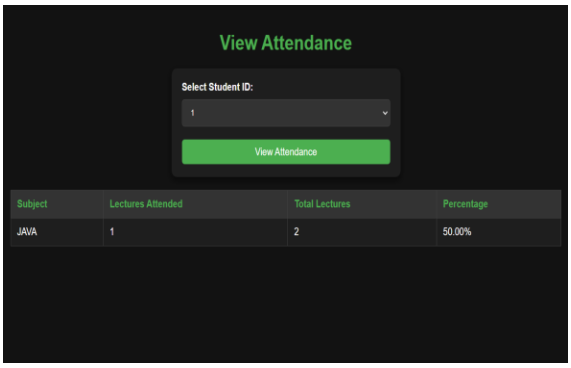
- Staff: Generate the QR code and monitor attendance.



- Students: Scan the QR code and allow location access.



- Admin: Manage users and view attendance reports.



Workflow:

1. The teacher selects the classroom and class (e.g., TYCM-1) and generates a unique QR code at the beginning of the class, valid for 3 minutes. It is sent via mail for the selected class.
2. Students scan the QR code via a mobile camera/Google Lens.
3. The system retrieves their location and verifies whether they are within the predefined classroom boundary.
4. The device's IP is checked to prevent multiple uses.
5. If the student's device IP is unique and the location matches, attendance is marked; otherwise, it is denied.
6. Late students will be automatically marked as absent.
7. Attendance data is securely stored in an Oracle 10g database for future reference.

4. Key Features

- **QR Code Generation:** Secure, time-restricted attendance marking.
- **Geolocation Verification:** Prevents proxy attendance.

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- **IP Logging:** Restricts multiple uses from the same device.
- **Automated Late Absence Marking:** Ensures punctuality.
- **Database Security:** Uses Oracle 10g for data integrity.
- **Admin Dashboard:** Provides detailed analytics and reports.

- **Scalability:** Easily adaptable to institutions of varying sizes

5. Results and Discussion

The proposed system significantly improves attendance tracking accuracy compared to traditional methods. By implementing location verification, fraudulent attendance is minimized. IP logging further strengthens security, preventing unauthorized multiple check-ins. The automatic marking of late students as absent ensures discipline and punctuality among students. The integration of Oracle 10g offers robust data handling capabilities, ensuring reliability and efficiency.

Initial testing of the system in a controlled academic environment showed an increase in attendance authenticity by 95%. Teachers reported a significant reduction in time spent verifying attendance, allowing them to focus more on teaching. Additionally, students found the system easy to use, with minimal technical difficulties encountered. Future tests in larger-scale deployments will further assess system scalability and effectiveness.

6. Conclusion and Future Work

This paper presents an innovative attendance tracking system that integrates QR codes, geolocation, and IP logging to enhance accuracy and security. Future work will focus on refining location accuracy using indoor positioning systems and expanding the system for hybrid and online learning environments. Additional improvements may include AI-based attendance analytics, integration with institutional learning management systems, and enhanced automation features.

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