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Smart Qr Code and Geo-Fenced Attendance System

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Abstract- This paper presents Q-Track, a Smart QR Code and Geo-Fenced Attendance System designed to provide a secure, efficient, and automated solution for attendance management in educational institutions. Traditional attendance systems, including manual registers and biometric methods, suffer from limitations such as time consumption, proxy attendance, and lack of real-time monitoring. To overcome these challenges, the proposed system integrates dynamic QR code generation with geo-location verification.In this system, a unique and time-bound QR code is generated for each class session by the faculty. Students scan the QR code using their mobile devices to mark attendance. To ensure authenticity, the system incorporates geo-fencing technology, which validates the real-time location of the student. Attendance is recorded only when both QR authentication and location verification are successful, thereby eliminating proxy attendance and ensuring reliability.The system is implemented as a web-based application with a user-friendly interface accessible on both mobile and desktop devices. It includes modules for user authentication, QR code generation, attendance tracking, and report generation. Real-time data processing enables faculty to monitor attendance instantly and generate detailed reports for analysis.The proposed solution enhances accuracy, reduces manual workload, and improves transparency in attendance management. By combining QR technology with geo-location services, the system provides a scalable and cost- effective approach suitable for modern academic environments.

Keywords- Smart Attendance System, QR Code-Based Attendance, Geo-Fencing, Automated Attendance, Digital Attendance Management.

I. INTRODUCTION

Attendance management is an essential process in educational institutions to monitor student participation and maintain academic discipline. Traditional attendance methods such as manual registers and biometric systems have several limitations. Manual systems are time- consuming and prone to human errors, while biometric systems require additional hardware and maintenance. Moreover, these systems do not completely prevent proxy attendance or ensure real-time monitoring.

With the advancement of technology, digital attendance systems have been introduced to improve efficiency. Among them, QR code-based systems provide a fast and convenient way to record attendance. However, these systems alone are not fully secure, as QR codes can be shared, allowing students to mark attendance remotely without being physically present.
To address these challenges, this paper proposes Q-Track, a Smart QR Code and Geo-Fenced Attendance System that integrates QR code authentication with location-based verification. In this system, faculty members generate a unique QR code for each session, which students scan using their mobile devices. To ensure authenticity, geo-fencing technology is used to verify whether the student is within the predefined classroom boundary.

The proposed system follows a dual verification mechanism, combining QR code scanning and real-time location validation. This approach effectively eliminates proxy attendance and improves the reliability of attendance data. The system is implemented as a web-based application, making it accessible on both mobile and desktop platforms. Furthermore, the system provides real-time attendance tracking and report generation features, enabling faculty to monitor student participation efficiently. By reducing manual effort and improving transparency, the proposed solution offers a scalable and cost-effective approach for modern attendance management

II. RELATED WORK

The traditional attendance system continues to be widely used in academic institutions, but it suffers from several limitations such as time consumption, manual errors, and proxy attendance. To overcome these issues, various automated attendance systems have been proposed using different technologies.

Web-based attendance systems have been developed to digitize attendance tracking and improve record management. These systems allow faculty to manage attendance through online platforms, but they often lack strong authentication mechanisms. Biometric systems such as fingerprint and facial recognition have also been introduced to enhance security. Although these systems provide better accuracy, they require expensive hardware and may face issues related to maintenance and environmental conditions.

QR code-based attendance systems have gained popularity due to their simplicity and ease of use. In these systems, students scan QR codes to mark attendance, reducing manual effort. However, QR codes can be shared among students, which leads to proxy attendance. To address this issue, some systems have integrated additional verification methods such as time-based validation and secure session management.

Location-based attendance systems using GPS technology have also been proposed to ensure the physical presence of users. These systems use geo-fencing techniques to define a specific boundary within which attendance can be marked. While this approach improves authenticity, it may face limitations such as location inaccuracy in indoor environments.

Recent studies have focused on combining multiple technologies to improve attendance accuracy and security. Hybrid systems integrating QR codes with geo-location verification provide a more reliable solution by ensuring both identity authentication and physical presence. These systems reduce the chances of misuse and enhance overall system performance.

Despite these advancements, many existing systems still face challenges such as scalability, cost, and reliability. Therefore, there is a need for a more efficient and secure attendance system that combines ease of use with strong verification mechanisms.

III. METHODOLOGY

A. Requirements Analysis

The proposed Q-Track system is designed to provide a secure and efficient attendance management solution using QR code and geo- fencing technologies. The functional and system requirements are categorized into student data, class data, and system platform. The system ensures proper authentication, real-time attendance tracking, and location validation.

TABLE 1: FUNCTIONAL REQUIREMENTS

Smart Attendance System	
Objective	Attendance
Platform	Web Application
Student Data	Name Register Number Faculty Course
Class Data	Name Location
	Date Event Start Time, End Time

TABLE 2: SOFTWARE AND HARDWARE REQUIREMENTS

Smart Attendance System	
Software/Hardware	Usage
VS Code	Platform
Laptop with 2GHz CPU, 4GB RAM	Specification for system development
Mobile phone (GPS enabled)	Google lens/any scanner to scan QR code and to share GPS location information

B. Work Flow

BEGIN

// **Step 1:** Scan QR Code Scanned_QR ← Scan_QR_Code()
// **Step 2:** Validate QR Code
IF Validate_QR(Scanned_QR) = FALSE THEN Display("Invalid QR Code. Attendance Denied.")
EXIT END IF
// **Step 3:** Get Student Location Student_Location ← Get_Student_Location()
// **Step 4:** Validate Location
IF Validate_Location(Student_Location) = FALSE THEN Display("Invalid Location. Attendance Denied.")
EXIT END IF
// **Step 5:** Record Attendance Record_Attendance(Student_ID, Session_ID)
// **Step 6:** Confirm Attendance Display("Attendance Successfully Recorded.")

END

The Figure 1 illustrates the workflow of the proposed system, which consists of multiple components such as the Faculty Web Portal, Random QR Code Generation module, Attendance Management module, Student Web Portal, QR Authentication module, Location Validation module, and Database.
Initially, the faculty member generates a unique QR code for each attendance session through the faculty web portal. This QR code acts as a digital token and is specific to a particular class or lecture. Generating a new QR code for every session

ensures security and prevents misuse or reuse of previous QR codes.

Once the QR code is generated, it is shared with students through a classroom display, projector, or online platform. This ensures that only students who are physically present in the classroom or authorized area can access the QR code. Additionally, a limited time window is provided for scanning to avoid unauthorized attendance marking.

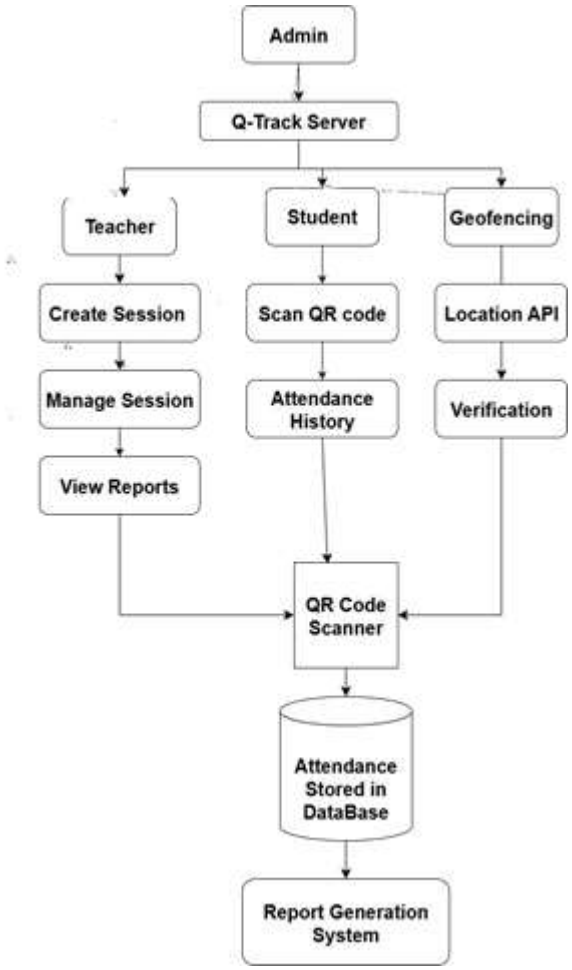

Figure 1: Proposed system work Flow

Record Attendance: If both the QR code and student location are verified successfully, the system records the student's attendance. This automated recording eliminates manual errors and reduces administrative workload. Attendance data is securely stored in the system for future reference and can be used for reports or analytics.

Attendance Successfully Recorded: After successful recording, the system confirms the attendance entry, notifying the student and faculty. This ensures that students have proof of their attendance, and faculty can track attendance records in real time. The automated process enhances accuracy and transparency in student attendance management. instructor can add the students roll numbers manually This section provides step by step screenshots of the suggested prototype. Figure 3 depicts the user interface
where the user must enter a username and password to access the proposed system. Figure 4 depicts the QR code in proposed systems, which offers a modern and efficient alternative for quickly and precisely recording attendance. Users can indicate their attendance without manually

Reject Attendance (if conditions fail): If the QR code is invalid or the student's location does not match the required area, the system rejects the attendance request. A notification is sent to inform the student that their attendance was not recorded. This step prevents proxy attendance, misuse of QR codes, and ensures that only genuinely present students are marked as attended.

IV. IMPLEMENTATION

A. System Architecture

The figure 2 illustrates the architecture of the proposed system. First, the user has to scan the QR code displayed by the teacher using their mobile devices, which takes them to the login page. Once the user login procedure is done then the where user needs to submit their credentials. The application will request the student's location to verify that he or she is at the right location for attendance recording.

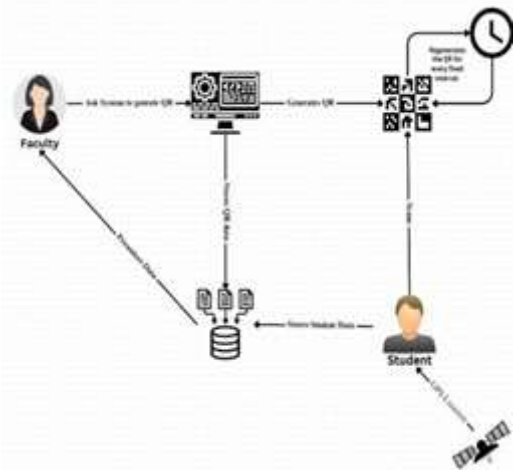

Figure 2: System Architecture

B. Experimental Setup

To evaluate the performance of the proposed system, experiments were conducted within classroom environments in an academic institution. The evaluation focuses on three major aspects: user acceptability, system performance, and system

functionality. The system is designed with two primary interfaces, namely the instructor view and the student view, to ensure smooth interaction and usability for both users.

C. Instructor View

On Web Administration main menu page there are various modules that needs to be manage; Login Page, QR Code Generator, Add manual Roll No. and Download Presenters Data. To take attendance instructor has to login to the web application to generate the QR code. Besides,
entering it by scanning unique QR codes with their mobile devices, reducing errors and saving time. Figure 5 depicts full information on the presenters and absentees list. The complete list of students who attended class can be obtained as a CVS file which is shown in Figure 7.

Figure 3: Login Page

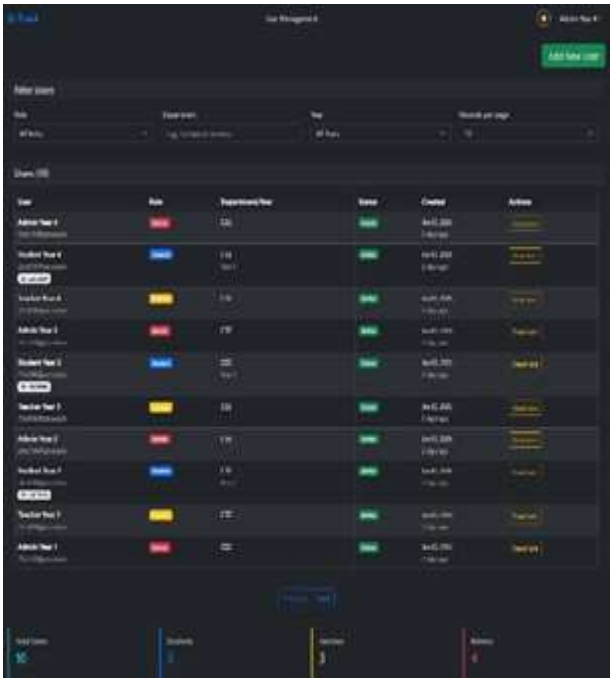

Figure 5: Teacher Page

Figure 4: Admin Page

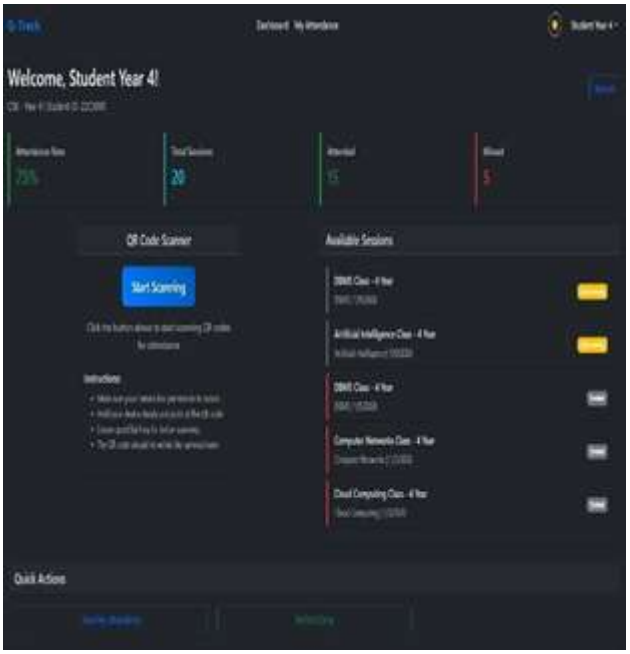

Figure 6: Student Page

Criteria	Technology Used	Authentication Mechanism	User Interfaces / Platforms	Data Acquisition & Management	Verification & Validation	Unique Features / Strengths
Attendance Monitoring System Using Face Recognition	Face recognition (image capture, grayscale images)	Facial recognition with 60-image registration	User-friendly GUI for attendance tracking."	Multiple facial captures, CSV/DB storage, notifications.	Face-matching based attendance verification.	Biometric attendance with notifications and feedback
QR Code Based Attendance Management System	QR code generation and scanning	Dynamic QR code-based attendance system	Web for teachers, mobile for students.	QR-based attendance system with web access.	QR-based attendance with error minimization	Costeffective digital attendance for institutions.
A Location and QR Code-Based	QR code generation with location	Session QR + GPS for verification	"Faculty and Student Web Portals for	Dualverification automated attendan	QR authentication with location verification.	Dynamic QR and location validat
Solution for Efficient Attendance Management	validation (using GPS, Wi-Fi, or geofencing)		realtime attendance management	ce system.		ion ensure accuracy, security, and transparency.

VI. RESULTS AND DISCUSSION

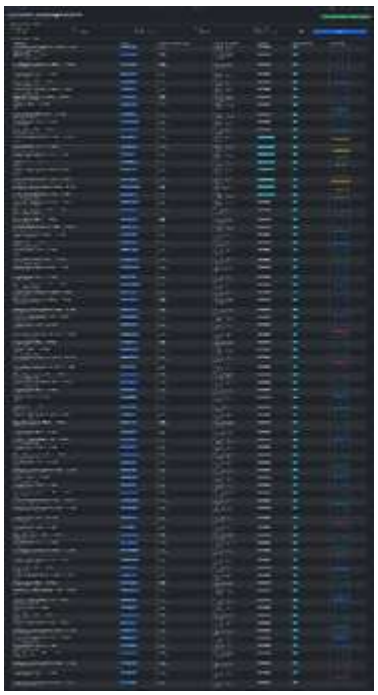
Figure 9: Attendance Check-in Counts per Minute

Thesmart attendance system was tested to determine its efficacy and accuracy with students in a real- classroom setting. A projector presented a dynamically created QR code, which was scanned by the students using their smartphone. The system utilizes react for the front, firebase firestore for storage of attendance, and students GPS-based location tracking to be present physically in the classroom. Every session began with a unique QR code generating staff that refreshes time- time to prevent abuse. The student had to scan this QR code, and the application verified it with session details. The system also received GPS coordinates that the student was inside the classroom. Provided both the QR code and location-based verifications were successful, the appearance was recorded in the Firebase, and success message is displayed. The appearance for invalid QR scans or wrong locations was denied, preventing proxy appearance through device ID tracking. Taking the error includes log analysis for manual troubles and performance

evaluation. The expected result was a fast, automatic and accurate appearance process with minimal faculty intervention.

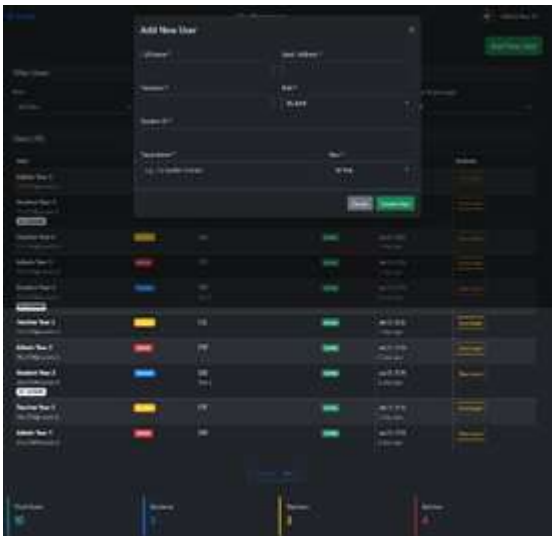

Figure 10: Trend of Attendance Check-ins over Time

Together, location verification and dynamic QR scanning offer a good, robust and scalable solution for attendance management. The method of this system provides several advantages. When compared to the existing digital attendance system, the developed system completed the task in less time, as shown in Figure 11 below.

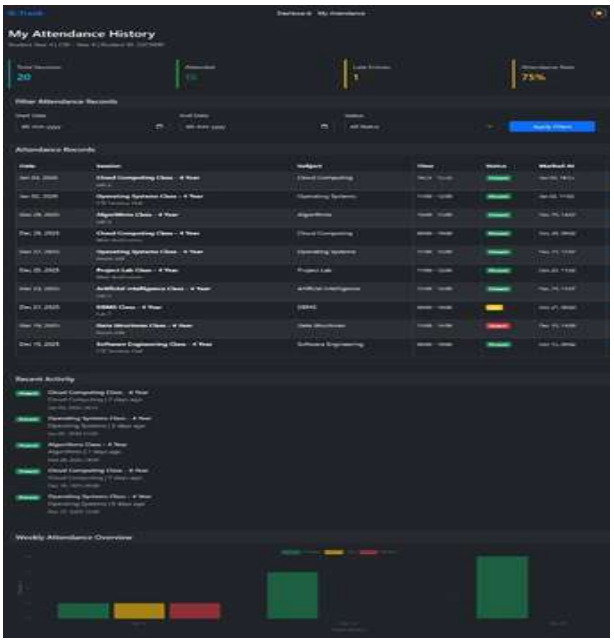

Figure 11: Time taken by Existing Digital Attendance System and smart attendance

VII. CONCLUSION

It allows the recording of student attendance through QR codes, ensuring exhaustive management of attendance for students by improving recording efficiency and accuracy. Add Roll No., where the teacher adds a roll number of a student and assists the students to get accounted for even with technical issues. The View Attendees feature gives real- time visibility into who has scanned the QR code by listing presentees in an ordered list so that faculty can track attendance throughout the session. The Download List feature also allows faculty to save the attendance data as an Excel file to maintain records and access them at a later time. Finally, the Stop QR locks the session by turning off any further scanning of QR codes and makes the instructor download the list of attendance, thus completing the attendance record. All such features thus make attendance a smooth and reliable procedure and ensure adaptability towards different classroom scenarios with an improvement towards experience in academic management.

FUTURE WORK

The future research directions are as follows:
Machine learning for anomaly detection: Developing machine learning algorithms will detect unusual attendance patterns. It may be variations such as frequent check-ins coming from the same source or irregular checking times that can prevent or detect fraud behaviour.
Facial Recognition for security purposes: By adding Facial Recognition as another authentication factor will enhance the stem and reduce spoofing

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