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Geo-QR Attendance Tracking Technique

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ABSTRACT

GPS In the modern era of digitization, educational institutions face the need for reliable, efficient, and secure systems to manage student attendance. Traditional attendance methods such as roll calls, paper-based registers, and biometric systems pose limitations including manual errors, proxy attendance, hygiene concerns, and high implementation costs. To overcome these issues, the Geo-QR Attendance Tracking System has been developed as a smart, contactless, and automated solution. This system leverages a combination of QR code scanning, real-time GPS location verification, and secure cloud storage using Firebase Realtime Database. For every lecture, the teacher generates a unique time-bound QR code which students scan via a web-based interface using their mobile devices. The system verifies the student's physical presence by capturing GPS coordinates and comparing them with the allowed location range.

The system also includes mechanisms to prevent duplicate attendance for the same session. Additionally, teachers can generate subject-wise reports in Excel format, while students receive monthly attendance summaries via email. A real-time dashboard with graphical visualizations (pie charts, bar graphs, etc.) helps teachers analyze trends by subject, date, and individual student. This solution is lightweight, cost-effective, and scalable, making it ideal for schools and colleges aiming to enhance accuracy, accountability, and transparency in attendance tracking..

KEYWORDS : Geo QR, Smart Attendance, GPS Tracking, Firebase Real-time Database, QR Code System, Web Application, Google Sign-In, Location-Based Validation, Real-Time Attendance , Location Verification Algorithm .

INTRODUCTION

The Geo QR Attendance Tracking System offers a modern, contact-less way to record student attendance. It uses QR code scanning and GPS location verification to ensure that students are physically present at the right place and time. The system works in real time and stores attendance data securely in the Firebase Real-time Database. Students can log in using their Google accounts, eliminating the need for manual registration. The system generates a unique QR code for each session, valid for a specific duration and location. Students scan this code to mark their attendance, which is verified through their device's GPS. The system is easy to use, cost-effective, and runs on basic hardware, making it suitable for schools and colleges. Teachers can download Excel reports, and students receive monthly attendance summaries via email. The system generates a unique QR code for each session, valid for a specific duration and location. Students scan this code to mark their attendance, which is verified through their device's GPS. The system is easy to use, cost-effective, and runs on basic hardware, making it suitable for schools and colleges. Teachers can download Excel reports, and students receive monthly attendance summaries via email.

LITREATURE SURVEY/BACKGROUND

- Traditional Technologies:
Researchers have explored RFID, biometrics, and facial recognition for attendance. While RFID offers speed, it allows proxy if cards are shared. Biometric systems face hygiene and cost issues; facial recognition struggles with lighting and requires expensive cameras. [1][2]
- Technological limitations related Many existing systems lacked a unified approach—either verifying identity (via login) or physical presence (via scan), but not both. This reduced reliability in practical classroom settings. [4].
- Prior QR-based models did not include GPS location checks. Others were overly dependent on cloud servers or failed offline. These gaps limited their scalability and accuracy. [4].
- Proposed smart solution realted The integration of QR scan, Google login, GPS location, and Firebase enables accurate and secure attendance. The system works on any basic device with a camera and internet, avoiding high infrastructure costs and ensuring real-time data handling. [5]

PROPOSED WORK

The proposed system aims to solve the problems of manual attendance, proxy entries, and lack of location verification by developing a smart, secure, and real-time attendance tracking system. The main objective is to combine QR code scanning, GPS location verification, and cloud-based storage to ensure reliable attendance records in educational institutions. In this system, each lecture session begins with a teacher generating a unique QR code that contains session details like subject name, date, time window, and expected GPS location. This QR code is valid only for a limited time and within a specific area.

I . System Architecture :

1. User Interface Layer: The system provides a responsive web-based interface that allows both students and teachers to easily access and interact with attendance features from any device.

2. Authentication Module: User identity is securely verified through Google Sign-In, ensuring automatic and reliable authentication without the need for manual registration.

3. QR Code Management: Teachers create unique QR codes for each class session that remain active only during predefined time intervals to prevent misuse.

4. Location and Scan Verification: The system captures the student's GPS location at the moment of QR code scanning and validates that the scan occurs within the allowed geographic area and time window.

6. Real-Time Dashboard and Alerts: Teachers have access to a live dashboard displaying current attendance status, and the system generates alerts for any invalid or suspicious scan attempts.

7. Reporting and Access Control: Automated attendance reports are generated regularly, with access permissions tailored to different roles—students, teachers, and administrators—to maintain data security and proper system governance.

II . Algorithm :

Geo-QR Attendance Tracking:

The teacher generates a unique QR code with a specific time window and subject details. Students scan the QR code through a web interface, which captures their real-time GPS location and timestamp. The system validates the scan by checking if the time and location fall within the allowed range. If valid and not previously recorded, the attendance is logged into the central database. Monthly reports are then generated and sent automatically to students.

System Algorithm Steps

Input: Teacher session details, student Google Sign-In, QR code scan, GPS location, and current time .

Output: Verified attendance record stored and confirmation or error message sent to the student .

Step 1: Student Login

- Authenticate the student using Google Sign-In and retrieve name and email ID.

Step 2: QR Code Scan

- Student scans the QR code generated by the teacher, which contains encoded data such as Subject, Session-ID, Start-Time, and End-Time..

Step 3: Capture Time and Location

- Fetch current system time and obtain student's real-time GPS coordinates.

Step 4: Time Validation

- Check if the current time falls within the QR code's valid time window.

Step 5: GPS Validation:

- If location is outside the allowed radius, mark it invalid.

Step 6: Attendance Decision

- If time valid and GPS location valid → Proceed to mark attendance.
- Else → Show error message ("Late", "Outside Location", or "Invalid QR").

Step 7: Record Attendance

- Store the following details in the database. Student-Name, Email, Subject, Session-ID, Time-stamp, GPS Coordinates.

Step 8: Send Confirmation

- Display a success message on-screen and optionally send confirmation via email or app.

III. Predictive Analytics :

Attendance Trend Analysis and Risk Prediction : The system uses past attendance data to identify patterns and predict which students may face attendance problems. This helps teachers detect issues early and provide personalized support or counseling to students at risk of low attendance..

Resource Optimization and Automated Alerts : By analyzing attendance trends and related factors like exams or holidays, the system helps schools plan resources efficiently. It also sends automatic reminders to students and parents to improve attendance and reduce absenteeism.

IV. Real-Time Dashboard Interface :

- **Data Receiver :** Collects student details, GPS location, and timestamp in real-time after QR scan, and stores it securely in the database..
 - **Visualization Layer :** A web dashboard built with React.js and Plot to visualize:
 - Converts raw attendance data into visual formats for better understanding.
 - Utilizes tools like Chart.js or Google Charts for dynamic graphs.
 - Displays data through pie charts, bar graphs, and heat-maps.Helps teachers analyze trends by subject, date, and student.Updates visualizations in real time as new attendance is logged.
- **Alert System :** Sends instant notifications for invalid scans or suspicious activities like location mismatch or late attendance.
- **Logging and Reporting :** Records every scan event with full details and auto-generates monthly reports for students and teachers.

V. Decision Support and Reporting :

- **Analytical Tools :** Uses charting libraries (e.g., Chart.js, Google Charts) to generate real-time insights. Analyzes attendance patterns by time, subject, and student performance.
- **Reporting Framework :** Auto-generates monthly reports in Excel/PDF formats. Email-based delivery system sends individual attendance summaries to student.

VI. User Interface :

- **Secure and User-Friendly Access :** The system uses Google Sign-In for automatic and reliable student authentication, capturing verified identity details.
- **Web-Based QR Scanning:** Students mark attendance by scanning QR codes via a browser, eliminating the need for app installation and simplifying the process.
- **Real-Time Dashboard:**Teachers monitor attendance live with location and timestamp data, enabling immediate insights and management.
- **Alert System:** The platform notifies users of invalid scans occurring outside authorized times or locations to maintain data accuracy.
- **Detailed Reporting and Export :** Teachers generate and export comprehensive attendance reports filtered by multiple criteria for efficient analysis.
- **Role-Based Access Control:** Different permissions ensure secure, role-appropriate access for students, teachers, and administrators.

System Functionality :

- 1.**GPS Location Verification:** Students' real-time GPS data is captured to verify their physical **presence during scanning**.
- 2.**Attendance Validation:** Scans are accepted only if done within allowed time and location limits.
- 3.**Centralized Data Storage:** Attendance records are safely stored in a centralized database for easy access.
- 4.**Duplicate Prevention:** Multiple attendance entries by the same student for one lecture are prevented.
- 5.**Automated Monthly Reports:** Attendance summaries are automatically generated and emailed to students each month.

RESULT AND DISCUSSION

The system effectively ensures accurate attendance tracking by combining QR code scanning with GPS and time validation. This approach prevents proxy attendance and ensures students are physically present during classes. Google Sign-In automates student authentication, reducing errors from manual entry. Attendance data is securely stored and updated in real-time using Firebase, allowing immediate access for teachers. The system runs efficiently on basic smartphones without requiring costly hardware. Automated monthly reports are emailed to students, keeping them informed about

their attendance status. Teachers can download comprehensive Excel reports for easy analysis. The real-time dashboard helps monitor attendance trends and detect irregularities quickly. Alerts notify users of invalid scans to maintain data integrity. Overall, the system improves transparency, accountability, and communication in educational settings. It is a scalable, cost-effective, and user-friendly solution suitable for schools and colleges. By leveraging existing technologies, the system modernizes attendance management. It saves time for both students and teachers. The system's cloud-based architecture ensures data security and easy maintenance. This project demonstrates a practical and innovative way to enhance student attendance monitoring..

CONCLUSION

The Geo QR Attendance Tracking System offers a modern and effective solution to traditional attendance problems. By combining QR code technology with GPS verification, it ensures that attendance is marked only when students are physically present at the correct location and time. This reduces the chances of proxy attendance and increases accountability. The system's use of Google Sign-In for automatic student identification simplifies the process and eliminates manual errors. Real-time data acquisition and validation provide accurate attendance records that are securely stored in the cloud. Additionally, teachers can easily generate QR codes and access detailed attendance reports, making management more efficient. The integration of monthly email summaries keeps students informed about their attendance status, promoting transparency and responsibility. The system is designed to be cost-effective and accessible on basic mobile devices, making it suitable for educational institutions of all sizes. Overall, this project demonstrates how combining existing technologies such as QR codes, GPS, and cloud databases can create a reliable, user-friendly attendance tracking system. The Geo QR Attendance Tracking System is a practical step forward in modernizing educational administration and ensuring accurate student monitoring.

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