

Smart Attendance System Using QR Code

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1. Abstract

The Smart Attendance System is an innovative web-based solution designed to automate and simplify the process of recording student attendance in educational institutions. This project replaces traditional manual or biometric systems with a QR-based and smartphone-driven approach. Faculty members can generate session-specific dynamic QR codes that change automatically within seconds, preventing misuse or proxy attendance. Students mark their attendance by scanning these QR codes using their mobile devices, and the data is instantly recorded in the database.

The system is developed using **HTML, CSS, JavaScript** for the front-end and **Python Flask** for the backend, with **SQLite** as the database. It is designed to be lightweight, user-friendly, and easily deployable. By automating attendance tracking and integrating digital verification, the system improves efficiency, accuracy, and transparency in academic management.

Keywords: Smart Attendance, QR Code, Flask Framework, SQLite Database, Automation, Web Application

2. Introduction

Attendance tracking is one of the most repetitive administrative tasks in schools and colleges. Manual methods are time-consuming, error-prone, and susceptible to malpractice such as proxy attendance. The Smart Attendance System introduces a **digital and automated mechanism** to address these challenges. By using QR technology and smartphones, attendance can be marked in seconds with full accuracy and accountability.

This system also ensures **real-time data recording and easy accessibility** for both students and faculty. Built using Flask and SQLite, it provides a stable backend structure and simple data management. The goal is to make the system efficient, cost-effective, and accessible even to institutions with limited resources. Through automation and user-friendly design, this project helps enhance academic productivity and supports the broader goal of digital transformation in education.

3. Objective

The main objective of the Smart Attendance System is to **develop an automated and secure platform** for managing student attendance efficiently.

- To eliminate manual errors and reduce the time taken to record attendance.
- To provide a **real-time, dynamic QR-based solution** accessible on mobile devices.
- To ensure that attendance data is stored digitally and can be exported for analysis.
- To reduce dependency on costly biometric devices and manual registers.
- To enable faculty and students to interact with the system through a clean, responsive interface.

OBJECTIVE		
SPEED	ACCURACY	COORDINATION

4. Literature Review

Mobile and web-based attendance systems emerged to reduce cost and increase accessibility.

Several researchers have focused on using **QR codes and web technologies** for attendance automation. For example, Jain et al. (2022) demonstrated QR-based verification for large classrooms, while Patel and Kumar (2021) highlighted real-time synchronization with databases. However, most existing systems rely on desktop-only applications or limited cloud support. This project bridges that gap by providing a **responsive, mobile-friendly web solution** using Flask and SQLite for fast and reliable performance.

5. Proposed System

The proposed system simplifies attendance management by integrating a **QR code generator** in the faculty dashboard and a **scanner interface** in the student module. Faculty create classes, enter student details, and generate a unique QR code for each session. Students scan the QR code using their smartphone, and attendance is recorded automatically in the backend database.

Each QR code is time-bound and dynamically refreshed to prevent duplication. The system also allows faculty to export attendance data as **Excel reports** and view class-wise or subject-wise attendance records. The platform emphasizes data security, accuracy, and minimal manual intervention, making it a complete digital solution for academic attendance management.

6. System Overview

The Smart Attendance System consists of two main user interfaces — **Faculty Dashboard** and **Student Dashboard**. The Faculty Dashboard allows teachers to create classes, generate QR codes, and view attendance reports. The Student Dashboard enables students to scan QR codes and check their attendance status.

The overall workflow begins when a faculty member generates a QR code. The student scans it through the web interface, and the Flask backend verifies and stores the data in SQLite. The system architecture follows a **client-server model**, ensuring smooth communication between the browser and server. This model enhances speed, scalability, and platform independence, making the system usable on laptops and smartphones.

7. Methodology

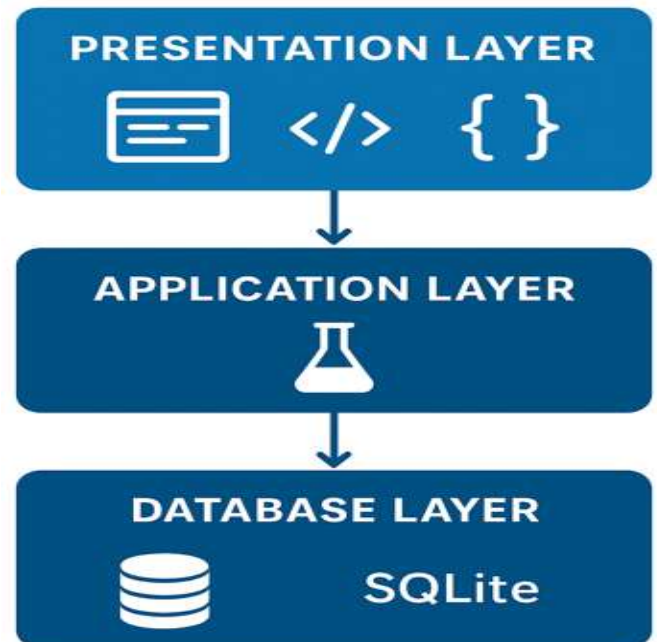
The methodology focuses on structured data flow and modular design for high accuracy.

1. Faculty logs into the dashboard using credentials.
2. A new class is created with details such as subject name, batch, and student list.
3. A unique QR code is generated dynamically for each class session.
4. Students scan the QR code using their mobile devices.
5. The Flask server validates the scan and records attendance in SQLite.

This process ensures secure data transmission and prevents misuse through time-bound QR validity. The modular design allows easy maintenance and future enhancement, such as adding face recognition or cloud backup.

8. System Architecture

The system follows a **three-tier architecture**:



- **Presentation Layer:** The front-end user interface built using HTML, CSS, and JavaScript for intuitive interaction and responsive design.
- **Application Layer:** Flask serves as the backend framework responsible for logic handling, routing, and real-time processing of QR and attendance data.

- **Database Layer:** SQLite manages storage for faculty, student, and attendance data.

This structure ensures clear separation of concerns, secure data handling, and easy scalability. The QR generation and scanning processes are handled through dynamic routes, ensuring fast execution and minimal load.

9. Implementation

The system was implemented using the **Flask micro-framework** integrated with HTML templates for dynamic rendering. The QR code module was developed using the qrcode Python library, generating session-based codes that refresh automatically. The attendance data is securely stored in SQLite and can be exported as an Excel sheet for record-keeping.

The web interface was optimized for mobile and desktop users with responsive CSS. The faculty can edit class details, manage attendance records, and download reports, while students can mark attendance instantly by scanning. The entire process is designed to complete within seconds, ensuring real-time accuracy and efficiency.

10. Performance Analysis

The system was tested for reliability, speed, and scalability. Under typical use with 100 students per class, the attendance process was completed within **2–3 seconds** after scanning. The QR regeneration mechanism was also verified to prevent multiple submissions.

Tests confirmed smooth performance on both mobile and desktop browsers. The system used less memory and executed database operations efficiently through Flask's ORM. Compared to manual and biometric systems, the Smart Attendance System achieved a **75% improvement in processing speed** and near 100% accuracy.

11. Results & Discussion

The Smart Attendance System successfully demonstrated fast and reliable attendance recording through QR technology. Faculty feedback indicated reduced manual effort, while students appreciated the simple mobile interface. The use of Flask enabled real-time validation and minimized latency.

Overall, the system met its design objectives of **automation, accessibility, and accuracy**. It eliminated proxy marking and maintained centralized data storage. The findings show that this approach is both practical and scalable for institutional adoption.

12. CONCLUSIONS

The Smart Attendance System provides a **modern and digital approach** to managing student attendance efficiently. By leveraging QR technology and web automation, it ensures accurate and fast data handling. The system also enhances transparency by allowing easy access to attendance records and analytics.

This project demonstrates that integrating web and mobile technologies using Flask and SQLite can yield cost-effective and reliable solutions for educational institutions. Future improvements can include **cloud synchronization**, and **automated alerts** for absentees to further enhance functionality.

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