



International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 05, May 2026)

Smart Attendance System using QR Code

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Abstract:- Attendance management is an essential activity in educational institutions. Traditional attendance methods require manual effort and are often affected by errors, time delay, and proxy attendance. To improve the attendance process, this project introduces a Smart Attendance System that combines QR code scanning and face verification. In this system, the faculty displays a QR code through the laptop. Students access a mobile-based attendance webpage, enter their details, and scan the QR code. After successful scanning, the system automatically opens the face verification camera for identity confirmation. Attendance is marked only after completing both processes.

The proposed system improves security, minimizes fake attendance, and reduces manual work. The project is implemented using HTML, CSS, JavaScript, QR code technology, and browser camera access. The system provides a simple, secure, and user-friendly solution for digital attendance management

Keywords:- QR Code, Attendance System, Face Verification, Web Application, Student Attendance, Camera Verification.

I. INTRODUCTION

Attendance plays a major role in monitoring student participation and academic performance in educational institutions. Many colleges still depend on manual attendance methods, where faculty members record attendance using registers or spreadsheets. These methods consume time and may lead to incorrect records. In recent years, digital attendance systems have become more popular due to their speed and efficiency. However, systems that use only login credentials or QR codes may still allow proxy attendance. Therefore, there is a need for a more secure attendance mechanism.

This project introduces a Smart Attendance System using QR code scanning and face verification. The faculty displays a QR code on the laptop screen during class hours. Students log into the attendance webpage using their mobile phones and scan the QR code. Once the QR code is scanned successfully, the face verification camera opens automatically to confirm the student identity. The main goal of the project is to provide a secure and automated attendance solution that is simple to use and easy to implement in educational institutions.

II. RELATED WORK

Several researchers have developed automated attendance systems using different technologies to improve attendance management efficiency and security.

A. QR Code-Based Attendance System

QR code-based attendance systems use unique machine-readable codes to identify students quickly. Researchers developed systems where faculty members generate session-specific QR codes and students scan them to record attendance. These systems reduce manual workload and improve attendance recording speed. However, QR-only systems may still allow unauthorized attendance if QR codes are shared among students.

B. Facial Recognition Attendance Systems

Facial recognition systems use biometric authentication to identify students automatically. Cameras capture facial images and compare them with stored facial datasets for identity verification. Improve authenticity and eliminate manual intervention.

However, environmental conditions such as lighting, camera quality, and face positioning can affect recognition accuracy.

C. RFID And Biometric Attendance Systems

RFID-based attendance systems use smart cards or tags for student identification. Fingerprint-based systems authenticate users through biometric verification. These systems improve automation but may suffer from hardware limitations, maintenance costs, and proxy attendance risks if cards are exchanged between students.

D. Web-Based Attendance Platforms

Modern attendance systems are increasingly implemented through web-based applications that provide centralized data storage and remote accessibility. Such systems allow faculty members to monitor attendance records, generate reports, and manage student information through secure dashboards.

2.1. Techniques Used in Smart Attendance System Using QR Code

The Smart Attendance Management System uses multiple technologies and authentication mechanisms to improve attendance accuracy, security, and operational efficiency. The major techniques implemented in the system are explained below.

A. QR Code Generation Technique

QR code technology is used to generate unique digital identities for students. During registration, every student receives an individual QR code linked with their academic details.



The QR code contains encoded student information and is scanned during attendance sessions for quick verification.

B. Facial Recognition Technique

Facial recognition is used as a biometric authentication mechanism to prevent proxy attendance. The system captures facial images using a camera and compares them with stored facial datasets. Facial feature extraction and comparison techniques help validate student identity accurately.

C. Database Management Technique

The system uses MySQL database technology for storing student information, QR code details, attendance logs, and authentication records. Centralized database management improves data consistency, security, and retrieval efficiency.

The attendance platform is developed using Flask web framework. Secure login authentication is implemented for administrators, faculty members, and students to ensure controlled access to attendance records and management functionalities.

E. Real-Time Attendance Verification

The system verifies attendance instantly during QR scanning or facial authentication. Attendance details are automatically updated in the database along with date and time information.

F. Automated Report Generation

Attendance reports are generated automatically based on student records, subject sessions, and attendance percentage calculations. This reduces manual documentation work for faculty members.

2.2 Challenges Smart Attendance System Using QR Code

Developing a secure and efficient attendance management system involves several technical and operational challenges.

Facial Recognition Accuracy: Facial recognition performance may be affected by lighting conditions, camera quality, facial expressions, and head positioning. Poor environmental conditions can reduce recognition accuracy.

QR Code Sharing Risk: Students may attempt to share QR codes with others to mark proxy attendance. Additional biometric authentication is required to improve attendance authenticity.

Large Database Management: Educational institutions may contain thousands of student records. Managing large volumes of attendance data efficiently requires optimized database design and storage mechanisms.

System Security: Attendance systems store sensitive academic and biometric information. Protecting the system from unauthorized access, data leakage, and cyber threats is an important challenge.

Internet Dependency: Web-based attendance systems require stable internet connectivity for real-time synchronization and database updates. Poor connectivity may affect attendance processing.

Hardware Limitations: Facial recognition requires cameras and sufficient processing capability. Low-quality hardware may reduce system performance and response speed.

Scalability Issues: The system must support increasing numbers of students, faculty members, and attendance sessions without affecting overall performance.

III. EXISTING SYSTEM

Traditional attendance systems mainly depend on manual attendance recording using registers, spreadsheets, or verbal roll calls. These methods require continuous human involvement and consume significant classroom time. Manual attendance systems are prone to errors such as duplicate entries, missing records, and incorrect attendance marking. Some institutions use biometric attendance systems such as fingerprint scanners and RFID card readers to automate attendance recording. Although these systems improve operational efficiency, they also face several challenges. RFID cards can be shared among students, resulting in proxy attendance. Fingerprint systems require dedicated hardware and may experience slow processing in large classrooms. Basic digital attendance systems provide electronic storage but often lack advanced authentication mechanisms.

3.1 Limitations of Existing System

A. Time Consumption: Manual attendance methods consume valuable teaching time during every classroom session.

B. Human Errors: Incorrected entries, missed attendance marking, and duplicate records frequently occur in manual systems.

C. Proxy Attendance: Students can mark attendance on behalf of absent classmates.

D. Poor Data Management: Maintaining large attendance records manually creates storage and retrieval difficulties.

E. Limited Security: Most traditional systems do not provide strong authentication and data protection mechanisms.

F. Lack of Real-Time Updates: Attendance reports are not updated instantly, making monitoring difficult.

3.2 Advantages of Existing System

A. Easy Attendance Maintenance: The existing attendance system provides a simple method for maintaining student attendance records in schools and colleges. Faculty members can manually record attendance without requiring advanced technical knowledge or specialized training. This makes the system easy to use in small educational institutions.

B. Low Initial Investment: Traditional attendance methods require only basic materials such as attendance registers, spreadsheets, or simple biometric devices. Since the system does not depend heavily on advanced software infrastructure, the implementation cost remains comparatively low for institutions.

C. Simple Record Management: Existing systems allow institutions to maintain attendance records in a structured format. Faculty members can verify attendance details manually and preserve records for academic evaluation and reporting purposes.

D. Basic Student Monitoring: Manual and traditional attendance systems help teachers monitor student participation and classroom discipline. Regular attendance tracking supports academic performance evaluation and institutional management activities.

E. Image Quality Degradation: After decryption, some systems may produce slight image distortion or quality loss. This is a serious limitation in fields such as medical imaging and military surveillance where exact image recovery is necessary.

F. Minimal Technical Requirements: Most traditional attendance systems operate without requiring internet connectivity, cloud storage, or high-end hardware devices. This makes them suitable for institutions with limited technical infrastructure and resources.

G. Reduced Administrative Workload: The proposed system reduces the workload of faculty members and administrative staff by automating attendance recording, data storage, and report preparation. Teachers no longer need to maintain physical registers or perform manual attendance calculations, which improves productivity and allows them to focus more on academic activities.

IV. PROPOSED SYSTEM

The proposed Smart Attendance Management System introduces a secure and automated attendance platform using QR code technology and facial authentication. The system is implemented as a web application using Python and Flask framework. During registration, each student provides personal information and facial data. The system generates a unique QR code for every registered student and securely stores all information in the database.

Faculty members can create attendance sessions through the administrative dashboard. The proposed solution minimizes manual intervention and prevents proxy attendance through biometric verification. The integration of QR scanning and facial authentication improves flexibility, reliability, and operational efficiency.

A. Automated Attendance Recording: The system records attendance automatically without manual intervention.

B. Reduced Proxy Attendance: Facial authentication prevents unauthorized attendance marking.

C. Fast Processing: QR code scanning enables quick and contactless attendance verification.

D. Real Time Monitoring: Attendance records are updated instantly in the database.

E. Centralized Data Management: All attendance records are securely stored and easily accessible.

4.1 Advantages of Proposed System

A. Improved Attendance Accuracy

The proposed Smart Attendance Management System improves attendance accuracy by automating the verification process using QR code scanning and facial authentication. Automated processing minimizes human errors such as duplicate entries, incorrect marking, and missing attendance records.

B. Prevention of Proxy Attendance

The integration of facial recognition technology significantly reduces proxy attendance. Since attendance is verified using biometric facial features, unauthorized users cannot easily mark attendance on behalf of absent students.

C. Faster Attendance Processing

QR code scanning enables quick and contactless attendance verification. Students can complete attendance procedures within a short duration, reducing classroom time consumption and improving overall academic efficiency.

D. Real-Time Attendance Monitoring

The system updates attendance records instantly in the centralized database. Faculty members and administrators can monitor attendance information in real time and generate reports whenever required.

E. Centralized Data Storage

All student information and attendance records are securely maintained within a centralized database system. This improves record organization, simplifies data retrieval, and reduces the risk of data loss associated with manual documentation.

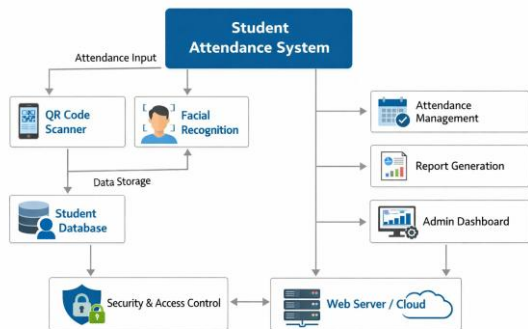
F. Enhanced Security and Reliability

The proposed system uses secure authentication mechanisms and controlled user access to protect sensitive academic information.

V. SYSTEM ARCHITECTURE

5.1 System Overview

System architecture defines the structure and interaction of different modules within the Smart Attendance Management System. The architecture consists of registration module, QR generation module, facial authentication module, attendance verification module, database module, and report generation module.



5.2 Modules And Functionalities

A. Registration Module:

This module collects student information such as name, roll number, department, and facial images. The collected information is stored securely in the database.

B. QR Code Generation Module

A unique QR code is automatically generated for every registered student. The QR code acts as a digital identity for attendance verification.

C. Facial Authentication Module

This module captures facial images through a camera and compares them with stored facial datasets for identity verification.

D. Attendance Verification Module

The system verifies attendance either through QR scanning or facial recognition. Verified attendance records are updated automatically.

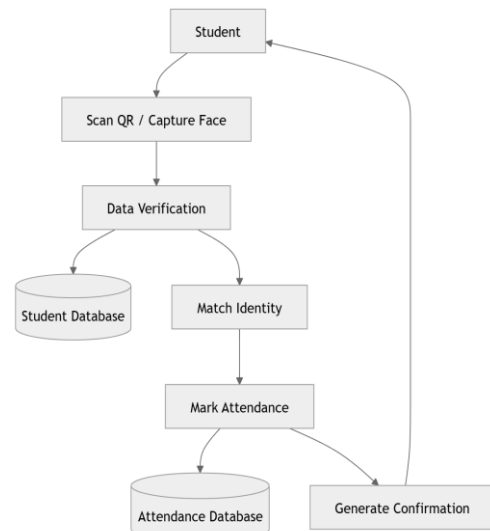
E. Database Module

The database stores student information, QR codes, attendance records, session details, and authentication data securely.

F. Report Generation Module

Faculty members can generate attendance reports based on student records, subject sessions, and date-wise attendance information.

5.3 ER DIAGRAM



5.3.1. Work Flow

The steps taken when a user interacts with the Student Attendance System are described in the system process. It guarantees accurate attendance recording, safe identification, and seamless operation.

User Authentication: Using a working username and password, the instructor or student accesses the system. Before allowing access, the system uses the database to confirm the credentials.

Attendance Request Processing: Depending on the system settings, students can use facial recognition or QR code scanning to record their attendance after successfully logging in.

Database Communication: To store and retrieve data, including student information, attendance records, QR codes, and face data, the program talks with the MySQL/SQLite database.

Verification and Logging: The system uses face recognition and QR codes to confirm the user's identification. Every activity related to attendance is entered into the database for tracking and reporting purposes.

Report Generation: For academic analysis and record keeping, administrators can create attendance reports in formats like PDF



VI. METHODOLOGY

The methodology of the Smart Attendance Management System begins with student registration. During registration, users provide personal details and facial images, which are stored securely in the database. The system generates unique QR codes for registered students. When attendance sessions are created, students can mark attendance through QR scanning or facial verification. In QR-based verification, the system scans the unique QR code and validates student identity. In facial recognition, the system captures real-time facial images and compares them with stored facial embeddings. After successful verification, attendance information is recorded automatically with timestamps and session data. Faculty members can monitor attendance records and generate reports through the administrative dashboard. The methodology ensures secure, efficient, and accurate attendance management while reducing manual effort and preventing unauthorized attendance marking.

VII. IMPLEMENTATION

The implementation of the Smart Attendance Management System is carried out using Python programming language and Flask web framework. Front-end interfaces are developed using HTML, CSS, and JavaScript, while MySQL database is used for data storage. The registration module collects student details and facial data. QR codes are generated using QR code libraries in Python. Facial authentication is implemented using image processing and facial recognition libraries. The system provides separate interfaces for students, faculty members, and administrators. Attendance sessions are created dynamically, and attendance records are updated automatically after successful verification. Database integration ensures secure storage of student records, attendance logs, and authentication details. The administrative dashboard allows report generation, attendance monitoring, and user management.

VIII. RESULTS AND DISCUSSION

The proposed Smart Attendance Management System was tested in a simulated academic environment to evaluate performance, reliability, and operational efficiency. The QR code scanning process successfully verified student identities within a short time. Facial recognition authentication accurately identified registered users under normal lighting conditions. The system effectively prevented duplicate attendance marking and minimized proxy attendance. Attendance records were updated instantly in the database, allowing faculty members to monitor attendance in real time.

The administrative dashboard simplified report generation and attendance analysis. Performance evaluation indicated that the system reduced attendance processing time significantly compared to manual attendance methods. The hybrid verification approach improved operational flexibility and increased attendance security.

IX. CONCLUSION

The Smart Attendance Management System using QR code and facial authentication provides an efficient and secure solution for automated attendance management in educational institutions. The proposed system eliminates the limitations of manual attendance methods by automating attendance recording and reducing administrative workload. The integration of QR code technology and facial recognition improves attendance accuracy, prevents proxy attendance, and supports real-time attendance monitoring. The web-based architecture provides centralized access to attendance data and simplifies report generation for faculty members and administrators. The proposed system demonstrates that modern authentication technologies can significantly improve academic management efficiency. Future enhancements may include cloud deployment, mobile application integration, geolocation verification, and advanced artificial intelligence-based facial recognition techniques.

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International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 05, May 2026)

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