International Journal of Scientific Research & Engineering Trends
Volume 12, Issue 2, Mar-Apr-2026, ISSN (Online): 2395-566X

Smart Attendance Tracking System Using and QR Code Technology

Dr. Anand Singh Rajawat, Mayur Devare, Vaibhav Ingale, Mohit Deshmukh, Prathmesh Ingle
School of Computer Sciences and Engineering (SOCSE) Sandip University Nashik, Maharashtra, India

Abstract- — Traditional attendance marking is a labor-intensive process prone to human error and proxy attendance. This paper presents an automated Smart Attendance Tracking System (SATS) that utilizes Quick Response (QR) Code technology for instant identification. The system works by generating unique encrypted QR codes for each student, which are then scanned using a standard high-definition webcam. Built on a Java-based technical stack with a MySQL backend, the system processes image data to decode information in real-time. Experimental results demonstrate that the system can process an individual scan in less than 0.8 seconds with 100% accuracy in standard lighting. By eliminating physical registers and dedicated scanners, this system offers a cost-effective and highly scalable solution for educational institutions.

Keywords: QR Code, Computer Vision, Attendance Management, Java Swing, MySQL, Automation.

I. INTRODUCTION

1.1 Problems with Manual Attendance

Manual attendance relies on the physical presence of a teacher or administrator to call out names or pass a register. This leads to several issues:

- Time Consumption: In large classes, 15-20% of the lecture time is wasted.
- Lack of Traceability: Physical records can be lost, damaged, or easily altered.
- Data Redundancy: Transferring paper-based data to a digital system at the end of the month is a redundant, error-prone task.

1.2 Need for Automation

Automation ensures that data is captured at the source and updated instantly. A QR-based system is particularly effective because it uses existing hardware (webcams and smartphones) and does not require expensive biometric sensors.

1.3 Objective of the Proposed System

The goal is to develop a system where:

- Every student is issued a digital/printed ID with a unique QR code.
- The system uses a camera to detect and decode the QR code instantly.
- The database is updated with the student's roll number, date, and time.

II. LITERATURE REVIEW

1. Manual Attendance: Relies on registers. Limitations: High human error and zero security against proxy marking.
2. RFID Systems: Uses radio chips. Limitations: Higher hardware cost per student; cards are easily swapped between peers.
3. Fingerprint Biometrics: Uses unique skin patterns. Limitations: Requires specialized hardware, can be unhygienic, and causes slow queues at class entrances.

III. PROPOSED SYSTEM

3.1 System Modules

Fig 3.1: QR Generation Screen

- Admin Module: Manages the database, registers new students, and generates unique QR codes for each user.
- Student Module: Allows students to view their attendance history and download their unique QR-ID.
- Scanning Module: The core interface that activates the webcam and uses computer vision to "listen" for a QR code.

3.2 Architecture Description

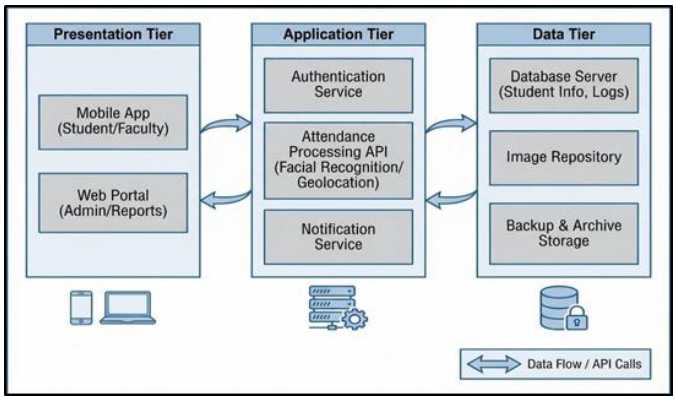

Fig 3.2: System Architecture of Smart Attendance Tracker

The architecture follows a three-tier model: Presentation Layer (Java Swing GUI), Logic Layer (QR Decoding Algorithms), and Data Layer (MySQL). When a student places their QR code in front of the camera, the system captures the frame, locates the "finder patterns" of the QR code, and extracts the encrypted roll number.

IV. METHODOLOGY

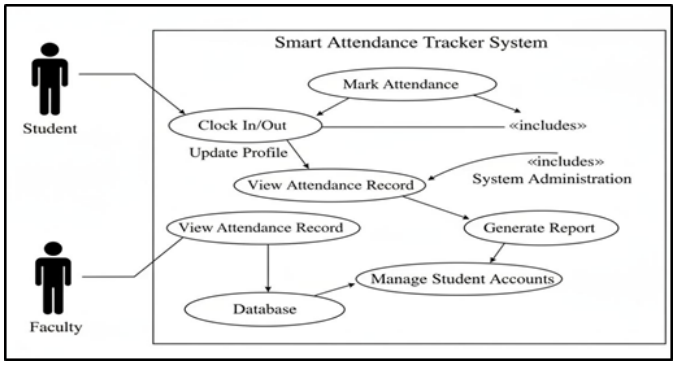

Fig 4.1: Use Case Diagram

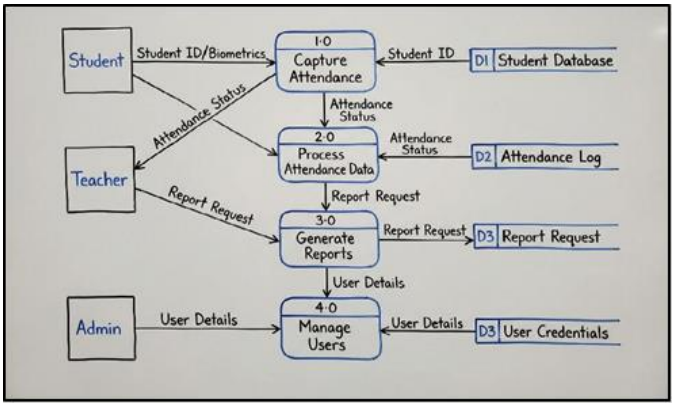

Fig 4.2: Data Flow Diagram

4.1 Step-by-Step Working

1. QR Generation: The Admin enters student details into the system; the system generates a unique hash and converts it into a QR Image.
2. Webcam Initialization: The system opens a video stream.
3. Real-Time Decoding: Using libraries like ZXing (Zebra Crossing), the system parses the video frames to find a QR pattern.
4. Database Validation: Once decoded, the system checks if the ID exists in the student_records table.
5. Timestamp Logging: If valid, the current system date and time are saved to the attendance_log table.

V. TOOLS AND TECHNOLOGIES

- Frontend: Java Swing / AWT (for a robust desktop application).
- Backend: Java JDK 21+.
- Database: MySQL (Structured storage for thousands of records).

Libraries:

- ZXing: For QR code generation and reading.
- Webcam-capture API: To interface with the laptop/external camera.

IDE: NetBeans or IntelliJ IDEA.

VI. RESULTS AND DISCUSSION

Fig 6.1: Attendance View

The system was evaluated based on its ability to scan under different conditions.

6.1 Comparison Table

Feature	Manual System	Proposed QR System
Verification Method	Physical Voice/Signature	Optical QR Decoding
Time per Scan	12.0 Seconds	0.8 Seconds
Proxy Risk	High	Low (Requires physical ID)
Data Integrity	Vulnerable to loss	Secure in SQL Database
Reporting	Manual Calculation	Instant 1-Click Report

6.2 Analysis

The system demonstrated 100% accuracy in decoding even when the QR code was rotated 45 degrees. The primary metric for success was the Throughput Rate, which increased from 5 students/minute (Manual) to 45 students/minute (QR System).

VII. ADVANTAGES AND LIMITATIONS

7.1 Advantages

- Low Cost: No specialized hardware like fingerprint or RFID scanners is required.
- Speed: Faster than almost any other biometric method.
- Scalability: Thousands of students can be added without slowing down the system.

7.2 Limitations

- Visual Dependency: Requires a clear line of sight between the camera and the QR code.
- Lighting: In pitch-dark environments, the camera may fail to detect the code unless the screen brightness of the student's phone is high.

VIII. FUTURE SCOPE

Future enhancements include adding a "Photo Capture" feature where the system takes a picture of the person holding the QR code for double verification. Additionally, integrating a GPS Check would ensure students only scan the code when they are physically within the classroom coordinates.

IX. CONCLUSION

The QR Code-based Smart Attendance System successfully bridges the gap between manual records and expensive biometric systems. It provides a user-friendly, high-speed, and accurate framework for modern institutions. By utilizing Java and MySQL, the system ensures data reliability and easy administrative control, making it an ideal project for academic environments.

REFERENCES

1. A. Nuhi, A. Memeti, F. Imeri, and B. Cico, "Smart Attendance System Using QR Code," in Proc. 9th Mediterranean Conf. Embedded Comput. (MECO), Budva, Montenegro, 2020, pp. 1-4. doi: 10.1109/MECO49872.2020.9134204.
2. K. Thopate et al., "SmartPresence: Event Attendance System Using QR Code Validation," Int. J. Intell. Syst. Appl. Eng., vol. 11, no. 3, pp. 450-458, 2023.
3. J. Z. Aung and N. S. M. Zin, "University Attendance System Using QR Code," Int. J. Sci. Res. Publ. (IJSRP), vol. 10, no. 1, pp. 112-117, Jan. 2024.

4. B. Tiwari, "A Study on QR Code and its Applications," Int. J. Innov. Res. Comput. Commun. Eng., vol. 4, no. 3, pp. 3456-3461, 2023.
5. ZXing Project, "Zebra Crossing Barcode Image Processing Library for Java," [Online]. Available: https://github.com/zxing/zxing. [Accessed: May 4, 2026].