

A Design of Dynamic Web-Based Attendance Management System Integrating the OEISUA Protocol and NFC-Enabled Virtual Access

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Abstract

The Web-Based QR Code Attendance Management System is designed to provide an efficient, accurate, and paperless method for managing student attendance using modern web technologies. Traditional attendance systems are time-consuming and prone to errors, which can lead to inefficiencies in academic management. This system overcomes these limitations by integrating QR code technology with a web-based platform. In this system, students access the platform through a web browser and log in using their credentials. The system generates a unique QR code for each session. Faculty members use a web interface to scan the QR code through a browser-based camera, which verifies the student's identity and records attendance automatically. The backend server processes all requests, performs verification, and updates attendance records in the database in real-time. The system ensures secure authentication, reduces manual effort, and minimizes proxy attendance. It also provides centralized data storage, allowing easy access to attendance records for both students and faculty. The use of a web-based approach eliminates the need for separate mobile or desktop applications, making the system easily accessible from any device with a browser. Overall, this system enhances accuracy, improves efficiency, and supports digital transformation in educational institutions by providing a smart and scalable attendance management solution.

Keywords— QR Code, Attendance Management System, Web-Based System, Authentication, Virtual Password, OEISUA, Database Management, NFC

I. INTRODUCTION

The QR Code Attendance Management System is a modern technological solution designed to automate and simplify the traditional process of recording attendance in educational institutions, offices, and organizations. Attendance tracking is an essential task that ensures discipline, accountability, and proper record maintenance. Conventional methods such as manual registers or biometric systems often face several challenges, including time consumption, proxy attendance, data errors, and maintenance costs [7].

In this system, each user is assigned a unique QR code containing their identification details. The QR code is generated using a secure system and shared digitally or printed on ID cards. During attendance marking, the user scans the QR code using a mobile device or scanner integrated with the system. The scanned data is then processed and stored in a centralized database in real time, eliminating the need for manual entry and significantly reducing human errors [9].

One of the key advantages of this system is its ability to prevent proxy attendance. Since QR codes are unique and can be combined with additional verification methods such as timestamps, GPS location, or authentication systems, it becomes difficult for unauthorized users to manipulate attendance records [13]. The system also promotes a contactless and hygienic environment, unlike biometric systems that require physical contact [7].

From a technical perspective, the system integrates several components including QR code generation, scanning

modules, database management, and a user-friendly interface. Technologies such as web development frameworks, cloud storage, and APIs ensure seamless operation [2]. The Web-Based QR Code Attendance Management System also incorporates OEISUA (Zero Effort Indoor Secure User Authentication) for enhanced security during registration and login, and a Virtual Password module for dynamic authentication.

The main contributions of this work are:

1. Implementation of a web-based QR code attendance system with real-time verification capabilities.
2. Integration of the OEISUA protocol for secure multi-phase user authentication.
3. Design of a Virtual Password module providing dynamic, session-based access keys.
4. Comparative analysis of the proposed system against existing manual and biometric approaches.
5. Development of a leave management and academic performance integration module.

A. Objectives

The key objectives of the proposed system are:

- To automate the attendance process using QR code technology for fast and accurate tracking.

- To minimize manual errors and reduce administrative workload in attendance management.
- To ensure secure and authorized attendance marking through authentication and encryption.
- To provide real-time attendance data for monitoring, reporting, and decision-making.
- To enhance efficiency, transparency, and convenience in educational and organizational environments.

B. Advantages

The proposed system offers fast and efficient attendance marking, reduces manual errors, prevents proxy attendance, and provides real-time data access. Its contactless nature ensures hygiene and safety. It is scalable for large institutions and easily integrates with payroll or academic evaluation platforms.

II. OVERVIEW OF QR CODE TECHNOLOGY

QR (Quick Response) code technology is a type of two-dimensional barcode that can store a large amount of data in a compact form. It was initially developed for tracking automotive parts but is now widely used in applications such as payments, authentication, and attendance systems [3]. QR codes support error correction using Reed-Solomon algorithms, which ensures accurate scanning even if the code is partially damaged.

A. Structure of QR Code

A QR code consists of black squares arranged on a white background in a square grid pattern. It includes key components such as position markers, alignment patterns, timing patterns, and data modules. Position markers help scanners detect the orientation quickly, while alignment patterns ensure accurate reading even when the code is slightly distorted.

B. Error Correction and Encoding

QR codes store information using different encoding modes such as numeric, alphanumeric, byte/binary, and kanji. Error correction codes are added using Reed-Solomon algorithms to ensure data recovery at four levels: Low, Medium, Quartile, and High. This robustness makes them suitable for both digital and printed formats [14].

III. RELATED WORK

Flight delay prediction has attracted significant research attention in recent years. Similarly, attendance management systems have evolved considerably with the adoption of digital technologies.

Haerani et al. [1] implemented an Android-based elementary school student attendance information system using the AppSheet platform to replace manual attendance methods, achieving an 89% improvement in attendance recording efficiency with positive responses from teachers and administrative staff.

Assyafa and Budi [2] developed a QR Code-based attendance system for Pondok Pesantren Mahasiswa Al-Hikmah Semarang using the Laravel framework and Agile methodology, demonstrating that the system automates student attendance, stores data in a structured manner, and provides accurate attendance reports.

Motwani et al. [4] proposed an automated, cloud-based attendance tracking system for large-scale social events using cameras for real-time face detection and recognition, achieving 90% overall accuracy with each video frame processed in 5 seconds.

Shrivastava et al. [7] implemented an IoT-based RFID attendance monitoring system demonstrating that automated systems significantly reduce time consumption and human error in educational institutions.

Amir et al. [9] developed a QR code-based attendance marking system using a web application built with HTML, CSS, JavaScript, Python, and MySQL, demonstrating notable enhancement in process time and reliability over conventional approaches.

Tamuno [10] designed a smart staff attendance management system using QR Code technology with a heuristic evaluation showing 72% conformity index, addressing attendance impersonation and poor performance monitoring.

Pati et al. [11] presented a novel approach integrating QR code technology with facial recognition for dual-factor authentication in educational institutions, enhancing attendance tracking reliability and reducing fraudulent activities.

Panjacharam and Harun [13] incorporated Role-Based Access Control with dynamic QR codes for staff management, demonstrating improved accuracy, efficiency, and transparency in attendance management.

Somaida et al. [16] implemented cryptography for database security in a QR Code and web-based student attendance system, confirming that integration of QR codes effectively supports digitalization of educational administration.

Castellanos et al. [19] designed an attendance management and registration system for cultural events using PHP Laravel, MySQL, and QR code technology with the Scrum methodology, incorporating real-time data analytics and JWT/OAuth2 security standards.

IV. EXISTING SYSTEM

Traditional attendance management systems such as paper-based manual registers are time-consuming, error-prone, and difficult to manage in institutions with large student populations [14]. Existing web-based systems designed using the Model-View-Controller (MVC) architecture with the Laravel framework and MySQL partially address these challenges by automating record-keeping and report generation.

A. Drawbacks of Existing Systems

- Deployment requires complex infrastructure setup and maintenance.
- Back-end systems are tightly coupled, making updates

difficult.

- Front-end interfaces lack real-time QR code verification capabilities.
- Database designs do not always support differentiation between theoretical and practical class hours.
- System design does not adequately prevent proxy attendance or unauthorized access.
- Requirement analysis often overlooks scalability for large student populations.

V. PROPOSED SYSTEM

To address these challenges, the Web-Based QR Code Attendance Management System integrates QR code technology with a web-based platform providing a paperless and automated approach. The proposed block diagram is shown in Fig. 1.

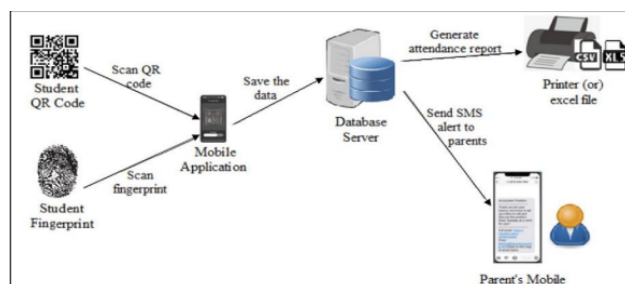


Figure 1. Proposed Block Diagram of the Web-Based QR Code Attendance Management System

A. Web Client

The student interface is the first point of interaction in the system. Students access the platform via a web browser using their login credentials and receive a unique session QR code for each class. The web client ensures compatibility across devices, allows students to view attendance history in real-time, and prevents multiple submissions.

B. Web Server

The web server acts as the core processing unit of the system. It handles all requests from students and faculty, manages authentication, coordinates communication between the QR generator, verification module, and attendance logic, and ensures real-time updating of attendance records in the database. It supports scalability, allowing multiple users to interact simultaneously.

C. QR Generator

The QR Generator module produces unique QR codes for each class session containing session-specific data. Each code has a time-based validity to prevent misuse. The module interacts with the backend server to ensure generated codes match the current class schedule, and all codes are secured against replication or tampering.

Figure 2. Staff Registration Interface

D. Verification Module

The verification module ensures the authenticity of students marking attendance. When a QR code is scanned, the system validates the student's credentials against the database in real-time, cross-checking the class session, student ID, and QR code validity. Mismatched or expired codes are rejected to maintain data integrity, and all verification attempts are logged for auditing purposes.

E. Attendance Logic

The attendance logic module calculates, records, and manages attendance data for each student. It interprets verification results, updates attendance status in the database, computes attendance percentages considering both theoretical and practical class types, and can trigger alerts for students with low attendance.

Figure 3. Student Registration Interface

F. Database

The database stores all critical data including student profiles, class schedules, and attendance records. It provides a centralized repository with relational integrity, linking students to specific courses and sessions. Secure access controls, real-time entry recording, query-based report generation, and backup/recovery mechanisms ensure consistent and accurate attendance tracking.

VI. SECURITY AND AUTHENTICATION MECHANISMS

A. OEISUA-Based Authentication

The proposed system adapts the OEISUA (Zero Effort Indoor Secure User Authentication) concept to provide secure registration and authentication. During registration, students provide their Student ID, Name, Email Address, Username, and Password, which are securely stored in the database. During login, students enter their credentials and are authenticated before accessing the QR attendance dashboard.

Figure 4. Student Security Registration Interface

B. Virtual Password Module

The Virtual Password module provides a dynamic authentication layer where the secret function calculation varies for different application packages. A random access key is split into three parts k_1 , k_2 , k_3 . The secret values are computed as:

$$\text{Part}_1 = k_1 + X, \quad \text{Part}_2 = k_2 - X, \quad \text{Part}_3 = k_3 \times X \quad (1)$$

These three parts are passed to a secret function expression:

$$F(k_1, k_2, k_3) = (k_1 \times k_2 \times k_3) \pm (k_1 + k_2 + k_3) \quad (2)$$

The generated access key changes dynamically with each session, preventing replay attacks and unauthorized access. This virtual (dynamic) approach ensures that even if a code is intercepted, it cannot be reused.

C. Additional Security Features

Security measures include user authentication, encrypted data transmission via HTTPS, unique QR code generation per session, role-based access control, activity logging, and data privacy restrictions. These mechanisms ensure that attendance records are accurate, reliable, and tamper-proof.

D. Near Field Communication Comparison

Near Field Communication (NFC) is a short-range wireless communication technology widely used in contactless payments and access control. In comparison, the proposed QR code approach offers equivalent identity verification without requiring specialized hardware, making it cost-effective and easily deployable in educational institutions.

Figure 5. Personal Information Form

VII. RESULTS AND DISCUSSION

The Web-Based QR Code Attendance Management System was implemented and tested in a college environment. The system includes the following functional modules whose results are described below.

A. System Modules

The implemented system comprises the following interfaces: Homepage, Login Page (Admin/Staff/Student), Staff Register Form, Student Register Form, Student Security Registration, Student Login Form, Student Random Number Table, User QR Code Form, Personal Information Form, Apply Leave Form, Attendance Details Form, Attendance Details Table, Staff Login Form, Staff Personal Information, Leave Acknowledgement Interface, Leave Status Report, Semester Mark Details, Mark Status, Attendance Details (QR Code), and Department Detail.

B. Attendance Recording

The attendance details table records student attendance with fields including Student No, Name, Major, Date, Status (Present/Absent), Semester, Period, and Staff ID. Table 1 shows sample attendance records for multiple students.

Table 1. Sample Attendance Records

Stud No	Name	Date	Status	Sem	Period
STUD10001	Sathish	2026-03-29	Present	Sem1	P2
STUD10002	Mahesh	2026-03-30	Present	Sem1	P1
STUD10003	Sakthi	2026-03-31	Present	Sem2	P1
STUD10003	Sakthi	2026-03-31	Present	Sem2	P2

Figure 6. Apply Leave Form

C. Academic Performance Integration

The system integrates semester mark details alongside attendance data. The Mark Status interface for student Sathish (STUD1000) shows Semester 1 subject-wise details with Internal Mark, External Mark, Total marks, and Status. All subjects achieved *First* class status with total marks ranging from 71 to 94, as shown in Table 2.

S.No	Roll No	Name	Major	Date	Status	Semester	Period	Roll No
10000	STUD10001	Sathish	CS	2026-03-29	Present	Semester1	Period2	STUD10001
10001	STUD10001	Sathish	CS	2026-03-29	Present	Semester1	Period3	STUD10001
10002	STUD10001	Sathish	CS	2026-03-29	Present	Semester1	Period1	STUD10001
10004	STUD10002	mahesh	CS	2026-03-30	Present	Semester1	Period1	EMP10002
10006	STUD10002	mahesh	CS	2026-03-30	Present	Semester1	Period2	STUD10002
10006	STUD10003	sakthi	CS	2026-03-31	Present	Semester2	Period1	EMP10003
10007	STUD10003	sakthi	CS	2026-03-31	Present	Semester2	Period2	STUD10003

Figure 7. Attendance Details Interface

D. Leave Management

The system includes a leave management module allowing students to apply for leave with details such as Type, From Date, To Date, Total Days, Permission Hours, Reason, and Document upload. The Leave Acknowledgement interface allows faculty to grant or deny leave requests with a digital signature. The Leave Status Report provides a clear summary of all approved leave applications.

E. Performance Analysis

The dynamic QR code generation with time-based validity and the virtual password module effectively prevents proxy attendance. The system successfully records attendance in real-time with minimal latency. Role-based access control ensures that only authorized users can view or modify sensi-

Table 2. Mark Status – Student Sathish (STUD1000), Semester 1

Subject	Int.	Ext.	Total	Status
C	15	79	94	First
C Lab	15	77	92	First
C++	12	67	79	First
C++ Lab	15	77	92	First
Fundamental Maths	15	56	71	First
HR	15	77	92	First
Java	15	57	72	First
Java Lab	15	77	92	First

tive records, and the centralized database supports both daily monitoring and long-term trend analysis. Table 3 compares the proposed system against existing approaches.

Table 3. Comparison of Attendance System Approaches

Feature	Manual	Biometric	Proposed
Proxy Prevention	No	Yes	Yes
Real-Time Update	No	No	Yes
Contactless	Yes	No	Yes
Scalability	Low	Med	High
Cost	Low	High	Low
Web Accessible	No	No	Yes

VIII. CONCLUSION AND FUTURE WORK

This paper presented the design of a Dynamic Web-Based Attendance Management System integrating the OEISUA protocol and NFC-enabled virtual access. The system provides a highly efficient, accurate, and paperless solution that addresses the limitations of traditional attendance methods. The integration of OEISUA-based authentication, the Virtual Password module, and role-based access control ensures that attendance records are secure and tamper-proof.

Key findings from this work include:

1. QR code-based attendance eliminates proxy marking and reduces administrative workload significantly.
2. The OEISUA protocol combined with the Virtual Password module provides robust multi-layer authentication.
3. The web-based approach ensures device-agnostic accessibility without additional hardware requirements.
4. The integrated leave management and academic performance modules provide a comprehensive academic administration solution.

Future Work

Several directions for future enhancement have been identified:

Mobile Application: Integration of dedicated mobile applications for Android and iOS with offline functionality and push notifications.

Biometric Authentication: Incorporation of fingerprint scanning or facial recognition for multi-layered security [11].

AI and Predictive Analytics: Implementation of machine learning for absenteeism pattern detection and early warning alerts.

LMS Integration: Synchronization with Learning Management Systems such as Moodle or Google Classroom for automatic linkage of attendance with academic records.

Cloud Deployment: Migration to cloud infrastructure to enhance scalability across multiple campuses.

Blockchain Verification: IoT-enabled smart classrooms and blockchain-based record verification for a future-ready platform [18].

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