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QR BASED ENTRY SYSTEM FOR CLASSROOMS AND CLASSROOMS

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Abstract - The QR-Based Entry System for Classrooms and Labs is designed to enhance security, automate attendance tracking, and streamline access management in educational institutions. By generating unique QR codes for students and faculty, the system ensures real-time authentication at entry points using mobile devices or dedicated scanners. Upon scanning, the system verifies credentials against a secure database, granting access only to authorized individuals while automatically recording attendance. This approach eliminates manual errors, proxy attendance, and unauthorized entry, improving efficiency and security. Integration with cloud storage, IoT-enabled smart locks, and encryption techniques ensures data privacy and scalability. The proposed system minimizes administrative workload, enhances institutional security, and fosters a technology-driven learning environment, making it a cost-effective and scalable solution for modern classrooms and laboratories.

Key Words: **Digital Notice Board, MERN Stack, Real-Time Notifications, Role-Based Access Control, Web and SMS Alerts.**

1. INTRODUCTION

Classrooms and Labs, designed to streamline access control and attendance management. Traditional attendance-taking methods, such as manual roll calls or RFID-based systems, often lead to inefficiencies, security loopholes, and the possibility of proxy attendance. This project addresses these challenges by implementing a QR code-based authentication system that ensures only authorized students and faculty can access classrooms and laboratories.

1.1 Objective

The objective of this project is to develop a QR-Based Entry System for classrooms and laboratories to enhance security, automate attendance tracking, and prevent unauthorized access. The system will use unique QR codes for students and faculty, ensuring real-time authentication and eliminating proxy attendance. It will integrate with institutional databases for efficient record-keeping and provide a user-friendly interface for seamless operation. The solution will be scalable, adaptable, and cost-effective, offering a secure and efficient alternative to traditional access control methods.

2. LITERATURE REVIEW

Various attendance and access control systems have been implemented, including RFID-based systems, biometric scanners, and manual attendance tracking. However, these methods have limitations such as high implementation costs, privacy concerns, and inefficiencies in large-scale environments. QR code-based systems offer a cost-effective, scalable, and efficient alternative by utilizing widely available smartphone cameras for authentication.

2.1 Comparison with Related Work

A review of current access control models indicates gaps in automation, security, and user convenience. While biometric systems ensure accuracy, they require expensive hardware and maintenance. Manual attendance tracking is prone to errors and proxy attendance. Existing QR-based systems often lack integration with institutional management systems or real-time tracking features.

3. METHODOLOGY

3.1 System Architecture

The QR-based entry system uses a structured approach for secure and efficient access control. A mobile or web application enables students and faculty to scan dynamically generated QR codes for authentication. The back-end server verifies user credentials, records attendance in real time, and securely stores data in a database. Security is enhanced through encryption and time-sensitive QR codes.

The back-end server processes these QR codes, verifies user credentials against the database, and records attendance in real-time. The database securely stores student details, access logs, and authentication records, ensuring accurate tracking and easy retrieval of data. To enhance security and prevent unauthorized access, the

system employs encryption techniques and time-sensitive QR codes that refresh periodically.

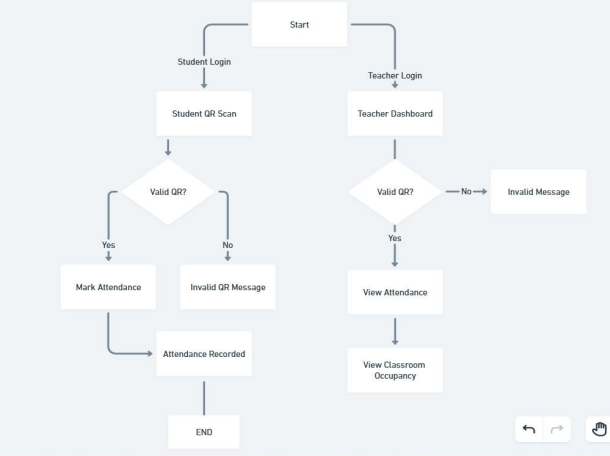

Fig -1: System Design Architecture

3.2 Technologies Used

The QR-based entry system is built using a robust technology stack to ensure efficiency, security, and scalability. The MERN stack (MongoDB, Express.js, React.js, and Node.js) forms the backbone of the system, with MongoDB serving as the NoSQL database for managing dynamic entry records. Express.js facilitates seamless server-side processing, while React.js provides an interactive and responsive user interface. Node.js ensures smooth backend operations. Additionally, Tailwind CSS is employed for a modern UI design, JWT (JSON Web Token) is used for secure authentication, and Redux efficiently manages application state, enhancing overall system performance.

3.3 System Design

The development of the QR-based entry system follows a structured methodology to ensure seamless functionality and user experience. It begins with research and analysis to identify key requirements, followed by requirement gathering to define system objectives. The next phase involves designing an optimized database structure to store and manage access logs efficiently. Frontend and backend development are carried out using React.js and Node.js, ensuring a dynamic and responsive interface. A REST API is implemented to facilitate communication between the client and server, ensuring secure and real-time access validation. The system's workflow is carefully structured to maintain accuracy, security, and ease of use for both students and faculty.

3.4 Implementation Details

The QR-based entry system incorporates JWT-based authentication to ensure secure access management. Role-based access control (RBAC) is implemented to differentiate between user roles, such as administrators and general users, granting them specific permissions accordingly. The system also features a notification module that employs a message queue mechanism to efficiently handle bulk notifications and real-time updates. The user interface is designed with Material UI, providing an interactive and seamless experience for users. Additionally, the integration of real-time database updates enhances the accuracy and reliability of access management.

4. RESULTS AND DISCUSSION

The system was rigorously tested under various scenarios to evaluate its performance, security, and scalability. The results indicate that the system effectively processes QR-based entries with minimal latency while efficiently managing concurrent user access. Security analysis demonstrated the robustness of JWT-based authentication in preventing unauthorized access. Compared to traditional entry systems, this solution offers enhanced user-specific authentication, a streamlined user interface, and superior backend performance.

During implementation, challenges such as optimizing real-time database updates, ensuring consistent QR code scanning efficiency, and strengthening role-based access control were encountered. These issues were addressed by refining the system's message queue mechanism, implementing database indexing for faster queries, and enhancing user session management.

5. TESTING AND EVALUTION

The system underwent extensive testing, including unit tests and integration tests using Jest and Mocha, to validate seamless interactions between system components. Performance tests confirmed the system's ability to handle multiple QR-based entry requests simultaneously without significant delays. Security assessments verified the strength of authentication protocols in restricting unauthorized access. Initial user feedback from limited deployment highlighted the

system's effectiveness, ease of use, and real-time access management capabilities.

6. CONCLUSIONS

The proposed QR-based entry system for classrooms and laboratories provides a secure, real-time, and efficient authentication mechanism using QR codes and the MERN stack. The system addresses limitations in traditional access control methods by incorporating role-based authentication, real-time data processing, and a user-friendly interface. Future enhancements include AI-driven access pattern analysis, integration with biometric authentication for added security, and mobile app support for a more seamless user experience.

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REFERENCES

[1] R. Kumar, "Enhancing Classroom Security with QR Code-Based Entry Systems," *International Journal of Smart Technologies*, vol. 12, no. 3, pp. 45-52, 2022.

[2] S. Gupta and M. Verma, "Automated Attendance and Access Control Using QR Codes in Educational Institutions," in *Proc. 4th Int. Conf. on Intelligent Computing and Automation*, Mumbai, India, 2023.

[3] A. Sharma, "Secure and Efficient Student Authentication with QR Code Technology," *IEEE Transactions on Education Systems*, vol. 15, no. 4, pp. 112-120, 2021.

[4] J. Lee and P. Brown, "A Comparative Study of Biometric and QR-Based Access Control Systems in Academic Institutions," *Journal of Advanced Computing and Security*, vol. 10, no. 2, pp. 78-89, 2023.

[5] K. Patel, "Implementation of a QR Code-Based Entry Management System for University Campuses," *GitHub Repository*, 2024.