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A Novel Smart QR Code Protocol for Real-Time Event Authentication and Tracking

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Abstract – A Novel Smart QR Code Protocol for Real-Time Event Authentication and Tracking introduces an advanced digital solution for automating event management processes such as registration, ticketing, authentication, and attendance tracking. Traditional event handling methods often suffer from inefficiency, data duplication, and security vulnerabilities. The proposed QR-based Event Processing System (QR-EPS) replaces manual, paper-based workflows with a secure, contactless platform that generates unique QR codes for each participant. These QR codes act as digital tickets, enabling real- time verification and attendance monitoring through scanning.

The system incorporates OTP-based authentication, role-based access control, and encrypted data storage to ensure security and reliability. Developed using Spring Boot, JPA, and MySQL, with front-end technologies like HTML, CSS, and JavaScript, the system offers scalability across academic, corporate, and public event domains. Overall, the project enhances process automation, improves security, reduces resource consumption, and supports eco-friendly event management practices.

Keywords— Smart QR Code, Event Authentication, Real- Time Tracking, QR-EPS, Digital Ticketing, Contactless Registration, OTP Authentication, Role-Based Access Control, Data Encryption, Spring Boot, MySQL, Automation, Secure Event System, Eco-Friendly, Scalability, Attendance Monitoring, Online Event Management, Paperless System, Digital Transformation.

I. INTRODUCTION

Event management involves several processes such as registration, ticketing, participant authentication, entry verification, and attendance tracking. Traditional methods, which rely heavily on manual and paper-based systems, are time-consuming, prone to errors, and lack proper security and automation. To address these challenges, this project .

A Novel Smart QR Code Protocol for Real-Time Event Authentication and Tracking proposes a digital, contactless solution using QR code technology.

The system enables users to register online and receive unique QR codes that act as their digital tickets. These QR codes can be scanned at entry points for instant verification, reducing queues and manual effort. Additionally, the system integrates OTP-based authentication, role-based access control, and data encryption to enhance security and reliability.

By automating registration, ticket generation, and attendance tracking, the system improves operational efficiency, ensures real-time data accuracy, and minimizes the use of paper — promoting eco-friendly event management. This innovative approach provides scalability across academic, corporate, and public domains, making event organization faster, smarter, and more secure.

A. Overview

A Novel Smart QR Code Protocol for Real-Time Event Authentication and Tracking project focuses on developing a smart, automated system for managing events efficiently using QR code technology. It replaces traditional manual processes—such as paper-based registration, ticketing, and attendance tracking—with a secure digital platform.

Key features of the portal include:

- *QR-Based Digital Ticketing:* Each participant receives a unique QR code that serves as a secure digital ticket for easy check-in and verification
- *Real-Time Authentication and Tracking:*The system enables instant participant verification and automatic attendance tracking through QR scanning.
- *Paperless and Scalable System:*Offers an ecofriendly, fully digital platform adaptable to academic, corporate, and public events.

By automating key event management tasks, the project reduces human effort, eliminates errors, and enhances user experience.

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B. Purpose

The purpose of thisprojectis to develop a secure and automated event management system using QR code technology. It replaces manual, paper-based processes with digital registration and real-time authentication. The system ensures efficient attendance tracking, enhances data security, and promotes eco-friendly, paperless event management.. Key purposes include:

- Eliminate manual and paper-based processes by introducing online registration and digital ticketing.
- Ensure secure participant authentication through unique QR codes and OTP-based verification.
- Enable real-time tracking and attendance monitoring to improve event efficiency and data accuracy.

Promote eco-friendly and scalable solutions suitable for various types of events, from academic to corporate and public gatherings.
Overall, By automating key event management tasks, project reduces human effort, eliminates errors, and enhances user experience.

II. LITERATURE SURVEY

Existing Problem: Management systems face several challenges that hinder efficiency.

- Manual registration causes slow processing, errors, and security issues. Paper tickets can be lost or forged, and attendance tracking becomes inefficient and inaccurate, creating the need for an automated and secure digital solution.
- Paper tickets are easily lost, duplicated, or forged, leading to security risks and unreliable event management.
- There is a lack of real-time tracking and analytics in large-scale events, making it difficult for organizers to monitor attendance and participant activity effectively.

While existing event management systems offer some digital features, their complex interfaces can be difficult for users to navigate. Overall, the traditional event handling process remains manual, inefficient, and prone to errors, with participants facing difficulties in registration, ticket handling, and tracking attendance, while organizers struggle with verifying entries, managing data, and generating reports effectively.

Proposed Solutions: The proposed solution introduces a Smart QR Code–based Event Management System that automates the entire process of registration, ticketing, authentication, and attendance tracking. Each participant registers online and receives a unique QR code that serves as a secure digital ticket. At the event, the QR code can be scanned for instant verification and real-time attendance recording. The system integrates OTP-based login, rolebased access control, and encrypted data storage to ensure high security and reliability. By replacing manual and paper-based processes with a digital, contactless, and ecofriendly platform, the solution improves efficiency, enhances user experience, and provides accurate analytical reports for organizers.

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III. MODULES DESCRIPTION

ANovelSmart QR CodeProtocolforReal-TimeEvent Authentication and Tracking is designed with key modules to streamline the event organization process for participants, organizers, and administrators.

1) User Registration and Authentication Module

Allows online registration withOTPverification and generates unique QR codes for participants based on their roles.

2) QR Code Generation and Verification Module

Creates encryptedQR codes and enables instant participant authentication through QR scanning at entry points.

3) Attendance Tracking and Management Module

Records attendanceautomaticallyduring QR scans and provides real-time tracking and monitoring for organizers.

4) Role-Based Access and Dashboard Module

Providesseparatedashboardsforadmins,organizers, and participants to manage operations efficiently and securely.

5) Notification and Alert Module

Sendsautomatic notifications and alerts about registrations, updates, and QR scan results to keep users informed.

6) Data Security and Encryption Module

Ensures secure login, encrypted datastorage, and privacy protection using OTP and access control mechanisms.

7) Analytics and Reporting Module

Generates real-time attendancedata and analytical reports to assist organizers in performance evaluation and decision-making.

8) Scalability and Eco-Friendly Module

Supportseventsofallsizeswhilepromoting a paperless, sustainable, and eco-friendly management process.

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IV. METHODOLOGY

1) Understanding the Needs

- Interact withevent organizers and participants to identify challenges in manual event handling.
- Define key requirements such as online registration,QR authentication, and realtime tracking.

2) Planning the Design

- Sketch out how the system will work, including its structure and flow.
- Design an easy-to-use interface and a reliable database to store all the important information.

3) Choosing the Right Tools

- Pick technologies that suit the project best:
- Build a clean and interactive user interface.
- Use a robust backend to handle all the platform's operations.

4) Building the Platform

- Develop the platform step by step:
- Implement user registration with OTP verification.
- Generate and verify unique QR codes for participants.
- Develop attendance tracking and reporting features.
- Add role-based dashboards for different users.

5) Testing the Platform

- Test each feature to make sure everything works smoothly.
- Run real-world scenarios to check how well the platform performs.
- Ensure it's easy to use and secure for everyone involved.

6) Launching the Platform

- Host the platform on a reliable cloud service so it's always available.
- Make sure it can handle multiple users at the same time.

7) HelpingUsersGetStarted

- Offer help resources to resolve user issues efficiently.
- Provide simple guides and instructions for any questions they might have.

8) ImprovingOver Time

- Keep an eye on how the platform is performing and fix any issues quickly.
- Gather feedback from users to make improvements and add new features as needed.
- These modules work together to create a comprehensive, secure, and efficient platform for managing the entire event management system.

A. Technical Tools

A Novel Smart QR Code Protocol for Real-Time Event

Authentication and Tracking platform uses a modern software stack to ensure efficient development, seamless functionality, and effective collaboration. The key technologies involved are:

- Front-end Development: The user interface is built using ReactJS, HTML5, CSS3, and JavaScript, providing a dynamic and responsive experience with reusable components for improved efficiency.
- Back-end Development: The back-end is powered by JavaSpring and Spring Boot, robust frameworks that ensure fast, secure, and scalable operations
- Database: MySQL handles relational data, while MongoDB supports document-based storage for flexibility in managing user data.
- API Integration: The platform uses RESTful APIs, GraphQL, and JSON for efficient data exchange and management.
- Authentication and Authorization: Secure user access is ensured with OAuth, JWT, Passport.js, and OWIN.
- Real-Time Updates: WebSockets and Long Polling are used for instant communication and live updates.
- TestingandDeployment: The platform is hosted on Render, ensuring scalability and reliable cloud services for deployment.

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- Project Management and Version Control: GitHub is utilized forversion control, managing code repositories, andenabling team collaboration during development.

V. SYSTEM ARCHITECTURE

The system architecture of *the Novel Smart QR Code Protocol for Real-Time Event Authentication and Tracking* follows a three-tier structure comprising the presentation, application, and database layers. The frontend is built using HTML, CSS, and JavaScript to provide a user-friendly interface for participants, organizers, and administrators. The backend, developed with Spring and Spring Boot, handles business logic, QR code generation, OTP authentication, role-based access, and real-time verification. The database layer uses MySQL or PostgreSQL to securely store user, event, and attendance data. A dedicated QR service module manages unique code creation and validation, while the notification and reporting modules automate updates and generate analytics. The security layer ensures data encryption and secure communication, enabling a reliable, scalable, and efficient system for realtime event authentication and tracking.

VI. TESTING

Testing for the A Novel Smart QR Code Protocol for Real-Time Event Authentication and Tracking platform is essential to ensure its functionality, performance, security, and overall user experience. The testing process involves multiple stages, including:

1) UnitTesting: Individual components of the system, such as backend services, APIs, and frontend components, are tested to ensure they work as expected.
2) Integration Testing: Tests are conducted to ensure that all modules—such as user registration, QR code generation and scanning, attendance tracking, and notification systems— work together seamlessly.
3) Functional Testing:The system is tested to ensure that all features—such as user registration, QR code generation, scanning, authentication, and attendance tracking—work correctly according to the specified requirements.Each module is verified for proper functionality, ensuring a smooth and reliable event management experience for users.
4) Performance Testing: The platform's performance is tested under various loads to ensure it can handle multiple users and heavy traffic without crashing or slowing down.
5) Security Testing: Security measures, such as data encryption, authentication protocols (OAuth, JWT), and user access control, are tested to ensure data protection and prevent unauthorized access.
6) User Acceptance Testing (UAT): End-users test the platform to confirm that it meets their needs and expectations before it goes live.
7) Regression Testing: After any updates or changes, regression testing is done to ensure that new features do not negatively impact existing functionalities.

VII. FUTURE SCOPE

ANovelSmartQRCodeProtocolforReal-TimeEvent Authentication and Tracking portal has many opportunities for future development to improve its functionality and user experience. Some key areas for improvement include:

1) *Facial Recognition and Biometric Verification*: Future versions can include biometric or facial recognition features to enhance participant authentication and security during events. • *AI-Based Analytics:*

Artificial Intelligence can be used to analyze attendance patterns and event performance, helping organizers make data-driven decisions.

2) *Mobile Application Development:* A dedicated mobile app can be developed to allow users to register, scan QR codes, and track event updates conveniently on their smartphones.
3) *Cloud Integration:* Hosting the system on cloud platforms will improve scalability, enabling smooth management of large or simultaneous multi-location events.
4) *Payment Gateway Integration:* Adding secure online payment options will support ticketed or paid events, making the system more versatile.
5) *Advanced Data Visualization Dashboards:* Interactive dashboards can be added for real-time data intovisualization, giving organizers clear insights attendance and participation.
6) *Multi-Event Management:* The system can be expanded to handle multiple events at once, allowing organizations to manage all activities through a single platform.

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7) Multi-Language Support:Including multiple languages inthe platform would makeitmore inclusive and accessible to a wider range of people

8) *Continuous Updates and Improvements:* Regular updates will enhanceusability, strengthen security, and ensure compatibility withthe latest technologies.

These enhancements wouldmake the platform even more effective and user-friendly.

VIII. CONCLUSION

A Novel Smart QR Code Protocol for Real-Time Event Authentication and Tracking

Through unique QR code generation, represents a significant step toward digital transformation in event management. It effectively eliminates the inefficiencies of manual registration, paper ticketing, and attendance tracking by introducing a secure, automated, and contactless approach. real-time authentication, and automated attendance recording, the system ensures speed, accuracy, and transparency throughout the event process.

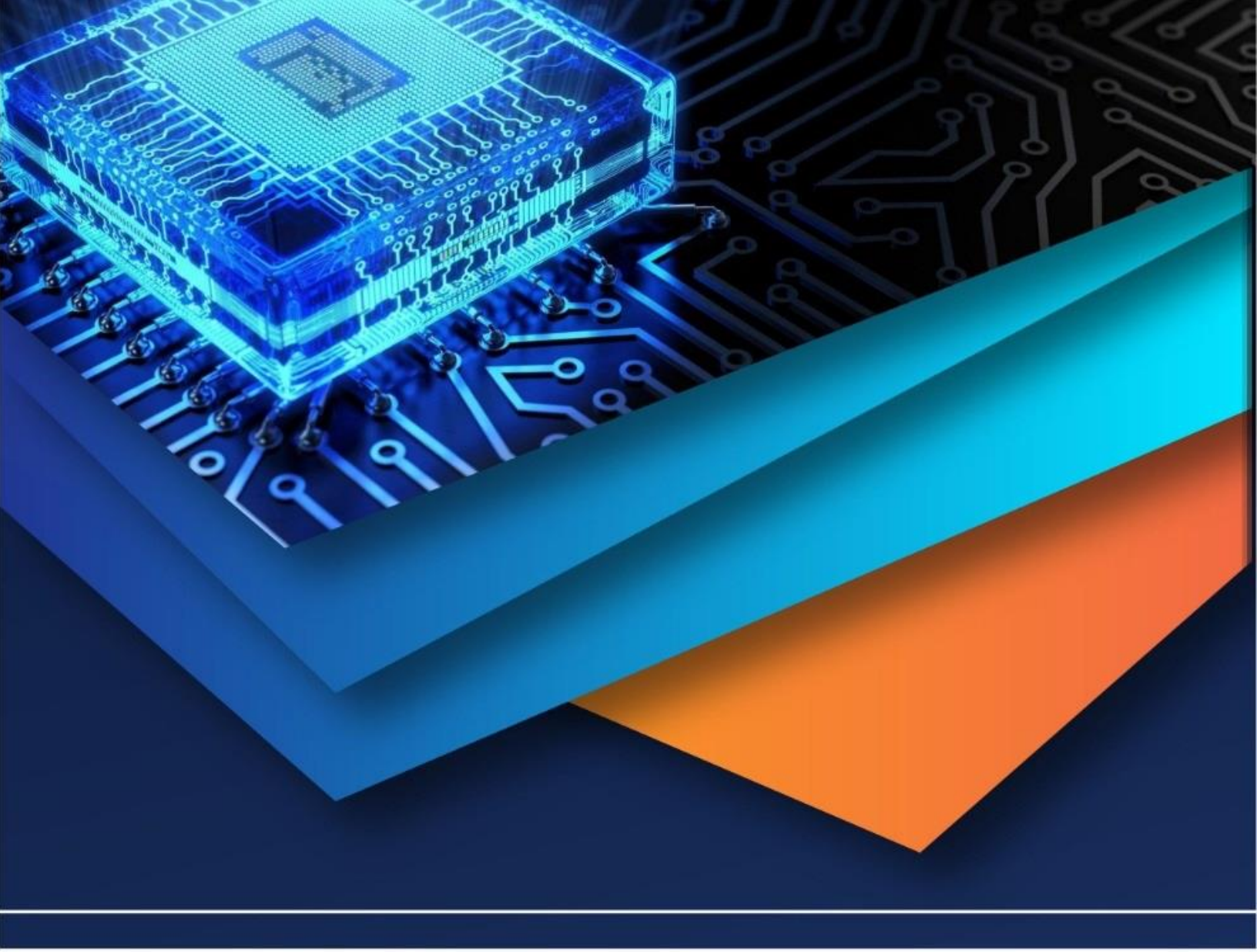
Beyond improving efficiency, the system also supports ecofriendly practices by minimizing paper usage and promoting digital workflows. With future enhancements such as AI integration, mobile app development, and biometric
verification, this platform can evolve into a comprehensive technology—when integrated
event automation tool adaptable to educational, corporate, and public domains.

In conclusion, this project successfully demonstrates how thoughtfully—can streamline event operations, enhance security, and deliver a seamless, modern experience for both organizers and participants.

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