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AI-Enabled College Event Management Portal using QR-Based Attendance and Automated Certification

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ABSTRACT

College events such as technical fests, workshops, cultural programs, seminars, sports competitions, and hackathons are important for improving student participation, collaboration, and overall campus development. However, many institutions still manage events manually using paper-based registration systems, spreadsheets, and physical attendance tracking methods. These traditional approaches are time-consuming, error-prone, difficult to manage, and inefficient for handling large numbers of participants.

This research paper presents an AI-Enabled College Event Management Portal, a web-based platform designed to digitalize and automate the complete lifecycle of college event management. The proposed system integrates student authentication, event creation, online registration, QR-code-based attendance tracking, automated notifications, certificate generation, feedback analysis, and real-time dashboards into a single unified platform.

The portal is developed using a modern three-tier architecture consisting of HTML, CSS, JavaScript, Node.js, Express.js, and MongoDB. The system uses JWT-based authentication for security, REST APIs for communication, and QR technology for accurate attendance verification. Automated PDF certificate generation and AI-based recommendation features further enhance the functionality of the platform.

The proposed solution reduces manual effort, improves attendance accuracy, enhances communication between administrators and students, and provides real-time analytics for better decision-making. The research demonstrates that the platform offers a scalable, cost-effective, and user-friendly solution suitable for colleges and educational institutions.

Keywords: College Event Management, QR Attendance, Web Application, Event Registration, Node.js, MongoDB, REST API, Automated Certificates, AI Recommendation System.

1. INTRODUCTION

1.1 Background

College events play an important role in enhancing the academic, technical, cultural, and social growth of students. Educational institutions organize multiple events throughout the academic year, including seminars, coding competitions, workshops, annual fests, sports activities, placement drives, and guest lectures.

Managing these events manually creates several operational challenges such as:

- Manual registration errors
- Duplicate entries
- Difficulty in attendance tracking
- Lack of centralized communication
- Delayed certificate distribution
- Poor event data management
- Difficulty in generating reports

Traditional event management methods require extensive paperwork and human involvement. As the number of participants increases, manual management becomes inefficient and difficult to maintain.

1.2 Need for Digital Event Management

With the advancement of web technologies and digital transformation in education, there is a growing need for centralized event management systems that automate repetitive tasks and improve operational efficiency.

A digital event management portal can:

- Simplify registration processes
- Automate attendance tracking
- Generate certificates instantly
- Send automated notifications
- Store records securely
- Provide real-time dashboards
- Improve communication between students and organizers

1.3 Problem Statement

Existing college event management methods suffer from the following limitations:

Problem	Description
Manual Registration	Requires paperwork and manual verification
Attendance Errors	Physical attendance sheets are inaccurate
No Centralized Platform	Event information is scattered
Certificate Delay	Manual certificate preparation consumes time
Lack of Analytics	Difficult to analyze participation trends
Communication Gap	Students miss important notifications

1.4 Proposed Solution

The proposed College Event Management Portal provides a centralized web-based platform that automates the entire event lifecycle.

The system includes:

- Student login and signup
- Event creation and management
- QR-code-based attendance
- Notification and reminder system
- Real-time dashboards
- Certificate generation
- Feedback collection system
- AI-based event recommendation engine

1.5 Objectives of the Research

The primary objectives of the proposed system are:

1. To automate event registration and management.
2. To improve attendance tracking accuracy using QR technology.
3. To reduce manual paperwork and operational delays.
4. To provide secure role-based authentication.
5. To generate certificates automatically.
6. To provide analytical insights using dashboards.

7.To develop a scalable and cost-effective web solution.

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2. LITERATURE REVIEW

Several digital platforms and event management systems have been developed to simplify event organization. However, many existing systems are either too complex, expensive, or lack automation features suitable for educational institutions.

2.1 Traditional Event Management Systems

Traditional systems mainly depend on spreadsheets, Google Forms, physical attendance sheets, and manual communication methods.

Limitations:

- High human dependency
- Data duplication
- Poor scalability
- Lack of automation
- Inaccurate attendance tracking
- No centralized data management

2.2 Existing Online Event Platforms

Many commercial platforms provide event management solutions for enterprises. These systems include registration forms, ticketing systems, and email communication.

Limitations in Educational Context:

- Expensive subscription costs
- Lack of student-specific modules
- No academic certificate generation
- Limited customization
- Complex interfaces

2.3 QR-Based Attendance Systems

QR technology has become popular for attendance management because of its speed and accuracy.

Advantages:

- Fast verification
- Contactless attendance
- Reduced duplicate entries
- Real-time database updates

- Improved transparency

However, many QR systems only focus on attendance and do not integrate event registration, certificates, and analytics.

2.4 AI in Educational Event Systems

Artificial Intelligence can enhance event management through:

- Personalized event recommendations
- Predictive analytics
- Smart notifications
- User engagement analysis
- Feedback sentiment analysis

Despite these advancements, many educational systems have not fully integrated AI-based features.

2.5 Research Gap

After reviewing existing systems, the following research gaps were identified:

Existing Limitation	Proposed Improvement
Separate attendance systems	Integrated QR attendance
Manual certificate generation	Automated PDF certificates
Lack of personalization	AI-based recommendations
Limited analytics	Real-time dashboards
Complex enterprise tools	Simple college-oriented interface

The proposed portal addresses these gaps through a unified, AI-enabled architecture.

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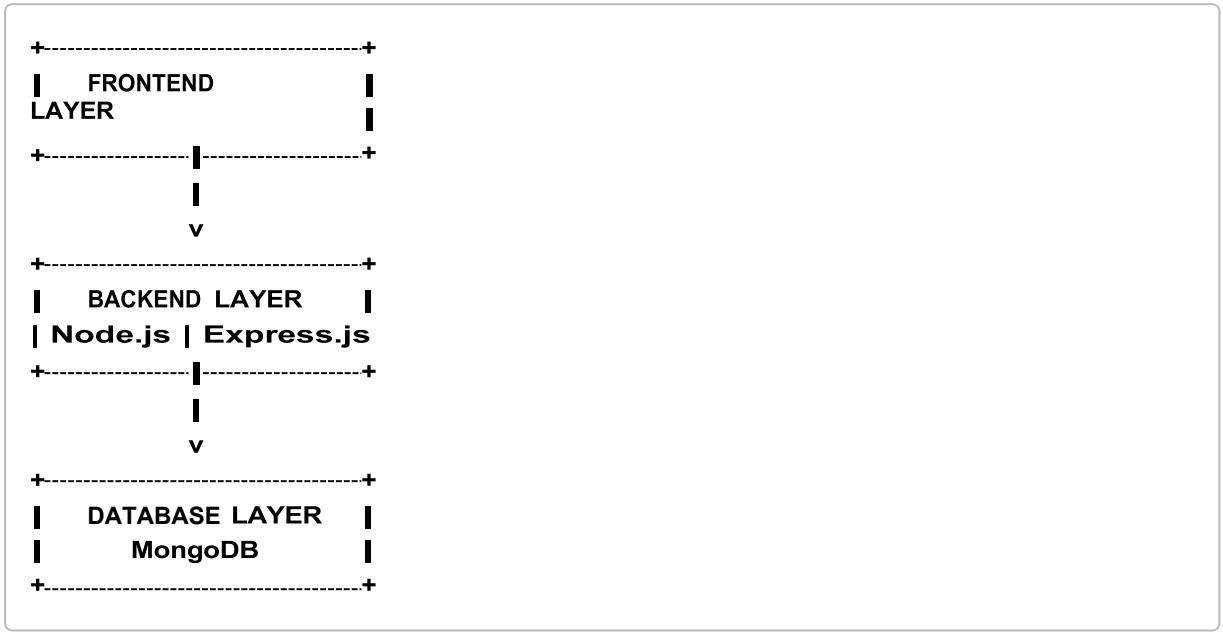
3. SYSTEM ARCHITECTURE

The College Event Management Portal follows a three-tier architecture consisting of frontend, backend, and database layers.

3.1 Three-Tier Architecture



3.2 Frontend Layer

The frontend is responsible for user interaction and interface rendering.

Technologies Used:

- HTML5
- CSS3
- JavaScript

Features:

- Responsive design
- Student dashboard
- Admin dashboard
- Registration forms
- Event listing pages
- QR scanner interface

3.3 Backend Layer

The backend handles business logic, authentication, APIs, and communication with the database.

Technologies Used:

- Node.js

- Express.js
- REST APIs

Responsibilities:

- User authentication
- Event management
- Attendance verification
- Notification services
- Certificate generation
- Data processing

3.4 Database Layer

MongoDB is used for storing event records, student data, attendance logs, certificates, and feedback.

Collections Used:

- Users
- Events
- Registrations
- Attendance
- Certificates
- Notifications
- Feedback

3.5 Advantages of the Architecture

- Scalable system design
- Easy maintenance
- Modular development
- High flexibility
- Better security
- Faster deployment

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4. MODULE DESCRIPTION

The proposed portal consists of multiple interconnected modules.

4.1 Authentication Module

The authentication module manages user login and registration.

Features:

JWT-based authentication
Role-based access control
- Email verification
- Password encryption using bcrypt

Roles:

Role	Permissions
Student	Register for events, download certificates
Admin	Create events, manage attendance
Faculty	View analytics and reports

4.2 Event Management Module

This module allows administrators to create and manage events.

Features:

- Create new events
- Edit event details
- Delete events
- Define event capacity
- Upload banners and posters

Event Details Stored:

- Event title
- Description
- Venue
- Date and time
- Registration limit
- Organizer information

4.3 Registration Module

Students can register for events online.

Features:

- Single-click registration

- Team registration support
- Waitlist management
- Registration confirmation email

Benefits:

- Reduced paperwork
- Faster processing
- Improved organization

4.4 QR Code Attendance Module

Each registered student receives a unique QR code.

Working Process:

1.Student registers for event
2.QR code generated automatically
3.QR shared via email/dashboard
4.Volunteer scans QR at event gate
5.Attendance recorded in database

Advantages:

- Real-time attendance
- Prevents fake entries
- Faster check-in process

4.5 Notification Module

This module manages communication between the system and users.

Notification Types:

- Registration confirmation
- Event reminders
- Attendance updates
- Certificate availability alerts

Technologies:

- Nodemailer
- Twilio SMS API
- In-app alerts

4.6 Certificate Generation Module

Certificates are generated automatically after event completion.

Features:

- PDF certificate generation
- Digital signature support
- QR verification code
- Email delivery

Benefits:

- Saves time
- Eliminates manual certificate preparation
- Reduces printing costs

4.7 Feedback and Analytics Module

Students can provide event feedback after participation.

Features:

- Star ratings
- Text comments
- Anonymous feedback option
- Sentiment analysis

Analytics Provided:

- Event popularity
- Attendance trends
- Feedback scores
- Participation reports

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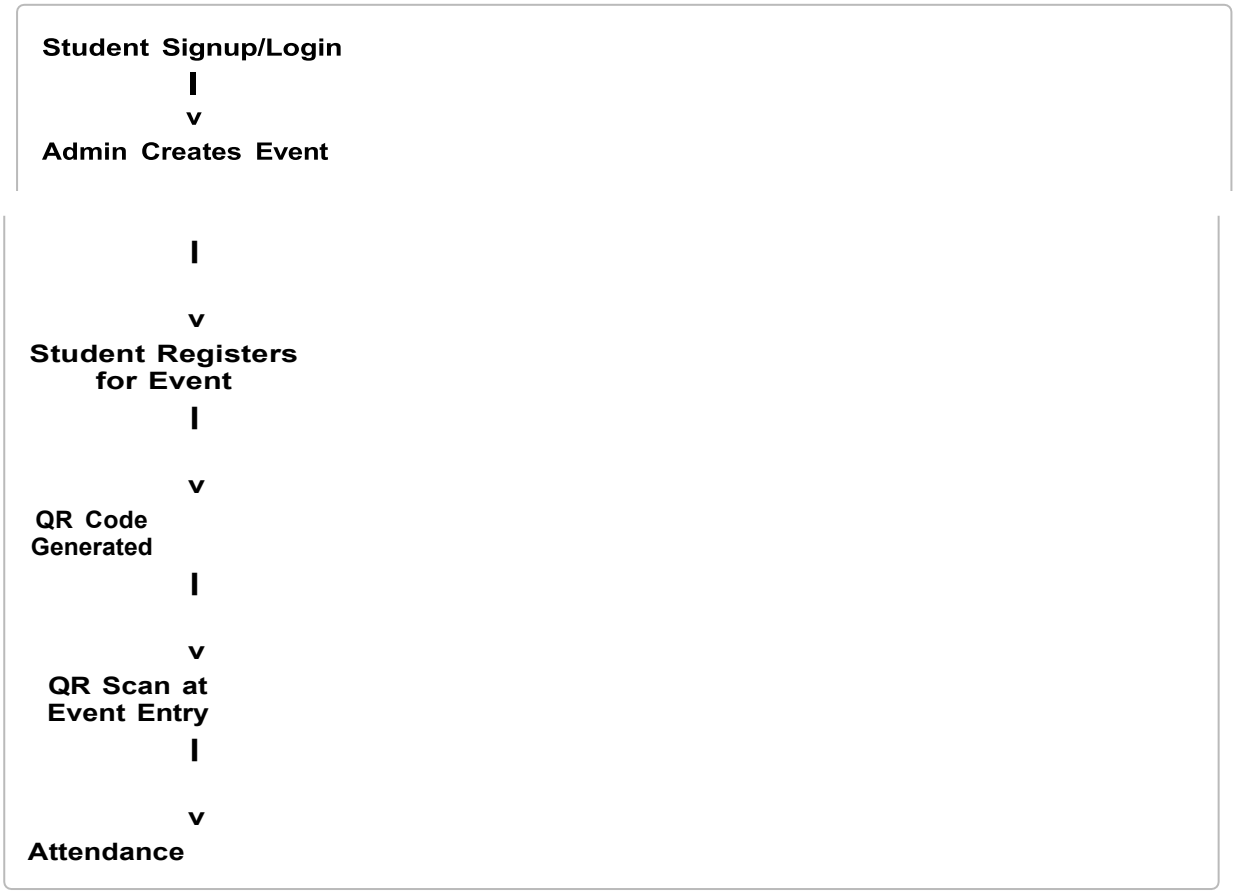
5. SYSTEM WORKFLOW

The workflow of the proposed system is illustrated below.



Workflow Explanation

Step 1: Student Registration

Students create an account using email verification.

Step 2: Event Creation

Admin creates events through the dashboard.

Step 3: Event Registration

Students select and register for events.

Step 4: QR Generation

Unique QR codes are generated automatically.

Step 5: Attendance Verification

QR codes are scanned at the venue.

Step 6: Certificate Generation

Certificates are generated after event completion.

Step 7: Feedback Collection

Students provide feedback for analytics.

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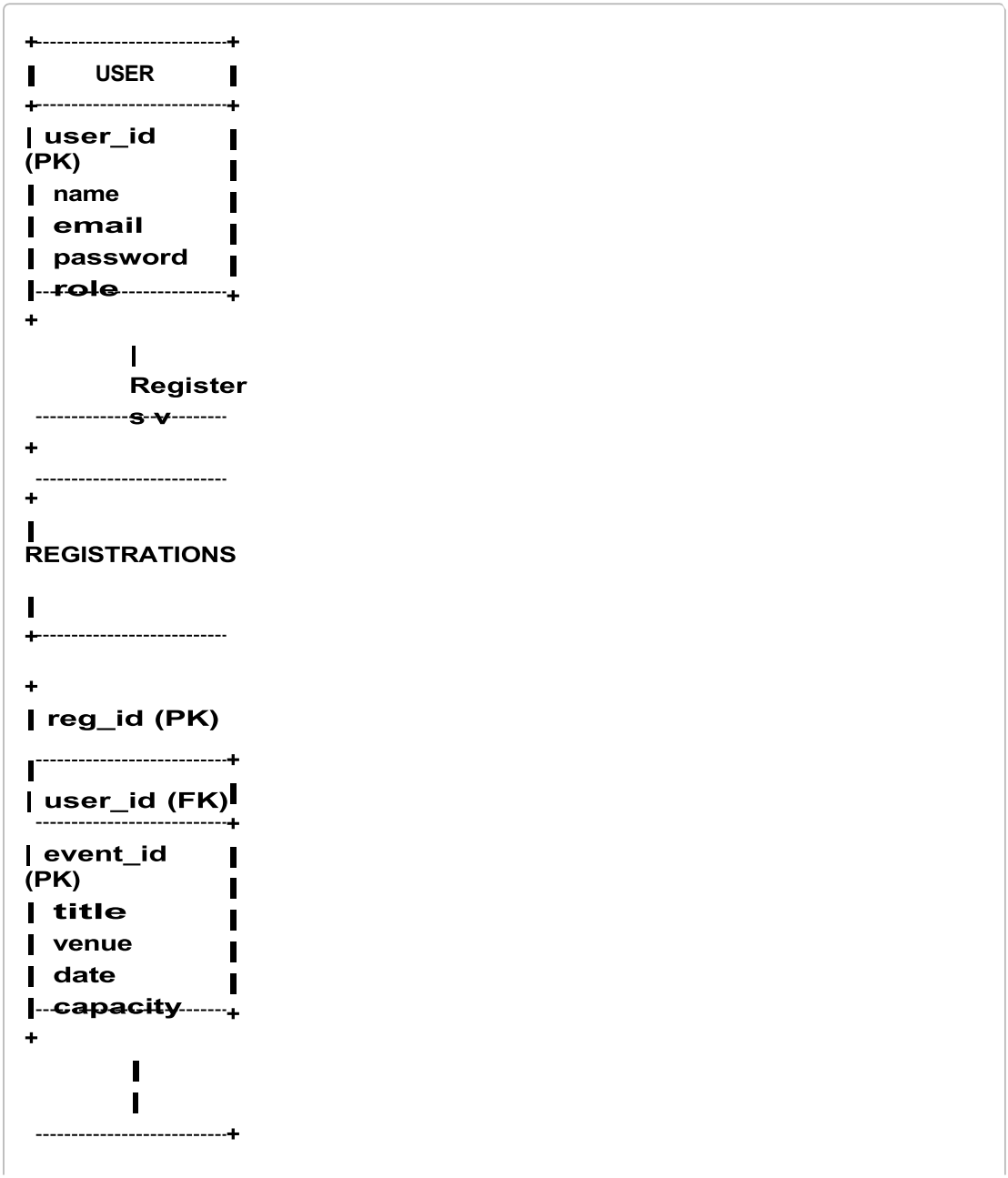
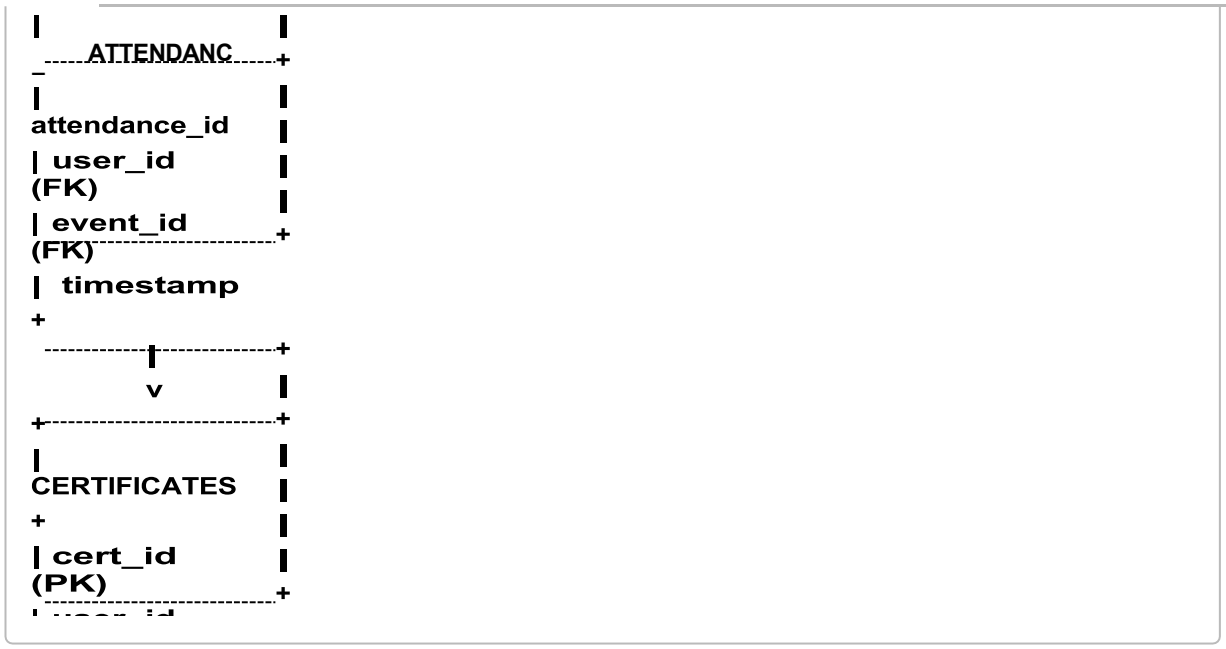
6. ER DIAGRAM

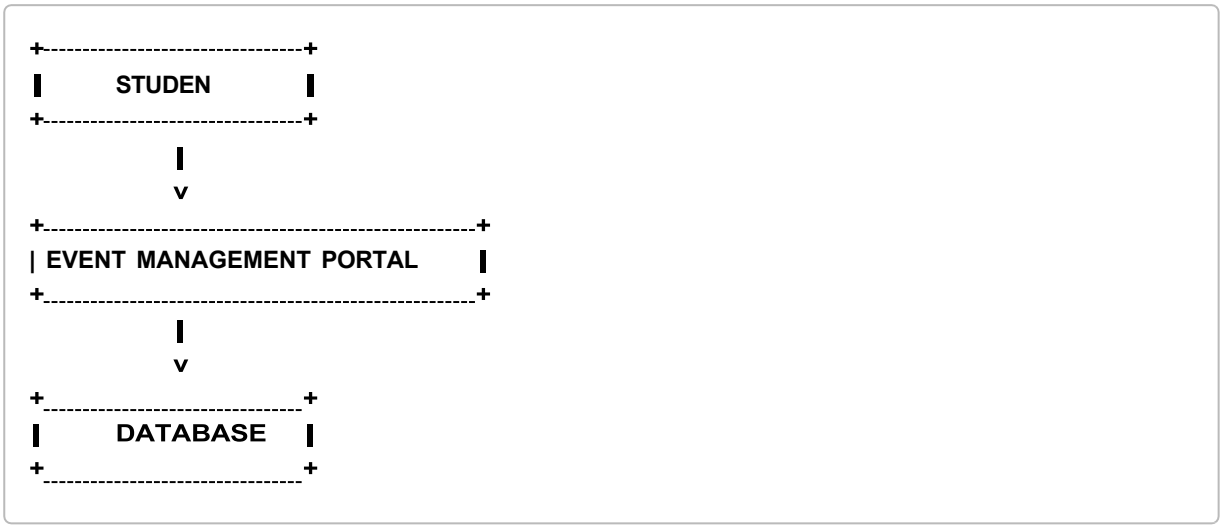
Entity Relationship Diagram



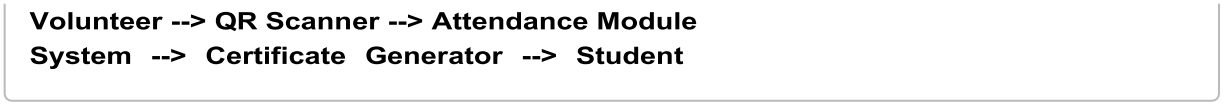


7. DATA FLOW DIAGRAM

7.1 Level-0 DFD



7.2 Level-1 DFD



8. METHODOLOGY

The development of the portal follows the Software Development Life Cycle (SDLC).

8.1 Requirement Analysis

The initial stage involved gathering requirements from students, faculty members, and event coordinators.

Functional Requirements:

- User authentication
- Event registration
- QR attendance
- Notifications
- Certificate generation

Non-Functional Requirements:

- Security
- Scalability
- Reliability
- Responsiveness

8.2 System Design

Wireframes and UI mockups were designed to improve usability.

Design Principles:

- Simple navigation
- Mobile responsiveness
- Minimalist interface
- Dashboard-based management

8.3 Database Design

MongoDB collections were structured to ensure fast retrieval and efficient storage.

Relationships:

- One-to-many relationship between users and registrations
- One-to-many relationship between events and attendance

8.4 Implementation

Frontend Development:

- HTML pages created for interface
- CSS used for responsive styling
- JavaScript used for validation and interaction

Backend Development:

- Express.js used for REST APIs
- JWT implemented for security
- MongoDB connected using Mongoose

8.5 Testing

The system was tested using different approaches.

Testing Type	Purpose
Unit Testing	Validate individual modules
Integration Testing	Verify module interaction
Security Testing	Validate authentication
Performance Testing	Check response time
User Testing	Evaluate usability

9. HARDWARE AND SOFTWARE REQUIREMENTS

9.1 Hardware Requirements

Component	Specification
Processor	Intel i3 or higher
Component	Specification
RAM	4GB minimum
Storage	500MB free space
Device	Laptop/Desktop/Mobile

9.2 Software Requirements

Software	Purpose
VS Code	Development environment
Node.js	Backend runtime
MongoDB	Database
Chrome Browser	Testing
GitHub	Version control

10. TOOLS AND TECHNOLOGIES USED

Technology	Purpose
HTML	Structure of webpages
CSS	Styling and responsiveness
JavaScript	Client-side scripting
Node.js	Server-side logic
Express.js	REST API development
MongoDB	NoSQL database
JWT	Secure authentication
Nodemailer	Email notifications

11. FEASIBILITY STUDY

11.1 Technical Feasibility

The proposed system is technically feasible because it uses open-source technologies that are widely supported.

11.2 Economic Feasibility

The project requires minimal investment because:

- Open-source software is used
- Free hosting platforms are available
- No expensive hardware required

11.3 Operational Feasibility

The portal is user-friendly and requires minimal technical knowledge.

11.4 Legal Feasibility

The system follows:

- Data privacy guidelines
- Secure authentication practices
- Institutional policies

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12. RESULTS AND DISCUSSION

The proposed system was evaluated using student and administrator testing.

12.1 Performance Evaluation

Parameter	Manual System	Proposed System
Registration Time	5–10 minutes	30–60 seconds
Attendance Tracking	Manual	QR-based automated
Certificate Preparation	2–3 days	Instant
Notification Delivery	Manual	Automated
Data Accuracy	Moderate	High

12.2 Observed Improvements

Faster Registration

The digital platform reduced registration time significantly.

Accurate Attendance

QR scanning eliminated duplicate attendance entries.

Reduced Human Error

Automation improved data consistency.

Improved User Experience

Students reported easier access to event information.

12.3 Dashboard Analytics

The admin dashboard provides:

- Total registrations
- Event participation trends
- Attendance percentage
- Feedback statistics

13. ADVANTAGES OF THE SYSTEM

Advantage	Description
Automation	Reduces manual work
Scalability	Supports large events
Security	JWT-based authentication
Accessibility	Accessible from any device
Cost Effective	Uses open-source technologies
Accuracy	QR attendance minimizes errors
Real-Time Analytics	Instant reports and dashboards

14. LIMITATIONS OF THE CURRENT SYSTEM

Despite several advantages, the current system has some limitations:

- Requires internet connectivity
- No dedicated mobile application
- Limited AI recommendation accuracy
- No integrated payment gateway
- Single institution deployment

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15. FUTURE SCOPE

The future enhancements planned for the system include:

15.1 AI-Based Event Recommendation

Machine learning models can recommend events based on:

- Student interests
- Past participation
- Department activity

15.2 Mobile Application

A dedicated Android and iOS application can improve usability.

15.3 Payment Gateway Integration

Integration with Razorpay and Stripe can support paid events.

15.4 Multi-College Architecture

The platform can be converted into a SaaS-based multi-tenant system.

15.5 Advanced Analytics

Future dashboards may include:

- Heatmaps
- Participation prediction
- Student engagement analytics

15.6 AI Chatbot Support

AI chatbots can help students with:

- Event queries
- Registration support
- Schedule reminders

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16. CONCLUSION

The AI-Enabled College Event Management Portal successfully digitalizes and automates the complete lifecycle of event management within educational institutions. The system integrates registration, QR-based attendance, notifications, certificate generation, and analytics into a centralized platform.

The proposed solution significantly reduces manual effort, improves operational efficiency, enhances data accuracy, and provides better user experience for students and administrators. The use of modern technologies such as Node.js, Express.js, MongoDB, JWT authentication, and QR-based verification ensures scalability, security, and reliability.

The research demonstrates that the proposed portal can serve as an effective and affordable solution for colleges seeking digital transformation in event management.

With future integration of AI, predictive analytics, mobile applications, and cloud scalability, the system has the potential to evolve into a comprehensive smart campus event ecosystem.

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APPENDIX

A. Core Modules of the Portal

Module	Function
Authentication	Login & Signup
Event Management	Create & Manage Events
Registration	Student Event Enrollment
Attendance	QR-Based Verification
Notification	Email & SMS Alerts
Certificates	Auto PDF Generation
Analytics	Reports & Insights
Feedback	Ratings & Reviews

B. Estimated Project Cost

Component	Cost
Development Tools	₹0
Libraries & Frameworks	₹0
Hosting	₹0 (Free Tier)
Database	₹0
Domain	Optional
Total Estimated Cost	Minimal