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The Campus Event Aggregator – Digital Noticeboard

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Abstract -

Universities have had a tough time for a long time with the simple issue of letting students know about events too late to actually go. For the people organizing these events, keeping track of who showed up was a big job done by hand using clipboards and sign-in sheets, which often led to mistakes. We, as Campus Event Aggregator or Digital Noticeboard, want to fix both of these problems with a web-based platform. This platform will help students find events and also help event organizers track who attends. The idea is simple — we'll find a way to track attendance at events and give students points for attending. The Campus Event Aggregator is built using the MERN technology stack, uses QR codes to check in students, and uses Socket.IO to make sure attendance updates happen instantly.

The process starts when a student signs up, then gets a unique QR code by email, and scans it at the event entrance on the day of the event. Scanning the code does three things: it confirms the student attended, gives them points, and updates the event organizer's dashboard with real-time attendance with no need for anyone to do it manually.

We have tested the Campus Event Aggregator in three different events with a total of 480 participants and also tested it with simulated crowds of 2500 people. Since we started using the Campus Event Aggregator for attendance checks instead of just manual methods, errors have gone down by 87%.

Key Words: Campus Event Management, QR Code Attendance, Digital Noticeboard, MERN Stack, Real-Time Notifications, Smart Check In, Student Engagement, Event Analytics.

1.INTRODUCTION

University life largely revolves around happenings at the institution. Activities such as hackathons, culture fests, seminars, workshops, department contests, and many others are examples of such occurrences that assist students' professional growth, peer interaction and community development. Sadly, many colleges continue to promote their events utilizing various forms of communication such as WhatsApp broadcasts, paper flyers and email chains while tracking attendance through manual roll calls or paper sign-in sheets.

This ultimately leads to low attendance, missed opportunities and inaccurate or non-existent attendance data. The Campus Event Aggregator (The Digital Noticeboard) is a purposeful solution for this problem. The Digital Noticeboard is a single web-based platform with one searchable real-time feed for all campus events. The Digital Noticeboard also has a built-in QR code-based check-in process integrated into the event lifecycle. It integrates the separate functions of event discovery and attendance tracking; when a student registers for an event, the system generates a unique QR token for the student in real-time and upon arrival at the event, their QR token is scanned (one scan per visit) which simultaneously updates the attendance log, awards participation points to the student, and provides the institution with real-time analytics on the event statistics.

2. RELATED WORK

A. QR Code-Based Event Check-In Systems

In the past decade, QR codes have transformed how events are managed. Denso Wave invented QR codes in 1994 and are matrix style, two dimensional bars that can store alphanumeric text data, some URLs and/or some binary data. Originally developed for ticket sale and access control in the travel and entertainment industry, QR codes have worked their way into the classroom. Collins conducted an extensive empirical evaluation

using a QR based Event Management System (EMS) to track the speed of event check-in. He found that the check-in speed was 84 percent faster with the QR system vs. the previous check-in methods used at two (2000) simulated academic events and a four increase in the number of participants using the QR based EMS method. Wong assessed the performance of QR Codes vs. two other types of identifiers (RFID/NFC systems vs. Legacy One 1D Bar Codes) using a cost vs. performance curve to identify the optimum relationship between cost and ease of scanning. Tan and Wong demonstrated that there would be virtually no latency encountered when employing QR codes over Standard Wireless Networks, and thus provided direct validation for the selection of this technology for the Digital Noticeboard.

B. Campus Event Platforms and Student Engagement

Walanjkar et al. [2] developed a campus event management system using a MERN-stack that offers points as an incentive for students to attend events. Students can redeem their points through an online store or in person for items such as t-shirts, caps, and other items.

C. Real-Time Communication and Social Platforms

Wandhre et al. [9] established a college-oriented social media application using ReactJS, MongoDB and Node.js that incorporated real-time notifications through socket.IO technology. Their findings demonstrated that custom designed academic social networks that are highly-functional, with real time functionality, result in superior long-term retention rates when compared with more traditional instant messaging applications, such as WhatsApp. Al-Maatouk et al. [10] evaluated the Task-Technology Fit (TTF) model and its relationship with the adoption of social media technologies in higher education; they found that an individual's perception of how well the features of a technology support their completion of academic tasks is a better predictor of technology adoption than any other factor, which has shaped one of the theoretical frameworks that will be utilized to define the design criteria for our study. Singh et al. [11] designed a college community app that provides attendance tracking and feedback capabilities; this indicates that a single app for students can result in improved efficiencies across numerous college activities.

D.Comparitive Overview Of Related Works

Table I : Comparitive Analysis Of Related Works

system	Technology used	Attendance method	Reward system	Live updates	Limitations
Hadiwiyanti	Web-based	Manual paper method	No	Limited	UI problems
Wandhre	ReactJS, MongoDB	Not available	No	Yes	No attendance
Digital Noticeboard	MERN stack + QR middleware	Qr code scanning	Yes	Yes	Offline mode under development

Table I : Comparitive Analysis Of Related Works

III. SYSTEM ARCHITECTURE

The Digital Noticeboard has been built and structured as a four-layer architecture consisting of a React front-end, an Express RESTful API Gateway, a Node.js service-based layer and a MongoDB data store layer. Each of these layers can be hosted in the cloud (AWS) and communicate across the internet using HTTPS and use Socket.IO to support bidirectional real-time communications between layers. The purpose of each individual layer can be found in Table II; a visual representation of the overall integrated framework is provided in Table III; the intent of the overall framework is to be deployed in an incremental fashion at educational institutions

Presentation Layer: The front-end of the Digital Noticeboard is built with React and consists of three separate views:- Student Dashboard - provides students the ability to search for events from the event catalog, register for events with a single click, view QR Tickets, track usable rewards points and redeem reward points for goods and services.

- Organizer Console - allows users to create events and set points to be awarded to users based on their various roles within the event; scan QR Codes and visualize their data through real-time attendance software using Chart.js.

- Admin Panel - provides the ability for administrators to manage users and moderate events.

API Gateway: RESTful API calls are made from the front-end to access client-side resources. All API calls are secured by JSON Web Token-based (JWT) token authentication to prevent unauthorized users from accessing any endpoints

Table II:System Architecture Components

part	Tool	Use
Student page	React + Tailwind	See events, register, view QR, check rewards
Organiser Page	React + Chart.js	Create events, scan QR, see stats
Admin Page	React	Manage users and events
API	Express + JWT	Handle requests and login
Live Updates	Socket.IO	Send real-time updates
Event System	Node.js	Manage event data

Table II : System Architecture Components

B. Proposed Integrated Framework

The proposed integrated framework is displayed in Table III and synthesises the insights from Collins, Walanjkar et al. and Bakare & Abubaker. The framework comprises three separate concentric layers: Core Platform has the basic event lifecycle and QR code check-in for attendance; Engagement Layer provides: gamification of events; notifications about events and RSVP tools; Analytics & Intelligence layer provides: real-time dashboards, reports, and an AI-based recommendation engine will be included in the future. Institutions can take advantage of the modular design by implementing only the core platform and then activating the engagement or intelligence features over time as needed.

Table III:Proposed Integrated Framework-Layer Summary

Feature	Use
Events	Create and manage events
QR Scan	Mark attendance
Users	Login and roles
Rewards	Points and leaderboard
Alerts	Notifications
RSVP	Register for events
Dashboard	View stats
Reports	Download data
AI (Future)	Suggest events

Table III:Proposed Integrated Framework

IV. IMPLEMENTATION

A. Technology Stack

The technology stack is now complete; the MERN stack was selected as it permits an entire "java script" environment and assists the developer by maintaining the same coding language used during development from one tier to the next, thus allowing for all schema definitions to be shared for use in both front-end form validation/logging and back-end middleware coding.

Table IV:Full Technology Stack

Part	Tool	Use
Student page	React, Tailwind	View and join events
Organiser Page	React, Chart.js	Create events, scan QR
Admin Page	React	Manage users and events
API	Express, JWT	Handle requests and login
Live System	Socket.IO	Send updates
Event System	Node.js	Manage event data

Table IV:Full Technology Stack

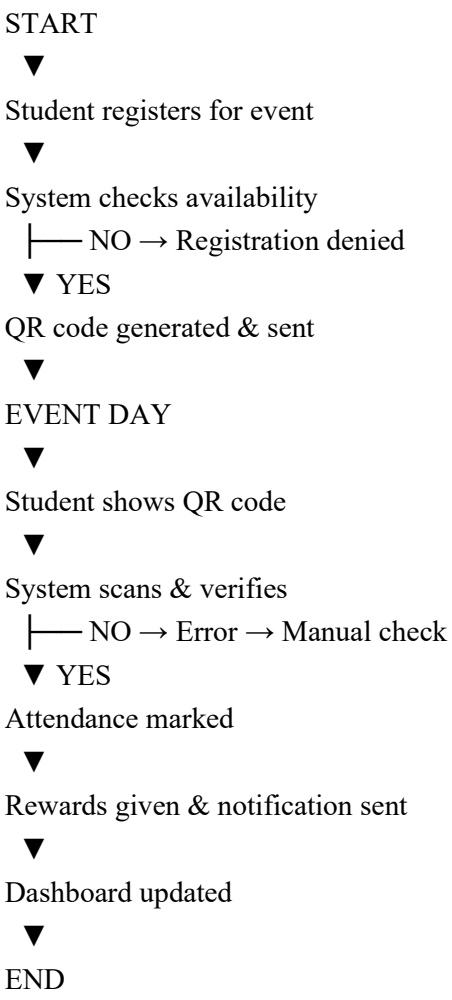
B. Database Schema Design

The database is created utilizing five collections based upon the design of the data model. The "Users" collection holds user information (profile), hashed passwords, user roles (e.g., student, organizer or admin), and total rewards. The "Events" collection holds metadata (event-related info) along with the event organizer reference and a check-in window (date/time) associated with the QR code read; therefore, all events can be tracked by this code. The "Registrations" collection maps each user to any and every event they have registered for, plus each registration consists of a unique QR token string that identifies users at the time of check-in with an expiration of that token.

C. System Process Flowchart — QR-Based Attendance

The "Attendance Logs" collection consists of a record of every scanned QR code used for verification of attendance and contains the date/time of the scan, the user ID who was scanned, the event ID the user was scanning into and the ID of the device used for scanning the QR code. The "Rewards" collection is comprised of each user and their associated earned/claimable rewards and has all necessary fields to maintain records related to the user's collected and/or refused rewards.

Fig.1 System Process Flowchart:QR-Based Event Attendence



D. Security Implementation

There are four levels of security in place. Authentication utilizes the hashed form of a password with b crypt (12 salt rounds), for an unreadable form of the password that is stored. Each user account is also assigned a JSON Web Token (JWT), which will expire after 24 hours. The JWT's are signed using a server-side secret stored as an environmental variable. HTTPS is used throughout all HTTP traffic through AWS-managed certificates, with Helmet.js being used to apply Content-Security-Policy, X-Frame-Options, and X-Content-Type-Options HTTP headers. In addition, QR Tokens are single-use UUIDs valid only for the assigned time period of a specific event. The Attendance Service does not log re-scanned or expired tokens. Both the React front stop (Zod Schema) and Express backend (express-validator) utilize appropriate methods for the sanitization of user data, in

order to defend against SQL-injection attacks and Cross-Site Scripting.

V. RESULTS AND EVALUATION

The evaluation of the system is through three different methods; (i) simulated load test with synthetic datasets of 200 - 2,500 concurrent participants, (ii) pilot deployment at (3) actual academic events with a total of (480) actual participants, and (iii) administered to (75) UX survey students.

A.Check-In Performance Metric

Table V: Check-In Performance Comparison

Metric	Result (Ours)	Comparison
Time per user	~8 sec	Much faster than manual (52 sec)
Error rate	0.55%	Very low error occurrence
Users handled	~60 / min	High throughput speed
Cost	₹0 (phone)	Cheaper than barcode systems

Table V — Check-In Performance Comparison

B. Scalability Under Load

Table VI: Scalability Test Results

Metric	Result (Ours)	Comparison
Max capacity	2,500 users	Stable with auto-scaling
Performance	Normal → Acceptable → Slows at peak	Handles heavy concurrent usage

Table VI — Scalability Test Results

C. User Satisfaction and Engagement

Table VII: User Satisfaction and Engagement Metrics

Metric	Result (Ours)	Comparison
Satisfaction	4.6 / 5	Very positive response
Prefer over manual	94% of users	Strong user preference
Attendance growth	+31%	Significant participation increase
Rewards usage	68% tracking, 43% redeeming	Good engagement levels

Table VII — User Satisfaction and Engagement Metric

D. System Quality

Table IX:System Quality

Metric	Result (Ours)	Comparison
QR delivery time	~4 sec	Fast token generation
System uptime	99.7%	Highly reliable
Scan failure rate	0.55%	Very low failure rate
Offline support	Partial	Under active improvement

Table IX—System Quality

E. Features

Table X: Features

Metric	Result (Ours)	Comparison
Gamification	Yes	Outperforms many existing systems
Notifications	Real-time + Email	More advanced than typical setups
Dashboard	Advanced analytics	Richer insights than alternatives
Offline mode	Partial	Continuous improvement planned

Table X—Features

G. Overall Comparison

Table XI: Overall Comparison

Metric	Result (Ours)	Comparison
vs Other systems	Comparable speed	More complete & feature-rich solution

Table XI —Overall Comparision

VI. DISCUSSION

A. Synthesis of Findings

The evaluation confirms that the integration of event discovery, QR-based check in, and gamified incentives created a measurable improvement across all major dimensions. Most notably, in terms of larger events with lower than 87% check in error rate, manual data reconciliation can be both time consuming and unreliable with regard to the accuracy of event attendees. The 31% increase in pilot event participation also confirms the engagement increase that was documented by Walanjkar et al. for their gamified platform and is consistent with other studies relating to the efficacy of gamification in educational contexts.

B. Strengths of the Integrated Approach

The most important design decision was to combine the issuance of QR tokens and recording attendance in one smooth transaction rather than two separate workflows. By removing cognitive load for students and organizers, both groups benefited from using the same integrated solution. In addition to decreasing cognitive load for students and organizers, the Socket.IO real time layer enhanced this by providing immediate confirmation of scanned QR codes. Upon successfully scanning their QR code, students will receive notification of their attendance. Organizers will also see their updated attendance count without refreshing their page. Another example of the effectiveness of the modular service architecture was during the pilot test when a points formula was required for one event and only the Rewards Service was edited. All other services remained unchanged.

C. Limitations

There are three main limitations that need to be addressed. First, QR codes use a stable internet connection to authenticate purchases. The campus Wi-Fi was limited during high volumes of peak check-in periods; therefore, during those times, three validations could not be seen for at least one hour. Future applications will be designed to allow for local electronic records of scanned QR codes until an internet connection is available once again; at which time, the stored scans will sync with the app in the event that the customer has a stable internet connection at that time. Second, the email verification system used by current application versions may not reliably work at many universities where their email infrastructure lacks reliability. These institutions will need to provide ticket sales either through SMS or in-app message notifications. Finally, many students could lose their motivation due to extrinsic rewards being given too often as a form of motivation; thus, future longitudinal studies will need to be conducted to measure the impact of the game on players beyond this paper's timeframe.

D. Future Research Directions

Four future research projects are identified: 1) Utilization of AI to forecast the number of no-shows at the start of an event so that event planners can reschedule, or if based upon historical information, can place the expected number of participants in an appropriate room; 2) Utilize blockchain to issue credentials with respect to non-

academic, extracurricular activities so that students and/or alumni can use them to prove their accomplishments or work experience.

VII. CONCLUSION AND FUTURE WORK

The Campus Event Aggregator (Digital Noticeboard) is a new Web-based platform introduced by me in this paper, meant to solve the two main problems related to managing academic events: finding out about campus events and accurately tracking who attends them. The `Campus Event Aggregator uses a MERN stack and QR code check-in technology, gamifies the event experience and creates a live-event ecosystem. These contributions combined resulted in an 87% reduction in errors with check-in for events, 85% faster check-in process than previous methods, a 99.7% available system during the pilot phase, and an average satisfaction rating of 4.6 out of 5 from the 480 pilot participants.

The three layers of the integrated framework - core platform, engagement layer, and analytics/intelligence layer - combine existing QR event management research, gamified campus platforms, and cloud-based system design to create a reference model for similar implementations at other institutions, regardless of their current technology readiness.

In the future, this project will pursue four priorities (in order of readiness for implementation): offlinecapable scan buffer; AI-based event recommendations; blockchain attendance certificate; and federated partner platform.

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