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Smart College Event Management & Participation Portal

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Abstract—Co-curricular events are central to academic life in Indian colleges, yet the processes around them — announcement, registration, approval, attendance capture, certificate issuance, and reporting — remain largely manual and fragmented across notice boards, messaging groups, spreadsheets, and ad-hoc web forms. This paper presents the design, implementation, and evaluation of a Smart College Event Management and Participation Portal: a unified, role-based web platform that digitises the complete event lifecycle for a higher education institution. The system adopts a three-tier architecture with a React client, a Node.js/Express REST service layer, and a MongoDB document store, supported by JSON Web Token authentication, role-based access control across four actor classes, QR-code-driven attendance capture, automated PDF certificate generation, and an analytics dashboard for participation reporting. A comparative analysis against manual workflows and generic platforms such as Google Forms and Eventbrite is presented. The portal was piloted over one semester across 14 events in 3 departments with 1,240 registrations, yielding a 78% reduction in organiser administrative effort, a 94% reduction in certificate turnaround, and a 41% relative increase in cross-departmental participation. A 10-item implementation checklist is developed and four open challenges are identified: offline attendance resilience, identity integrity, timetable conflict resolution, and sustainable hosting for resource-constrained institutions.

Index Terms—Event Management System, College Portal, Participation Tracking, Role-Based Access Control, QR Code Attendance, MERN Stack, Automated Certificate Generation, REST API, MongoDB, Educational Technology, Campus Automation, Analytics Dashboard.

I. INTRODUCTION

Technical symposia, cultural festivals, workshops, hackathons, and guest lectures form a substantial part of the learning experience in Indian higher education. The National Education Policy 2020 emphasises holistic education in which co-curricular participation is integral rather than peripheral, and both NAAC and NBA accreditation frameworks require institutions to document participation and produce auditable evidence across an assessment cycle [1], [2].

Despite this, the machinery behind campus events remains conspicuously analogue. Events are announced on notice boards and duplicated into messaging groups; registrations arrive through a standalone form; approvals travel as printed letters between coordinator, head of department, and principal; attendance is recorded on a sheet passed along a row of chairs; and certificates are designed individually and issued weeks later. The resulting record is fragmented, non-auditable, and difficult to aggregate at institutional level.

This fragmentation imposes three costs. Administratively, organisers spend disproportionate effort on clerical reconciliation. In terms of equity, announcements propagating through informal channels systematically disadvantage students outside a coordinator's network, suppressing cross-departmental and first-year participation. Institutionally,

C. Event Lifecycle Module

An event transitions through a defined state machine — DRAFT, PENDING_APPROVAL, APPROVED, PUBLISHED, REGISTRATION_CLOSED, ONGOING, COMPLETED, ARCHIVED — with REJECTED and CANCELLED as terminal branches. Every transition writes an immutable audit entry capturing actor, timestamp, and prior state. This trail is what converts an operational database into accreditation evidence: it establishes not merely that an event occurred, but that it was proposed, reviewed, and approved through the sanctioned chain.

D. Registration and Participation

Capacity ceilings are enforced atomically at the database layer, eliminating the overbooking race condition naive implementations exhibit under concurrent submission. Oversubscribed events promote waitlisted candidates automatically on cancellation. Eligibility rules restricting an event by department, year of study, or attendance threshold are declared per event and validated server-side. Team events support a captain-led invitation flow in which member acceptance precedes finalisation.

E. QR-Based Attendance Verification

Attendance is where a registration list becomes a participation record, and is the stage most vulnerable to

participation data held in personal drives and closed groups cannot answer basic longitudinal questions during an accreditation cycle.

This paper contributes: (1) a requirements analysis of the campus event lifecycle drawn from stakeholder interviews; (2) a role-based architecture for a unified portal; (3) a working MERN implementation with QR attendance and automated certification; (4) a comparative analysis against manual and generic alternatives; (5) empirical results from a one-semester pilot; and (6) an implementation checklist with four open challenges.

II. BACKGROUND AND RELATED WORK

A. The Manual Campus Event Workflow

Semi-structured interviews with eleven stakeholders — four faculty coordinators, three student council members, two heads of department, and two administrative staff — identified a seven-stage workflow: proposal, approval, publicity, registration, execution, attendance recording, and certification with report submission. Only registration showed consistent digital support, and even there the tool of choice produced an isolated spreadsheet with no link to approval or attendance records [3].

B. Generic and Commercial Platforms

Platforms such as Eventbrite and Meetup address ticketing and discovery for public events, assuming an open audience and no institutional hierarchy. They provide no faculty approval chain, no linkage to enrolment or departmental structure, and no accreditation-oriented reporting [4]. Survey tools such as Google Forms are widely adopted because they are free and familiar, but they capture a submission rather than manage a lifecycle: they cannot reliably enforce capacity, verify attendance, or issue certificates.

C. Institutional Systems and Research Gap

Enterprise campus ERP suites do include activity tracking, but licensing cost and customisation rigidity place them beyond most self-financed and aided colleges [5]. Several authors have proposed campus event systems, typically as CRUD web applications demonstrating registration and listing [6], [7]; comparatively few report a deployed evaluation with real participation data, integrate verified attendance, or model the approval hierarchy that distinguishes an institutional event from a public one [8]. The gap addressed here is therefore not the absence of event software but the absence of an institution-aware system treating approval, participation, verification, and reporting as one connected lifecycle.

III. PROPOSED SYSTEM ARCHITECTURE

A. Architectural Overview

inaccuracy under manual handling. Each confirmed registration generates a signed, time-bounded QR token bound to participant and event identifiers. A coordinator scans the token at the venue; the server validates the signature, checks the event window, and rejects replayed or duplicate scans. Because connectivity in auditoriums is unreliable, the scanner queues scans locally and synchronises on reconnection [11].

F. Certification, Notification and Analytics

On completion, certificates are generated in bulk as branded PDFs embedding participant name, event, date, role, and a verification code resolvable through a public endpoint, allowing a recruiter to confirm authenticity without institutional intervention. Notifications are dispatched through a queued engine with user-configurable preferences. The dashboard aggregates participation by department, year, category, and period, exposing accreditation-ready exports and identifying students with zero recorded participation for mentor follow-up [12].

IV. COMPARATIVE ANALYSIS

Table I situates the portal against the two incumbents: the manual workflow and generic form or ticketing platforms. Generic platforms match or exceed the manual process on registration convenience alone, offering nothing on approval workflow, verified attendance, certification, or institutional reporting. The manual process retains the approval chain but delivers it over days rather than minutes and leaves no queryable record. Three differentiators are absent from every alternative: enforcement of a multi-level academic approval hierarchy; certificate issuance tied to confirmed attendance rather than registration; and native generation of the participation summaries accreditation reporting demands [13].

V. IMPLEMENTATION AND SECURITY

The client uses React 18 with Tailwind CSS; the service layer uses Node.js, Express, and Mongoose with a job queue for asynchronous certificate and notification workloads. Five collections are maintained — Users, Events, Registrations, Attendance, Certificates — with a compound index on the event-participant pair enforcing registration uniqueness. Participant name and enrolment number are selectively denormalised into the registration document so roster rendering avoids a per-row lookup under load.

Authentication uses short-lived JSON Web Tokens with refresh rotation. Inputs are validated against declared schemas at the API boundary, rate limiting is applied to registration and authentication endpoints, and passwords are stored using a memory-hard hashing function. Personal data handling follows minimisation and purpose limitation consistent with the Digital Personal Data Protection Act 2023, with explicit consent

The portal follows a three-tier separation. The presentation tier is a single-page React application, responsive across mobile and desktop on the observation that most student interaction occurs on a phone. The application tier is a stateless Node.js and Express REST service exposing versioned JSON endpoints, permitting horizontal scaling during the registration surges that cluster in the minutes after an announcement. The data tier is a MongoDB document store, selected because event objects are heterogeneous — a hackathon carries team structures and problem statements while a guest lecture carries neither [9].

B. Role-Based Access Control

Four actor classes are defined. A Student discovers events, registers, views a personal participation history, and downloads certificates. A Faculty Coordinator creates proposals, manages rosters, marks attendance, and issues certificates. A Head of Department approves or rejects departmental proposals and views analytics. An Administrator manages provisioning and institution-wide reporting. Authorisation is enforced in API middleware rather than the client, so hiding a user-interface control is never the sole defence against an unauthorised action [10].

captured at registration for display of participant names in published result lists [14], [15].

VI. RESULTS AND EVALUATION

The portal was deployed for one semester across three departments, covering 14 events and 1,240 registrations from 612 distinct students, with baseline measurements drawn from the preceding semester's manually administered events.

Organiser effort, measured as self-reported coordinator hours per event spent on roster compilation, attendance transcription, and certificate preparation, fell from a mean of 9.4 hours to 2.1 hours, a reduction of 78%. Certificate turnaround from completion to participant receipt fell from 23 days to approximately 1.3 days, a reduction of 94%, the residual delay attributable to coordinator confirmation of winner lists rather than system processing.

Cross-departmental participation — registrations originating outside the organising department — rose from 19% to 27%, a relative increase of 41%, consistent with the hypothesis that a single institution-wide discovery surface reduces the disadvantage imposed by informal announcement channels. Registration-to-attendance conversion was measurable for the first time at 71%. System Usability Scale scores from 168 students and 9 coordinators returned means of 82.4 and 79.1, both above the conventional threshold for acceptable usability [16]. Table II presents the module-wise implementation checklist derived from the deployment.

TABLE I — Proposed Portal vs. Manual Process vs. Generic Platforms

Dimension	Proposed Portal	Manual Process	Generic Platforms	Institutional Impact
Announcement reach	Institution-wide feed with targeted eligibility filters	Notice board plus informal groups	External link circulated manually	Reduces network-based participation inequity
Approval workflow	Multi-level digital approval with audit log	Printed letters routed physically	Not supported	Days of routing reduced to minutes; auditable
Registration control	Atomic capacity limits, waitlist, eligibility rules	Manual list checking, frequent overbooking	Basic response caps, unreliable	Eliminates oversubscription disputes
Attendance capture	Signed QR tokens, replay-protected, offline queue	Paper sheet circulated in hall	Not supported	Participation becomes verifiable evidence
Certificates	Automated bulk PDF with public verification code	Designed and sent individually	Not supported	Turnaround from weeks to hours
Reporting	Live dashboard with accreditation-ready exports	Compiled manually per request	CSV of raw responses only	Supports NAAC and NBA documentation cycles
Data ownership	Retained on institutional infrastructure	Dispersed across personal files	Held by third-party vendor	Aligns with DPDP Act 2023 obligations
Recurring cost	Hosting and maintenance only	Printing, stationery, staff hours	Per-event or subscription fees	Predictable and low for affiliated colleges

TABLE II — Implementation Checklist — 10 Action Items and Pilot Outcomes

#	Implementation Action Item	Primary Owner	Priority	Pilot Outcome
1	Map the existing event lifecycle with stakeholder interviews	Project team	Critical	11 stakeholders, 7 stages identified
2	Define role matrix and API-level authorisation rules	Development team	Critical	4 roles, enforced server-side
3	Implement event state machine with immutable audit log	Development team	Critical	10 states, full transition history
4	Enforce atomic capacity limits and waitlist promotion	Development team	High	Zero overbooking incidents
5	Deploy signed QR attendance with offline queueing	Development team	Critical	71% conversion first measured
6	Automate branded certificates with verification codes	Development team	High	Turnaround down 94%
7	Configure queued notifications with user preferences	Development team	Medium	Opt-out rate below 6%
8	Build analytics exports aligned to accreditation formats	Administration	High	Departmental reports generated live
9	Capture consent and apply data minimisation at signup	Administration	Critical	DPDP-aligned consent recorded
10	Run coordinator training and staged departmental rollout	Administration	Medium	3 departments, 14 events, SUS 79.1

VII. FUTURE RESEARCH DIRECTIONS

A. Offline-Resilient Attendance

Connectivity inside auditoriums, laboratories, and sports grounds was the largest source of operational friction during the pilot. Future work should evaluate conflict-free replicated data types and local-first synchronisation for attendance capture, alongside short-range alternatives such as Bluetooth beacon proximity or NFC identity cards, characterising the trade-off each carries between verification strength and deployment cost [17].

B. Identity Integrity

Any system converting attendance into a credential creates an incentive to falsify it. Token sharing, in which a registered but absent student forwards a QR code to a peer at the venue, was observed in a small number of cases. Lightweight countermeasures — device binding, venue-scoped rotating codes, or selective biometric confirmation for credit-bearing events — must be weighed against their privacy cost and proportionality [18].

C. Timetable-Aware Scheduling

Conflicts between events and academic instruction were a recurring complaint. Integration with institutional timetable data would let the portal surface conflicts at proposal time and recommend low-conflict slots. The underlying problem — maximising expected eligible attendance subject to room, faculty, and instructional constraints — is a constrained optimisation problem meriting formal treatment [19].

D. Participation Analytics and Equity

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Longitudinal data enables research into the relationship between co-curricular engagement and academic outcomes, and into equity of access across gender, year, and department. Such analysis demands methodological care: participation is self-selected, and correlational findings must not be presented as causal. Predictive modelling applied to individual students raises further concerns warranting explicit governance before deployment [20].

VIII. CONCLUSION

This paper presented the design, implementation, and evaluation of a Smart College Event Management and Participation Portal unifying the campus event lifecycle — proposal, approval, publication, registration, verified attendance, certification, and reporting — within a single role-aware platform. The differentiator for an institutional deployment is not registration convenience but integration of the approval hierarchy, verified participation, and accreditation-ready reporting.

A one-semester pilot across 14 events and 1,240 registrations produced a 78% reduction in organiser effort, a 94% reduction in certificate turnaround, a 41% relative increase in cross-departmental participation, and a first reliable registration-to-attendance conversion figure, with usability scores above accepted thresholds. Four open challenges remain: offline resilience, identity integrity, conflict-aware scheduling, and sustainable hosting for institutions without dedicated technical staff. None undermines the central finding that the fragmentation of campus event administration is a solvable engineering problem rather than an inherent feature of institutional life.

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