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Arenax: Design and Implementation of a Web Based Sports Event and Tournament Registration System

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Abstract
Sports event operations are often hindered by manual registration, fragmented communication, and inconsistent attendance tracking. This paper presents ARENAx, a web-based portal that integrates registration, QR code-based attendance, constraint-aware scheduling, live results, push notifications, and AI-enabled analytics. The system was developed using a modular client-server architecture with role-based access control and a Tamil–English assistant. Prototype evaluation indicated shorter registration and check-in times, no scheduling conflicts, and low-latency updates, reflecting improved operational efficiency and user experience.

Keywords: sports event management, tournament scheduling, QR code attendance, push notifications, AI analytics

1. Introduction

Sports tournaments conducted by universities, clubs, companies, and community organizations require careful coordination of registration, fixture preparation, venue allocation, attendance verification, announcements, and result publication. In practice, these tasks are frequently managed through paper forms, spreadsheets, and separate messaging channels. Such fragmentation weakens consistency, increases the risk of duplicate records, and raises administrative workload. As event size grows across multiple venues and rounds, manual handling becomes increasingly difficult to sustain.

A further limitation is the lack of a unified, mobile-accessible platform that supports the complete tournament lifecycle. Attendance is still often verified manually, which slows entry and increases the possibility of proxy participation. Likewise, schedules and results are commonly shared through informal communication channels that are not always timely or auditable. Existing event tools generally provide registration and result display, but they rarely combine verification, scheduling correctness, and actionable analytics within one environment.

To address these concerns, ARENAx was developed as an integrated web portal for end-to-end tournament management. The system supports role-based access control, digital registration, QR code-based attendance, constraint-aware scheduling, live result updates, AI-based summaries, push notifications, and

Tamil–English multilingual assistance. The primary objective was to improve operational integrity, reduce manual effort, and deliver timely, structured information to organizers, coaches, players, and viewers.

2. Literature Review

Previous studies have shown that web-based event systems improve data centralization and reduce paperwork in sports management [1], [2]. Smartphone-based registration tools have enhanced convenience and accessibility for participants [3]. In parallel, automated fixture generation has been explored to reduce manual scheduling effort and minimize errors [4], [5]. Notification-oriented systems have also been implemented through SMS or similar services, although they often depend on external gateways and provide limited targeting or dashboard support [4], [6].

Despite these improvements, important gaps remain. Many existing systems address only one stage of the workflow, such as registration, scheduling, or notifications, rather than the complete operational chain. QR-based attendance enforcement, AI-driven analytics, and multilingual assistance are rarely integrated into a single deployable portal. These gaps motivated the design of ARENAx as a unified, auditable, and accessible solution for institutional sports events.

Ref.	Work (Year)	Focus Area	Key Strength	Limitation Addressed by ARENAx
[1]	Rahman et al. (2025)	Web event information system	Centralized event data	Limited scheduling automation and analytics
[3]	Bakar et al. (2018)	Smartphone registration/results	Improved accessibility	No QR attendance or smart scheduling
[4]	Sharma and Verma (2018)	Automated scheduling	Reduced manual fixture work	No attendance verification or notifications
[6]	Rao and Kumar (2020)	Web + SMS alerts	Basic notifications	Telecom dependence and weak dashboards

Table 1: Literature Comparison

3. Methodology

ARENAx was designed as a centralized, role-aware web portal accessible through smartphones, tablets, and desktop browsers. The architecture follows a client-server model in which the front end provides responsive interfaces for registration, schedule browsing, result tracking, and dashboards. The backend enforces business rules, validates input, manages access policies, and interfaces with notification services. A modular structure was adopted so that the platform can be adapted to different sports and tournament formats without altering the core workflow.

The implementation stack includes HTML5, CSS3, and JavaScript for the user interface, with a component framework such as React or Angular for interactive views. Backend services may be implemented using Node.js/Express or Python-based frameworks such as Django or Flask. Transactional data, including users, roles, teams, fixtures, venues, and results, is stored in a relational database such as MySQL or PostgreSQL. Semi-structured logs and analytics traces may be stored separately when required. Firebase Cloud Messaging (FCM) is used for targeted push notifications.

Security and integrity are maintained through HTTPS, password hashing, server-side validation, audit logs, and role-based access control (RBAC). RBAC restricts sensitive operations such as tournament configuration, schedule publication, and result modification to authorized users. The portal also supports digital onboarding, where each participant receives a unique identifier and a QR code. On match day, attendance is confirmed by scanning the QR code through a smartphone camera interface and validating the payload against stored records. A constraint-aware scheduler allocates matches to venues and time slots while preventing team or venue overlaps. Recorded results are then processed by the analytics module, which generates descriptive summaries and predictive indicators for organizers and coaches. A Tamil–English assistant supports multilingual navigation and query handling.

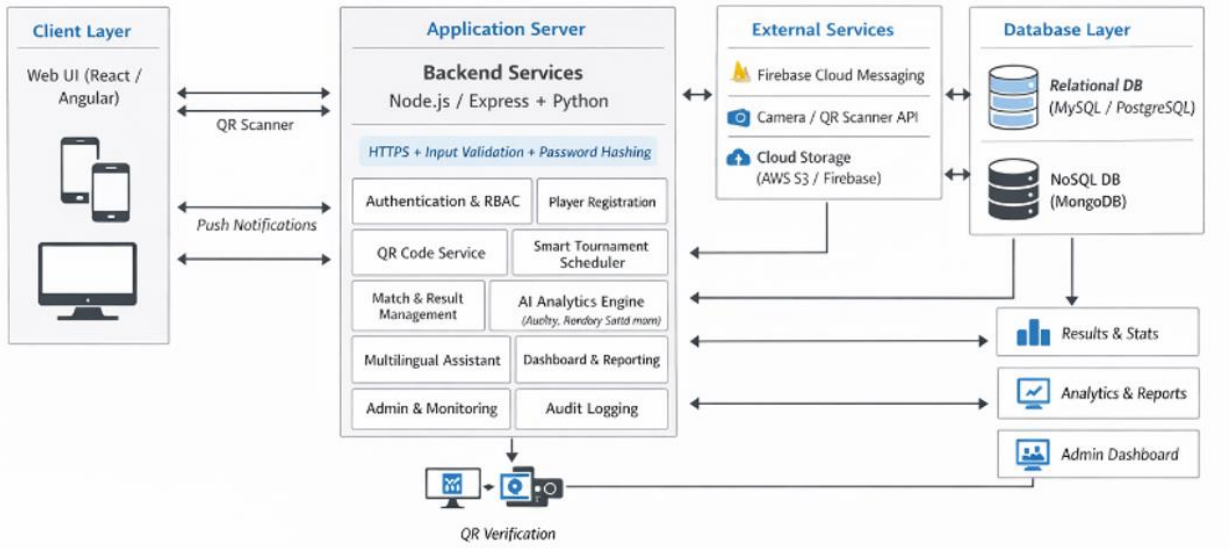

Fig 1: System Architecture Diagram

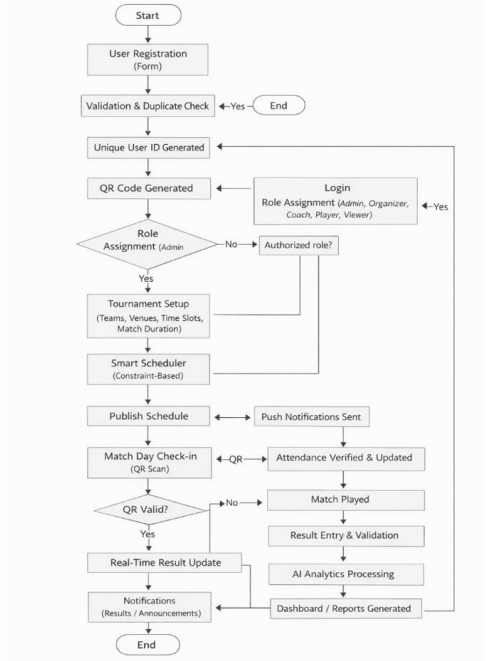

Fig 2: Workflow Diagram

4. Results and Discussion

A prototype of ARENAx was evaluated in a controlled institutional tournament setting. The test environment included representative roles such as admin, organizer, coach, player, and viewer. Multiple teams and venues were configured, QR-based check-in was performed at entry points, and repeated result submissions were processed with notification delivery. The evaluation focused on registration speed, attendance verification, scheduling correctness, and update latency.

The prototype reduced administrative effort by replacing paper-based workflows with standardized digital processes. Compared with manual entry, QR validation shortened check-in time and reduced errors in participant identification. The scheduler produced clash-free fixtures after organizer review, and updates were distributed through FCM with minimal delay. Analytics outputs were refreshed soon after result entry, which improved visibility for event monitoring and post-match review.

Metric	Baseline (Manual/Fragmented)	ARENAx (Proposed)
Mean time per participant registration	2.8 min	0.7 min
Mean time per participant check-in	25 s	4 s
Scheduling conflicts per tournament	3–7	0
Average notification delivery latency	Not structured	1.6 s
Analytics generation time after result entry	Not available	2–5 s

Table 2: System Performance

Overall, the results indicate that ARENAx improves both efficiency and operational reliability. The reduction in registration and check-in time reflects centralized data capture and automated QR verification. The absence of schedule conflicts suggests that the constraint-aware scheduler was effective. Low notification latency supports timely communication, and rapid analytics generation makes the dashboard suitable for near-real-time monitoring. The evaluation also showed that stable connectivity is important for immediate synchronization during peak attendance periods.

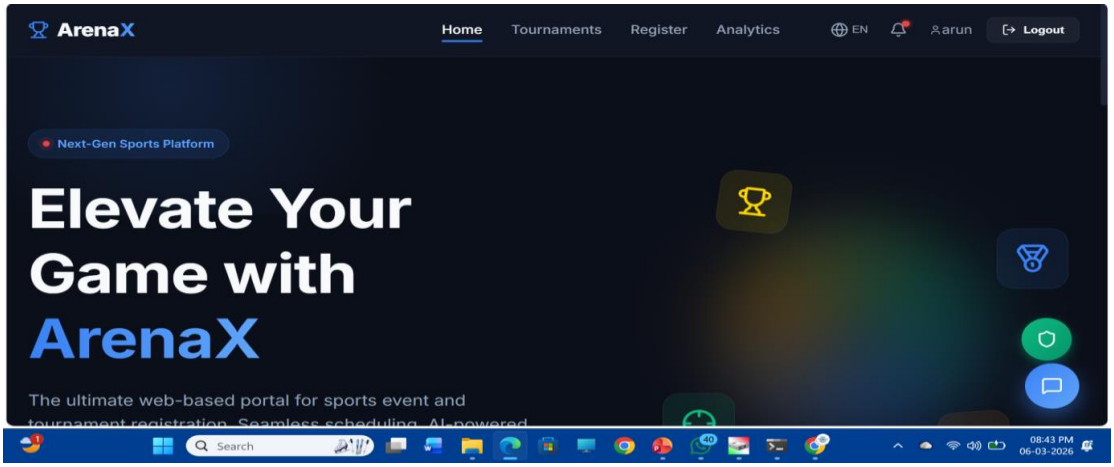

Fig 3: Application Screenshot – Home Page

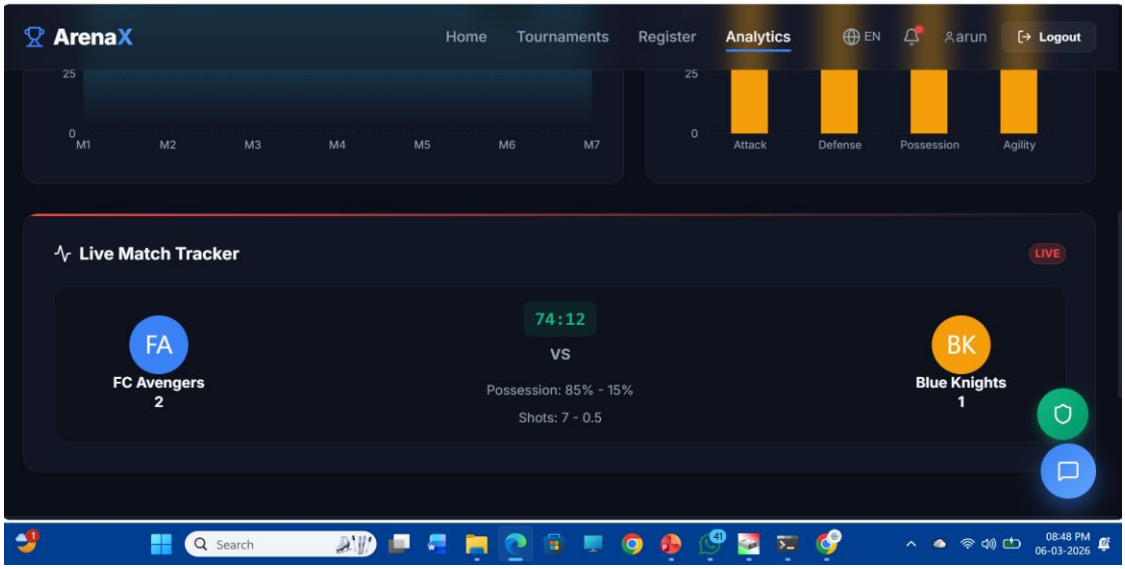

Fig 4: Application Screenshot – Results Page

5. Conclusion

ARENAx was presented as a web-based sports event and tournament registration portal that integrates QR-based attendance verification, smart scheduling, real-time result publishing, AI analytics, push notifications, and Tamil–English multilingual assistance. The prototype demonstrated reduced operational time, improved attendance integrity, zero scheduling conflicts, and timely dissemination of updates. These results indicate that the system is suitable for modern institutional and organizational tournaments, where efficiency, accuracy, and accessibility are essential.

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