

Gym Area Scheduling System

Project Proposal

Team Number: 23

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1. Problem Statement

College campuses with shared gymnasium facilities lack centralized, user-friendly systems for students and organizations to reserve spaces for practices, scrimmages, and tournaments. Current solutions often rely on fragmented processes such as email chains, physical sign-up sheets, or outdated booking systems that do not support real-time availability, team coordination, or competitive event organization. Our project delivers a unified scheduling platform purpose-built for athletic facility management, combining reservation capabilities with social features like team formation, group messaging, and achievement tracking, creating a cohesive experience that existing generic room-booking tools fail to provide.

Existing solutions like EZFacility and DSE Recreation Software provide robust administrative tools for gyms, offering facility scheduling, membership management, and intramural registration. However, these platforms are designed primarily for staff administrators rather than end-users, resulting in interfaces that prioritize back-office workflows over student experience. EZFacility excels at resource management and POS integration but lacks native tournament bracket generation and offers no built-in social features for team coordination.

DSE provides strong club sports registration but relies on web-based access without true native mobile applications, and neither platform includes community-building tools like group messaging, achievement systems, or gamification to drive ongoing student engagement. Our solution flips this model by having students be the main focus, giving them a mobile-first experience with native iOS and Android apps, integrated team formation and real-time chat, automated bracket generation for tournaments, and an achievement system that rewards participation, all while maintaining the scheduling fundamentals these legacy platforms provide.

2. Project Objectives

1. **Centralized Reservation System** : Provide a single platform where users can view real-time gym availability, reserve time slots for practices or scrimmages, and manage recurring bookings without scheduling conflicts.
2. **Tournament and Bracket Management** : Enable users to create, organize, and participate in tournaments with automated bracket generation, match scheduling, and result tracking.

3. **Team and Social Features** : Allow users to create teams, invite members, and communicate through integrated group chat and direct messaging, fostering community engagement around athletic activities.
4. **Gamification and Engagement** : Implement an achievement system rewarding both individual users and teams for participation milestones, tournament wins, and platform engagement to encourage continued use.
5. **Secure and Flexible Authentication** : Support single sign-on (SSO) via email-based routing to institutional identity providers alongside traditional email/password authentication, ensuring secure access for all campus users.
6. **Cross-Platform Accessibility** : Deliver a responsive application accessible on web browsers, iOS, and Android devices, ensuring users can manage reservations and communicate from any device.
7. **Extensible Architecture** : Design the backend to support future integrations, including hardware displays for gym availability and potential cross-service communication for larger campus ecosystems.

3. Stakeholders

- **Students and Student Athletes** : Primary users who reserve gym time for personal practice, team activities, and tournaments.
- **Intramural Sports Organizations** : Groups that organize recreational leagues and need scheduling and bracket tools.
- **Athletic Clubs and Teams** : Registered campus organizations requiring regular practice slots and scrimmage coordination.
- **Campus Recreation Departments** : Administrative staff responsible for facility management, policy enforcement, and usage reporting.
- **University IT Services** : Teams managing SSO integration and ensuring compliance with campus security standards.
- **Future: Facility Operations Staff** : Personnel who may interact with hardware displays showing real-time availability in gym spaces.

4. Deliverables

4.1 Cross-Platform Mobile and Web Application

A Capacitor-based application providing native experiences on iOS, Android, and web browsers. The frontend will be built with Vue 3 and Pinia for state management, delivering a responsive and intuitive interface for all scheduling and social features.

4.2 Backend API and Services

A NestJS backend written in TypeScript, using Prisma as the ORM for type-safe database interactions. The API will handle authentication, reservations, tournament logic, messaging, and achievement tracking. If cross-service communication becomes necessary (e.g., notification workers, analytics pipelines), BullMQ or Kafka will be employed for message queuing.

4.3 Database and Storage Infrastructure

PostgreSQL for relational data including users, teams, reservations, tournaments, and achievements. An S3-compatible object storage provider for user-uploaded content such as profile images and team logos. For messaging, we will utilize JSONB typing in PostgreSQL or a Set in Redis.

4.4 Authentication System

Secure sign-in supporting SSO via email-domain-based routing to appropriate institutional identity providers (e.g., campus SAML/OIDC), with fallback email/password authentication for users without institutional SSO access.

4.5 Tournament and Bracket Engine

A module for creating tournaments, automatically generating brackets (single elimination, double elimination, round-robin), scheduling matches against available gym slots, and recording results.

4.6 Messaging and Team Management

Group chat functionality for teams, direct messaging between users, and team management features including invitations, roles, and rosters.

4.7 Achievement and Gamification System

A framework for defining, tracking, and awarding achievements at both individual and team levels, with profile display integration.

4.8 Documentation and Deployment Artifacts

API documentation, user guides, and containerized deployment configurations for reproducible hosting.

4.9 (Future Scope) Hardware Display Integration

Architectural planning for ESP32-based e-ink or LCD displays running FreeRTOS/ESP-IDF firmware, capable of pulling pre-rendered availability images from the server for passive display in gym facilities.