



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 9.935

Volume 15, Issue 10, October 2026

AI-Based Smart Turf Booking System with Weather Recommendation

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ABSTRACT: This paper presents a Smart Turf Booking System with AI-assisted weather recommendation for efficient outdoor sports facility reservation. The proposed system enables users to view real-time turf availability, select suitable time slots, make secure online payments, and receive weather-based recommendations for cricket activities. The system is implemented using a web-based interface with separate customer and administrator portals. The backend uses Node.js REST services, while Supabase PostgreSQL provides persistent storage, row-level security, stored procedures, and realtime updates. Razorpay is integrated for payment processing and Open-Meteo provides hourly meteorological information. The weather recommendation module evaluates precipitation probability, temperature, cloud coverage, wind speed, and rainfall conditions to classify available slots as suitable, advisory, or high-risk. Administrative functions include turf and slot management, booking monitoring, verification and entry, reports, and system settings. The integrated design aims to reduce booking conflicts, improve operational visibility, and help users select outdoor sports slots with better weather awareness.

KEYWORDS: Turf Booking, Weather Recommendation, Online Reservation, Node.js, Supabase PostgreSQL, Razorpay, Open-Meteo, Real-Time Updates.

I. INTRODUCTION

Outdoor sports facilities commonly depend on manual or basic digital booking methods that may provide limited real-time availability and no information about weather conditions. This can lead to booking conflicts, inconvenient slot selection, and poor planning for outdoor activities during unfavorable weather.

The proposed Smart Turf Booking System integrates turf reservation, online payment, real-time slot management, and weather-based recommendations into a single web platform. The system provides separate customer and administrator interfaces to simplify booking and facility management. By combining reservation services with hourly weather information, the platform helps users make more informed decisions before confirming an outdoor sports slot.

II. RESEARCH GAP AND MOTIVATION

Existing turf booking platforms mainly concentrate on slot availability and payment functionality, while weather conditions are rarely integrated into the booking process. Manual management of slots can also result in inconsistent availability and simultaneous booking conflicts. These limitations create a need for a system that combines real-time reservation with environmental information.

The proposed system is motivated by the need to provide a convenient booking platform that not only manages reservations but also supports weather-aware selection of outdoor playing periods. The integration of booking, payment, administration, and weather services provides a unified workflow for customers and turf operators.

III. SYSTEM OBJECTIVES

The primary objective is to develop an efficient online platform for turf reservation and management. The system aims to provide real-time slot availability, prevent duplicate bookings through transactional database operations, support secure online payment, and provide weather-based recommendations for selected time slots. It also provides administrators with facilities for slot management, booking monitoring, verification and entry, reporting, and system maintenance.

IV. PROPOSED ARCHITECTURE

The proposed system follows a layered architecture consisting of users, web interface, application/backend services, external services, Supabase backend, and core data. Customers interact with the booking interface, while administrators use a dedicated portal for operational management. The web interface is implemented using HTML, CSS, and JavaScript and communicates with a Node.js HTTP server and REST-based booking services.

The application layer coordinates booking and slot management, payment integration through Razorpay, and weather retrieval through Open-Meteo. Supabase PostgreSQL stores turf, slot, customer, booking, and settings data. Row-level security policies, stored procedures/RPC functions, and realtime updates provide controlled data access and synchronized application state.

System Architecture of Smart Turf Booking System with Weather Recommendation

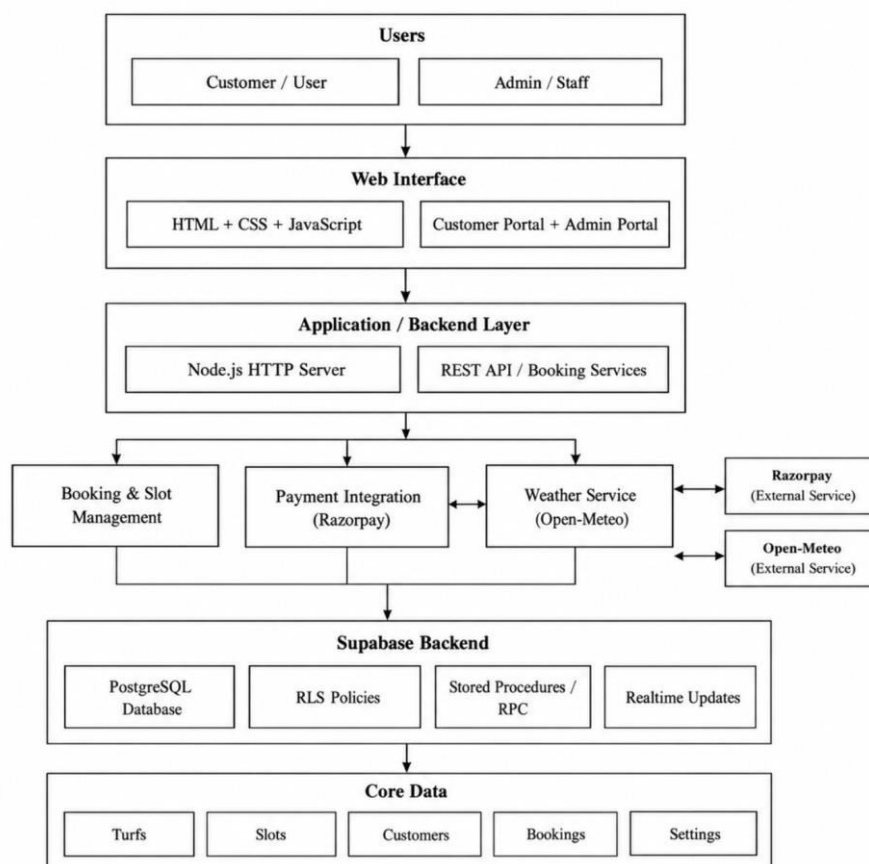


Fig. System architecture of the proposed turf booking and weather recommendation system.

Fig.1. System architecture of the proposed turf booking and weather recommendation system

BOOKING WORKFLOW

The booking workflow begins when a customer accesses the turf booking portal and selects a desired date and time slot. The system retrieves current availability and displays the relevant slot information. After selecting a slot, the customer provides the required contact details and proceeds to online payment through Razorpay.

The payment is verified by the backend before the booking is confirmed. The database transaction validates the slot and records the booking. After successful confirmation, the system generates a booking reference and a four-digit PIN that can be used for staff verification and customer check-in. This workflow is designed to reduce simultaneous booking conflicts and provide a traceable reservation process.

WEATHER RECOMMENDATION MODEL

The weather recommendation module obtains hourly meteorological data from the Open-Meteo service and evaluates parameters such as precipitation probability, temperature, cloud coverage, wind speed, and rainfall conditions. A rule-based decision mechanism classifies each selected time slot according to expected suitability.

In the implemented approach, a high precipitation probability generates a warning, while intermediate precipitation probability produces an advisory. Lower precipitation probability is considered comparatively suitable when the remaining weather conditions are acceptable. The recommendation is presented together with hourly weather information so that users can compare available slots before booking.

DATABASE DESIGN

The system uses Supabase PostgreSQL as its primary database. The database contains relational tables for turf information, available slots, customer details, bookings, and system settings. Booking operations are handled through controlled database transactions and server-side procedures to reduce the possibility of double booking. Row-level security policies restrict access to protected records, while realtime facilities support updated slot and booking information across the application.

The database design separates customer-facing reservation information from administrative management data while maintaining relationships between turfs, slots, customers, and bookings. This structure supports consistent storage, retrieval, and monitoring of reservation records.

IMPLEMENTATION DESIGN

The customer portal is implemented using HTML5, CSS3, and JavaScript, with responsive interfaces for booking and weather-aware slot selection. The Node.js backend provides REST services for authentication-related operations, turf and slot information, booking processing, and integration with external services. Supabase PostgreSQL is used for persistent storage and realtime synchronization.

The administrator portal provides dashboard statistics, turf management, slot scheduling, booking management, verification and entry, reports and analytics, and system settings. The weather recommendation interface presents date-wise and hourly conditions and identifies a recommended time window based on the available weather parameters.

SECURITY AND FAULT HANDLING

Security is considered throughout the proposed architecture, particularly for payment and booking operations. Sensitive payment credentials are maintained on the server side, and payment information is verified before confirming a transaction. Database transactions and row-level security are used to prevent conflicting bookings and unauthorized record access.

The system also handles external-service failures and unsuccessful payment or booking requests. Validation is applied to user inputs, while backend checks maintain booking consistency. Realtime synchronization helps keep slot information updated when reservation records change.

EVALUATION METHODOLOGY

The proposed system is evaluated through functional, concurrency, integration, reliability, and usability testing. Functional testing verifies major operations including slot selection, booking, payment verification, weather recommendation, administrative management, and entry verification.

Concurrency testing focuses on simultaneous requests for the same slot to determine whether the booking workflow prevents duplicate reservations. Integration testing examines communication with Razorpay and Open-Meteo. Reliability testing considers valid and failed requests, while usability testing examines representative customer and administrator workflows. The screenshots in the experimental results section document the implemented interfaces and functional output.

V. EXPERIMENTAL RESULTS

The developed system provides separate customer and administrator interfaces for turf booking, slot scheduling, weather recommendation, verification, and operational monitoring. The following figures present the implemented functional outputs. The results are presented as interface-level functional evidence rather than unsupported numerical performance claims.

Test	Procedure	Observed Evidence
Booking integrity	Attempt booking through the selected slot workflow	Booking and slot state are managed through the application workflow
Slot management	Create, enable, disable, and schedule turf slots	Administrator can control slot availability and pricing
Weather integration	Open-Meteo hourly weather retrieval and recommendation	Weather panel presents hourly conditions and a recommended time
Verification	Enter the booking PIN at the turf entry gate	Booking verification interface supports check-in validation
Usability	Representative customer and administrator walkthrough	Separate dashboards provide task-oriented interfaces

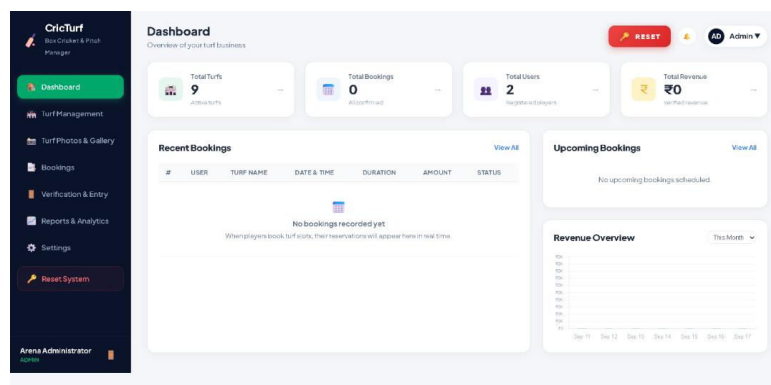


Fig.2. Administrator dashboard showing turf, booking, user, and revenue overview

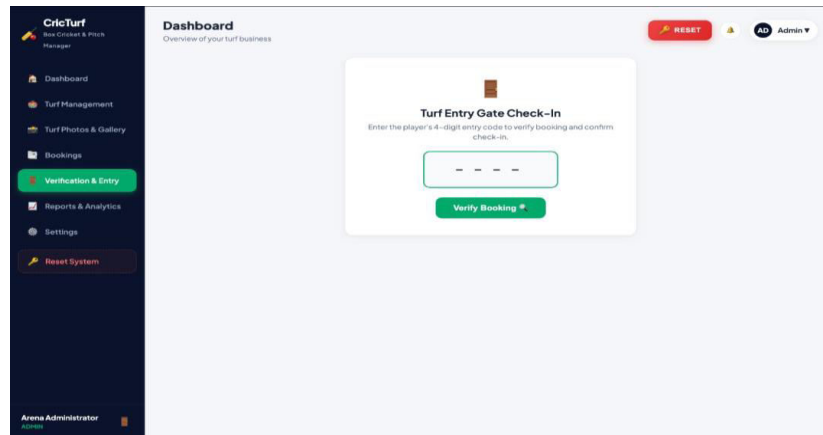


Fig.3. Administrator verification and entry interface for booking check-in.

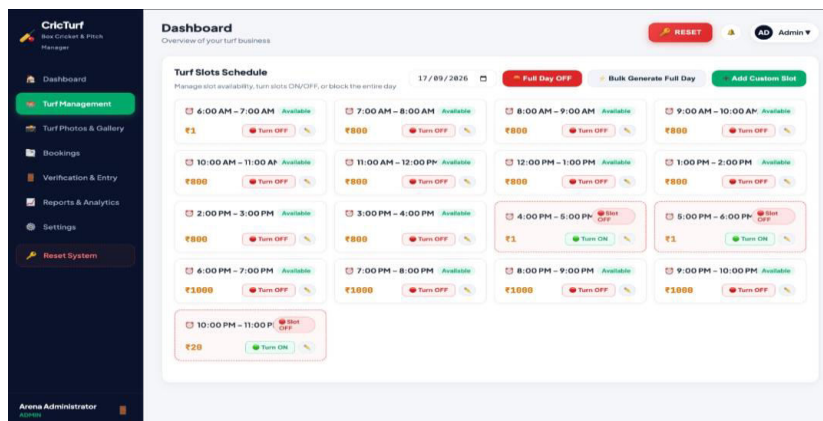


Fig..4. Administrator turf slot management and schedule control interface.

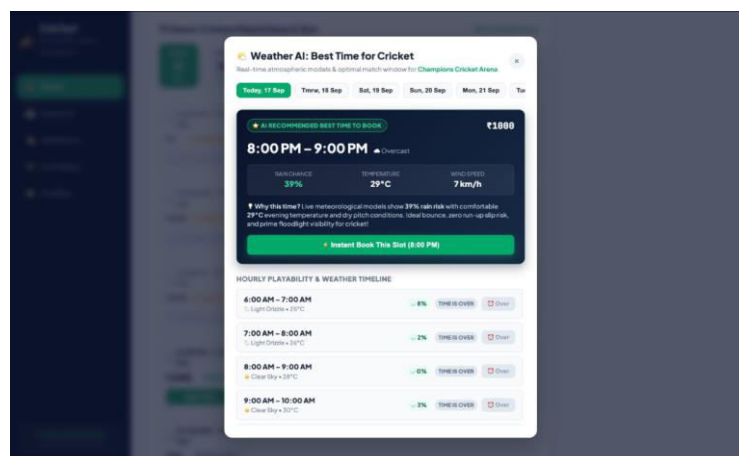


Fig..5. Weather AI interface showing hourly weather conditions and recommended booking time.

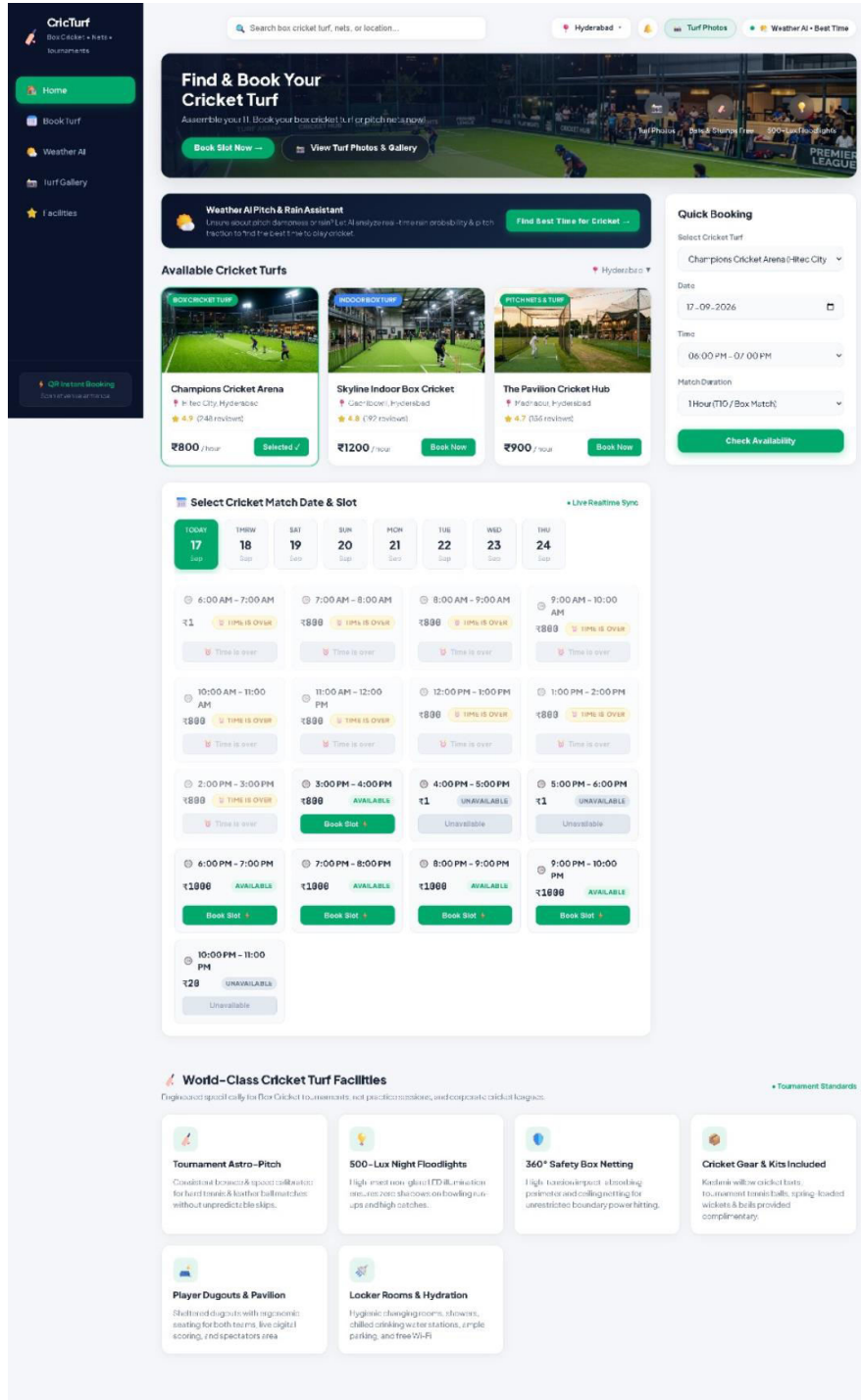


Fig.6.Customer dashboard for turf discovery, booking, and weather-aware slot selection

VI. DISCUSSION

The implemented system integrates turf reservation, payment processing, real-time database synchronization, and weather assistance into a unified platform. The transactional booking workflow is intended to reduce conflicting

reservations, while the weather recommendation module provides additional information for outdoor activities. The separation of customer and administrator interfaces simplifies facility management and customer interaction.

The experimental interfaces demonstrate that the system supports operational tasks such as slot scheduling, booking monitoring, entry verification, and weather-aware slot selection. The architecture is modular, allowing external services and backend components to be maintained independently.

VII. FUTURE WORK

Future work can focus on improving the intelligence and scalability of the proposed system. Historical weather and booking data can be used to develop machine-learning models for predicting slot suitability and customer demand. Dynamic pricing, personalized slot recommendations, automated notifications, mobile application support, and multi-location turf management can also be incorporated. Additional resilience mechanisms can be introduced for external service outages and high-volume booking periods.

VIII. CONCLUSION

The Smart Turf Booking System with Weather Recommendation provides an integrated approach to digital sports facility reservation and management. The system combines real-time slot availability, transactional booking, secure online payment, weather-based assistance, and administrative management within a single web platform. By incorporating hourly weather information into the reservation process, the system helps users make better-informed outdoor booking decisions while providing operators with tools for slot control, booking monitoring, and entry verification.

The modular architecture based on Node.js, Supabase PostgreSQL, Razorpay, and Open-Meteo provides a practical foundation for future enhancement with advanced prediction, personalization, and scalable multi-location management.

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