

An Intelligent Booking Platform for Sports and Conference Halls Using IoT Integration

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Abstract: *The Booking System for Sports and Conference Halls with IoT-Enabled Real-Time Display project aims to enhance facility management through an integrated digital platform and advanced Internet of Things (IoT) technology. This system simplifies the booking process by allowing users to check availability, make reservations, and receive instant confirmations via a centralized interface. IoT integration introduces smart sensors and real-time displays that provide up-to-date information on facility occupancy, environmental conditions, and event schedules. These sensors continuously monitor and transmit data, which is displayed on dynamic screens within the facility. This real-time data helps both users and facility managers stay informed, reducing scheduling conflicts and optimizing facility usage. The platform supports various user roles, including administrators, who manage bookings and generate reports, and facility managers, who oversee real-time data and maintenance. End-users benefit from an intuitive booking interface and live updates on availability and schedules. Overall, this system improves operational efficiency and user satisfaction by leveraging IoT technology for real-time monitoring and data-driven insights, modernizing the management of sports and conference halls.*

Keywords: Booking System, Sports Halls, Conference Halls, IoT Technology, Real Time Display, Digital Interface, Data-Driven Insights

I. INTRODUCTION

Background: Efficient management of sports and conference halls is essential for optimizing usage and enhancing user experience. Traditional booking systems often struggle with scheduling conflicts, lack of real-time updates, and limited data insights. Integrating digital platforms with IoT technology offers an opportunity to modernize and streamline facility management.

Problem Statement: Existing booking systems lack real-time facility updates, effective scheduling management, and automated monitoring, leading to conflicts, inefficiencies, and poor user satisfaction.

Objectives: The Booking System for Sports and Conference Halls with IoT-Enabled Real-Time Display aims to:

- Provide a centralized platform for easy booking and real-time availability checking.
- Integrate IoT sensors to monitor occupancy and environmental conditions.
- Display live facility data through dynamic screens for users and managers.
- Enhance administrative efficiency by enabling booking management and report generation.

II. LITERATURE SURVEY

Booking Systems: S. Jun et al. (2018) highlight the effectiveness of automated web-based booking platforms like BookMyShow in enhancing user convenience and reducing errors. Their research shows that online systems significantly improve booking efficiency compared to traditional manual processes.

IoT Integration: P. Wadhwa et al. (2019) discuss how integrating IoT technology provides real-time updates on facility availability. IoT-enabled displays enhance the user experience by offering instant access to occupancy information and environmental conditions.



Scheduling Optimization: D. Singh et al. (2020) explore the importance of efficient scheduling algorithms to maximize facility utilization. Their study emphasizes how optimized resource allocation minimizes booking conflicts and ensures smoother operations.

Payment Integration: R. Mehta (2019) highlights the role of secure payment gateways in booking systems. Streamlined payment processes not only automate transactions but also reduce cancellations and foster greater user trust in online booking platforms.

Community Engagement: M. Kim (2021) demonstrates that allowing users to join public events through booking platforms fosters community involvement. Increased social participation, especially in sports activities, leads to higher facility usage and improved user satisfaction.

III. METHODOLOGY

System Design and Architecture: It follows a modular architecture, combining web technologies, IoT, and database management to streamline the facility booking process.

User Authentication & Facility Management Module: Handles user registration/login using OAuth with JWT, manages different user roles (admin, facility manager, end-user), and maintains facility details (sports halls, conference rooms).

Booking Management and Recommendation Module: Allows users to check real-time availability, make bookings, and receive personalized suggestions via a Flask-based recommendation system.

Payment Integration Module: Integrates Razorpay for secure, seamless online payments during booking. Credentials are managed securely using Dotenv.

IoT and QR Code Module: Utilizes ESP32 microcontrollers and SSD1306 OLED displays to show real-time facility status like "Available" or "Booked for {Meeting Name}" using C++ (Arduino Framework) and simulated via Wokwi Simulator.

Tools and Technologies:

Frontend

- Language: TypeScript
- Framework/Library: React
- Bundler: Vite

Backend:

- Runtime: Node.js
- Web framework: Express.js
- Authentication: OAuth with JWT
- Email service: nodemailer
- Environment-variable management: dotenv
- Payment gateway: Razorpay
- Image CDN/optimization: ImageKit

Recommendation System

- Framework: Flask (Python)

Database

- Engine: MySQL
- ORM / Data-modeler: Sequelize

IoT

- MCU board: ESP32
- Display: SSD1306 OLED
- Language: C++
- Embedded framework: Arduino
- Simulator: Wokwi

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- IDE: PlatformIO
- Power supply: 3.3 V / 5 V breadboard module
- Wiring: jumper wires

DevOps / CI & CD

- Version control: Git
- Repo hosting: GitHub

IV. SYSTEM IMPLEMENTATION

The Sports and Conference Hall Booking System with IoT-enabled real-time displays is implemented using a modular, scalable architecture that integrates a web application with IoT-enabled real-time displays. The following technologies and components were used for system development:

Frontend Development: The user interface is developed using React with TypeScript, bundled with Vite for faster builds and performance. The frontend enables users to:

Register and authenticate securely.

Browse and book available sports or conference halls.

View booking status and recommendations.

Backend Development: The backend server is built with Node.js and Express.js, following a RESTful API architecture. Major functionalities handled include:

User management and authentication with OAuth and JWT.

Booking management, including creation, updates, and cancellation.

Communication with the database using Sequelize ORM.

A separate **Flask** server is integrated for the **Recommendation System**, which suggests suitable time slots based on historical usage patterns.

Database Management: Data storage is handled using MySQL. The database schema includes tables for Users, Facilities, Bookings, and Payments, ensuring relational integrity and efficient querying.

IoT Integration

Real-time facility status is managed through IoT devices:

ESP32 microcontroller controls the display system.

SSD1306 OLED displays show current facility status (e.g., "Available", "Booked for {Meeting Name}").

Devices are programmed using C++ and Arduino Framework, and tested via the Wokwi Simulator.

Displays are updated automatically whenever a booking status changes.

Payment and Media Management

Razorpay is integrated to manage secure online payments.

ImageKit is used for optimized storage and delivery of facility images.

Nodemailer handles notification emails for booking confirmations.

Dotenv is used for secure environment variable management.

CI/CD and Version Control

Git is used for version control.

GitHub is utilized for collaborative repository management and deployment pipelines.

CI/CD practices ensure regular integration and deployment of new features with minimal disruption.



V. RESULT

System Performance: Booking Buddy successfully integrated real-time booking management, IoT displays, and secure payment processing. The system performed well under normal conditions, with minor connectivity issues observed in larger facilities.

User Feedback: Users reported a positive experience with the interface, real-time updates, and secure payment system. The Recommendation System was helpful but showed delays during peak usage.

Scalability: The system handled small-scale bookings efficiently. However, further optimization is required for scalability to manage larger volumes of users and transactions without lag.

System Overview

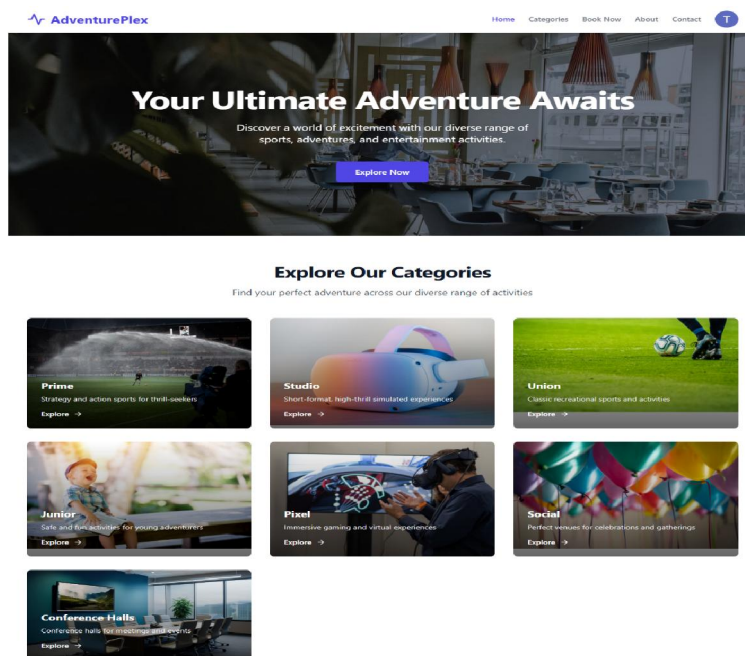


Fig. 1.Home Page

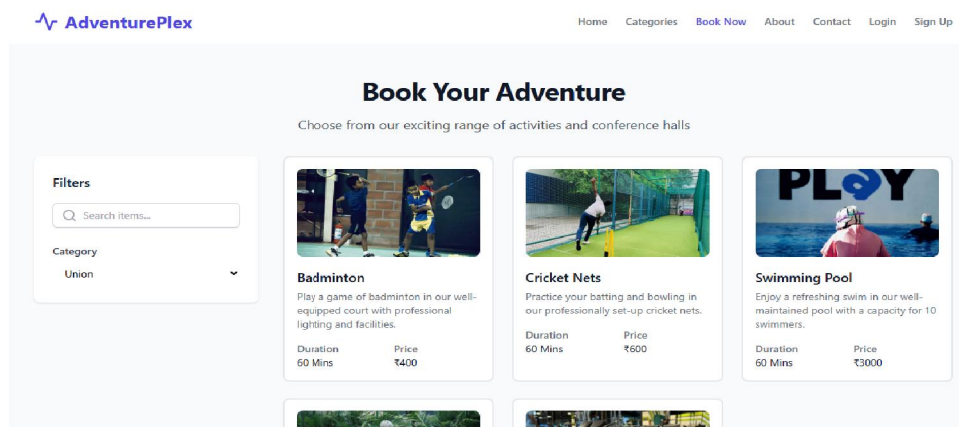


Fig. 2.Booking Module



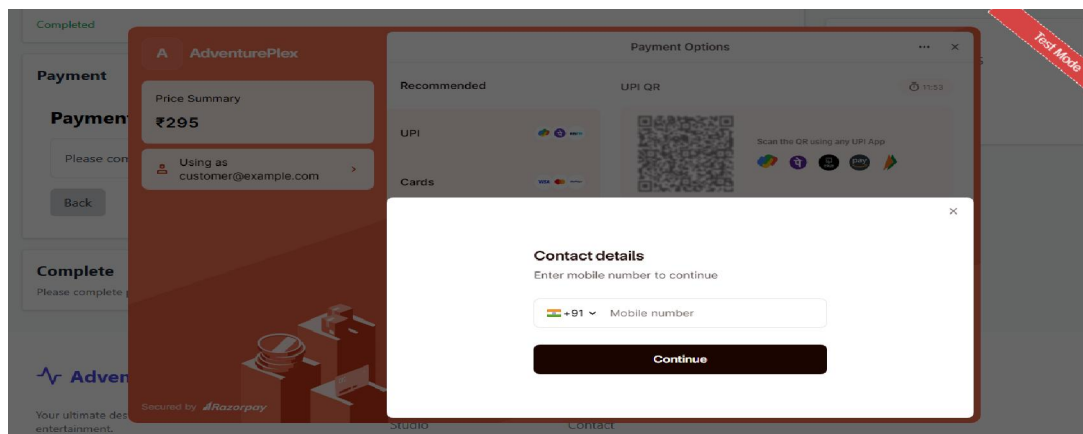


Fig. 3. Payment Module

Conference Hall Booking Confirmation

Dear Temp,

Your booking for **Alpha Conference Hall** on **2025-03-27** from **09:00:00** to **09:30:00** has been confirmed.

Your booking code is: **15**

Please find the attached QR code for authentication at the venue.

Thank you for booking with us!

One attachment • Scanned by Gmail



Fig. 4. Email

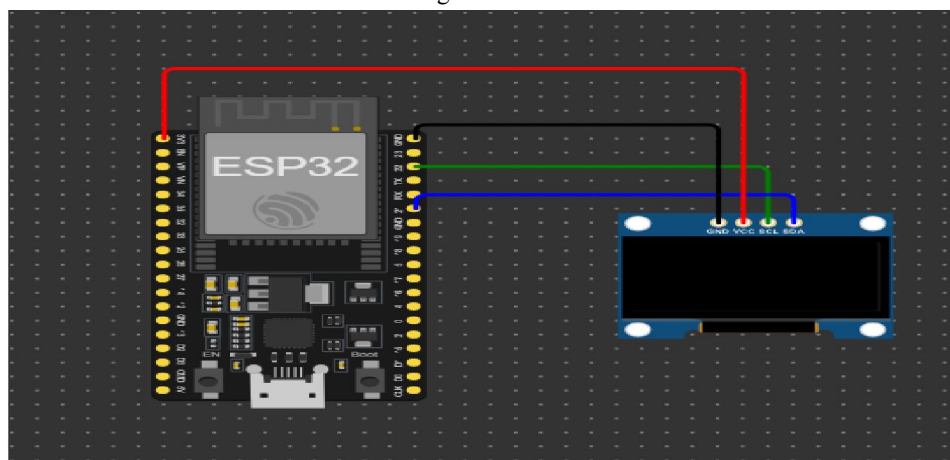


Fig. 5. IoT Setup

VI. CONCLUSION

The Booking Buddy system successfully modernizes sports and conference hall management by integrating IoT technology, real-time updates, and an intuitive booking interface. The system enhances user experience through efficient booking, secure payment processing, and real-time availability tracking. Despite some challenges with



scalability and connectivity in larger facilities, the system demonstrates great potential for streamlining facility management and improving user satisfaction. Future improvements will focus on optimizing performance during peak times and expanding system capabilities to support larger user volumes.

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