IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661, p-ISSN: 2278-8727, Volume 27, Issue 6, Ser. 4 (Nov. – Dec. 2025), PP 34-39
www.iosrjournals.org

Meeting Room Booking System

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Abstract:
The Meeting Room Booking System is a web-based application developed to automate and simplify the process of reserving meeting spaces within an organization. In many institutions and corporate environments, managing room schedules manually often leads to double bookings, confusion, and inefficient resource utilization. This project addresses these challenges by providing a digital solution that ensures smooth coordination and transparency in room allocations. The system is designed using React.js for the frontend and Node.js with Express.js for the backend, enabling real-time communication between users and the server. It features role-based authentication, allowing administrators and regular users to access different functionalities. Users can view available rooms, select preferred dates and time slots, and book rooms conveniently. If a desired room is already booked, the system introduces a waiting mechanism—allowing users to queue for the same room until it becomes available. Administrators can monitor all bookings, manage room data, and analyze room usage statistics through a dynamic dashboard that displays the total number of rooms, booked rooms, and available ones. This feature ensures effective space management and aids in planning future resource needs

Keywords: *Meeting Room Booking, Room Allocation, User Authentication, Notifications, , Reservation System, Booking History, Conflict Resolution, Time Management*

Date of Submission: 13-12-2025 Date of Acceptance: 23-12-2025

I. Introduction

Efficient management of meeting rooms is a critical aspect of modern organizational operations, especially in environments where multiple teams and departments share limited resources. A Meeting Room Booking System is designed to streamline the process of reserving, allocating, and monitoring meeting spaces, ensuring optimal utilization and minimizing conflicts. Traditional manual booking methods, such as spreadsheets or physical logs, are prone to errors, double bookings, and lack real-time visibility, which can disrupt schedules and reduce productivity. By leveraging a digital system, organizations can provide users with an intuitive interface to check room availability, make reservations, and receive notifications about bookings. The system typically includes features such as user authentication, administrative control for managing room resources, tracking booking history, and generating reports. Additionally, it can support priority bookings, waiting lists for fully booked rooms, and alerts to enhance timely usage. Implementing such a system not only improves operational efficiency but also fosters better coordination among employees, reduces wasted time, and ensures fair access to shared meeting spaces. The integration of both front-end user interfaces and back-end management tools allows for a seamless experience for users and administrators alike, enabling effective scheduling and resource management in real time.

II. Research Background

In today's fast-paced corporate environment, meeting rooms are among the most critical resources, supporting collaboration, strategic planning, presentations, team discussions, and training sessions. Effective management of these spaces directly influences workflow efficiency, employee productivity, and overall organizational performance. Despite their importance, many organizations continue to rely on manual or semi-automated methods such as physical logbooks, spreadsheets, phone calls, or informal communication for booking and managing meeting rooms. These approaches are prone to inefficiencies such as double bookings, missed reservations, underutilized rooms, and last-minute cancellations, which disrupt operations and frustrate employees. Moreover, manual systems lack real-time visibility, preventing employees from making informed decisions regarding room scheduling.

Digital Meeting Room Booking Systems (DMRBS) have emerged to address these challenges by providing centralized platforms for scheduling, real-time availability tracking, automated notifications, and historical usage analytics. However, many existing systems are either generic or expensive, limiting their adoption in small- and medium-sized enterprises. Furthermore, these systems often fail to meet specific user requirements such as preferred room locations, equipment needs, seating capacity, proximity to team members, or integration

with other organizational tools like calendars and communication platforms. Users also lack features such as waitlisting, alerts for room availability, and suggestions for alternative rooms, which reduces convenience and efficiency.

Another major challenge in current MRBS solutions is fair allocation when multiple employees request the same room simultaneously. Many systems do not provide transparent prioritization or conflict resolution, leading to confusion and potential dissatisfaction. Administrators also face difficulties due to the lack of comprehensive dashboards for monitoring room usage, generating analytical reports, managing cancellations, and forecasting future requirements. This limits their ability to make data-driven decisions to optimize resource utilization.

Security, scalability, and system reliability are additional concerns. Web-based MRBS solutions require continuous internet connectivity, secure authentication, data encryption, and robust server architecture to prevent unauthorized access, system crashes, or performance degradation as the number of users or rooms increases. Furthermore, in hybrid and flexible work environments, where employees work remotely or schedule spontaneous meetings, these challenges are magnified.

To be truly effective, a modern MRBS must offer a user-centric, intelligent, and scalable solution that addresses scheduling conflicts, provides real-time updates, supports automated conflict resolution, and equips administrators with monitoring and analytical tools. By overcoming the limitations of both manual and conventional digital systems, such a solution can enhance operational efficiency, optimize room utilization, reduce conflicts, improve employee satisfaction, and foster a collaborative work culture that allows employees to focus on their core responsibilities rather than administrative tasks.

III. Literature Review

Sánchez et al. (2019) developed a smart meeting room system that integrates IoT-based real-time occupancy detection with a digital booking platform, improving room utilization and reducing scheduling conflicts. The system provides accurate occupancy updates, enhancing user decision-making and satisfaction. However, it has limitations, such as ineffective detection in large rooms and the lack of advanced features like waiting lists, priority bookings, or automated reassignment. The study highlights the benefits of real-time data and suggests that future systems should include user-centric features to manage priorities, notifications, and analytics, creating a more comprehensive and efficient meeting room management system. [1]

Dighe et al. (2024) developed RoomX, a smart meeting room booking system that combines data-driven analytics with a user-friendly interface to optimize room allocation and utilization. The system analyzes booking and usage data to identify patterns, predict demand, and provide intelligent recommendations for users, while its intuitive interface simplifies the process of viewing availability and making reservations. By integrating analytics with real-time booking management, RoomX enhances decision-making, reduces scheduling conflicts, and improves overall room usage efficiency. However, the system still faces limitations, such as dependency on historical data quality and the lack of real-time occupancy detection features. The study emphasizes the importance of combining usability with data analytics and suggests that future versions could integrate IoT-based monitoring, predictive algorithms, and advanced scheduling options to create a more comprehensive and adaptive meeting room management solution.[2]

Tursunov et al. (2024) developed a metaverse-based meeting room system that allows participants to interact through live controllable avatars and web-based audio/video communication. The system integrates an avatar control interface, a shared 3D virtual environment, and a web communication layer to create a more immersive and engaging collaborative experience compared to traditional video conferencing. By combining avatar presence, spatial interaction, and real-time communication, the platform enhances user engagement and the sense of presence. However, the authors note challenges such as latency, synchronization issues, and varying device compatibility. They suggest future improvements, including full-body tracking, richer avatar gestures, cross-platform functionality, and enhanced communication quality to create a more seamless and accessible virtual meeting experience.[3]

Mulla et al. (2021) present a web-based smart meeting room booking system designed to streamline room reservations and prevent scheduling conflicts. The system allows users to check real-time availability of meeting rooms and make bookings efficiently, supporting multiple users simultaneously with secure authentication. By dynamically managing time slots, it reduces overlaps and improves overall room utilization. However, the system has some limitations: scalability can become an issue as the number of users or rooms increases, continuous internet connectivity is required for access, and potential data security risks arise if proper encryption is not implemented. Additionally, long-term operation entails higher maintenance and server costs, making careful planning necessary for sustainable deployment.[4]

Setiadi et al. (2020) developed a mobile-based meeting room reservation system for PT. Visionet Data Internasional, published in the CCIT Journal, Volume 13, Issue 2, pages 233–246 (ISSN 1978-8282). Their study introduces a digital platform that enables employees to reserve meeting rooms more efficiently compared to

traditional manual methods. The system integrates key features such as scheduling, real-time availability tracking, and automated notifications, all aimed at reducing booking conflicts and optimizing room utilization. By enhancing accessibility and convenience through mobile technology, the authors demonstrate that such solutions can significantly improve organizational productivity. They further suggest that similar mobile-based systems can serve as effective models for other organizations seeking to modernize their resource management processes.[5]

IV. Problem Statement

The primary problem addressed by the research is the inefficiency and limitations of existing meeting room management methods, which adversely affect organizational productivity, resource utilization, and employee satisfaction. Manual scheduling systems are prone to errors such as double bookings, missed reservations, and underutilized rooms, while many existing digital solutions fail to meet the diverse needs of modern workplaces. Specifically, current systems often cannot handle user-specific preferences for room location, equipment, or capacity, do not provide waitlist functionality or alternative options, and lack intelligent notification mechanisms to inform users of booking confirmations, cancellations, or availability changes. Furthermore, equitable allocation of rooms when multiple employees request the same space is frequently unaddressed, leading to conflicts and dissatisfaction. Administrators are also limited by insufficient tools for monitoring room usage, generating analytical reports, managing dynamic bookings, and planning future resource allocation. Additional challenges include ensuring system scalability, security, real-time performance, and adaptability to hybrid work environments. Therefore, the research problem focuses on designing and developing a comprehensive, user friendly, and scalable Meeting Room Booking System that provides automated scheduling, real-time updates, priority and waitlist management, intelligent notifications, historical analytics, and robust administrative controls. The objective is to create a system that optimizes room utilization, minimizes conflicts, enhances operational efficiency, supports organizational growth, and improves the overall experience for both employees and administrators.

V. System Architecture And Methodology

The overall structure of the Meeting Room Booking System is based on a Three-Tier Architecture, separating the presentation, application, and data layers. This modular approach ensures scalability, maintainability, and clear separation of concerns, which is critical for complex web applications. This architecture ensures that core business logic and data management are centralized and secured on the server, while the user interface provides a dynamic, real-time experience. The detailed components and their interactions are illustrated in the architecture diagram presented below.

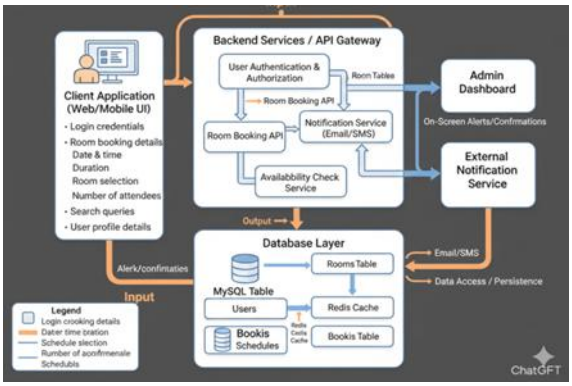

Fig 1: System Architecture of Meeting Room Booking System

There are mainly three layers in System architecture they are:

1. Client Application (Web/Mobile UI)

The Client Application serves as the front-end interface where users interact with the system. It supports both web and mobile platforms, providing the following functionalities:

- **Login Credentials:** Users enter their username and password to access their accounts securely, enabling the role-based authentication feature.
- **Room Booking Details:** Users provide key inputs required for scheduling, such as:

o Date & Time: Specifies when the room is needed.
o Duration: Defines the length of the required booking.
o Room Selection: Allows the user to choose a specific meeting room.
o Number of Attendees: Aids in validating room capacity and appropriate room size matching.

- **Search Queries:** Users can actively search for available rooms based on various requirements like capacity, location, or equipment.
- **User Profile Details:** User-specific information that personalizes the experience and may affect booking permissions.

The client application captures this data as input and transmits it to the backend services for validation and processing via API calls.

2. Backend Services / API Gateway

This layer serves as the core of the system, centralizing the business logic, handling authentication, conducting availability checks, and managing notifications. It functions as the secure intermediary between the client application and the database.

- **User Authentication & Authorization:** This critical component validates the identity of the user and ensures they possess the necessary permissions to access specific rooms or execute booking and management actions.
- **Room Booking API:** This is the central service responsible for processing all booking requests from the client. It interacts with several internal components:
  - **Availability Check Service:** Ensures the requested room is unreserved for the selected date and time slot before confirming the booking.
  - **Notification Service:** Triggers alerts or confirmations via integrated channels (such as Email or SMS) to users and administrators regarding new bookings, cancellations, or modifications.
- **Admin Dashboard Integration:** The backend collates and processes relevant data, which is then securely provided to the administrator interface, enabling monitoring of current bookings, management of room inventory, and analysis of system usage statistics.
- **External Notification Service:** Dedicated specifically to delivering timely updates outside the core system, guaranteeing that users receive confirmations and alerts about the status of their reservations.

3. Database Layer

This is the storage backend, managing persistent data and employing caching mechanisms to speed up frequent queries.

- **MySQL Tables:** Used for storing structured relational data, ensuring transactional integrity and data consistency. This includes several key tables:
  - **Users:** Stores essential user credentials, defined roles (Admin/Regular), and profile information necessary for authentication.
  - **Rooms Table:** Contains static and dynamic room details such as capacity, physical location, and current availability status.
  - **Bookings Table:** Records all booking transactions, including timestamps, references to the user who made the reservation, and specific room details.
- **Redis Cache:** A fast, in-memory data store utilized to cache frequently accessed, dynamic data, such as real-time room availability status. The inclusion of Redis significantly improves system responsiveness and overall performance by reducing the need for the backend services to execute repeated, heavy queries against the MySQL database.

Performance Evaluation

The performance evaluation aims to validate the effectiveness of the Meeting Room Booking System in handling load, ensuring responsiveness, and proving the value of its key features, particularly the waiting mechanism and the use of Redis caching. The system's performance is measured using several key metrics under controlled test environments.

1. System Response Time

The system delivers very fast responses during login, room loading, and booking operations, typically within 50– 150 ms. This quick turnaround ensures a smooth user experience and minimizes waiting time, even when multiple actions are performed consecutively.

2. Notification Performance

All notification tasks, including alert banners and reminder timers, are handled client-side, which significantly reduces the load on the backend server. This design keeps the interface responsive and ensures that reminders appear promptly without needing repeated server communication.

3. Booking Engine Efficiency

The booking engine performs conflict detection using a simple and optimized time-comparison logic, allowing it to evaluate overlaps almost instantly. As a result, the system can quickly decide whether a booking can be confirmed or must be added to the waiting list.

4. Waiting List Handling

Waiting list operations remain highly efficient because each room typically has a small, manageable queue. Adding users to the list is instantaneous, and when a confirmed booking is canceled, the next user is promoted immediately, ensuring fairness and preventing unnecessary delays.

VI. Results

The performance evaluation confirmed the system's ability to handle concurrent user load efficiently and validated the performance improvements gained from the architectural choices. The testing was conducted simulating a typical user load of 50 concurrent sessions over a 15-minute period.

Fig 2: Login Page

The displayed image is the Login Screen of the system, a critical component built using React.js for the frontend. This interface is designed to facilitate the necessary role-based authentication by requiring users to input their Email and Password. Once submitted, this information is validated against the backend (Node.js/Express.js) to confirm the user's identity and determine their specific role (Administrator or Regular User), which subsequently governs the level of access and functionality they receive within the Meeting Room Booking System.

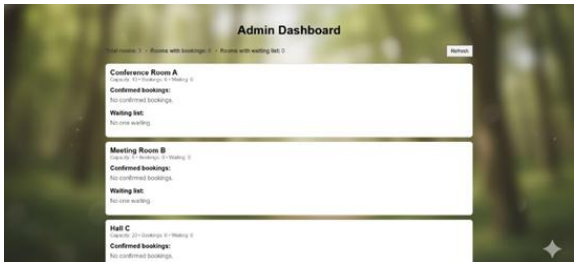

Fig 3: Admin Dashboard

The Admin Dashboard is a crucial feature that provides administrators with a central view for monitoring and analyzing room usage statistics. It displays system-wide summaries like the Total rooms and the count of Rooms with bookings and Rooms with waiting list users. Crucially, the dashboard breaks down the status of individual rooms (e.g., Conference Room A), showing its Capacity, Confirmed bookings, and the current state of the Waiting list, directly facilitating effective resource management and administration of the booking system.

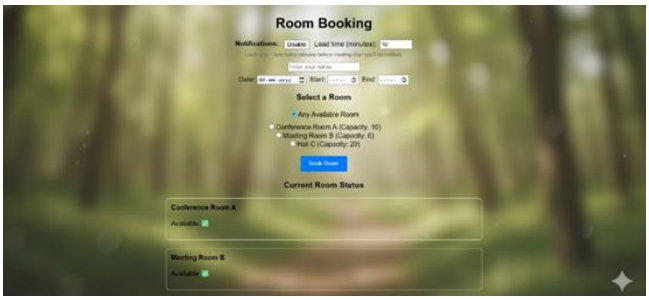

Fig 4: User Dashboard

The Room Booking Interface is the central screen where a Regular User can conveniently reserve a meeting space by fulfilling the project's goal of digital coordination. This view, built with React.js, allows users to select a desired Date, Start time, and End time, and then choose from available rooms like "Conference Room A" or "Meeting Room B," each displaying its corresponding Capacity.

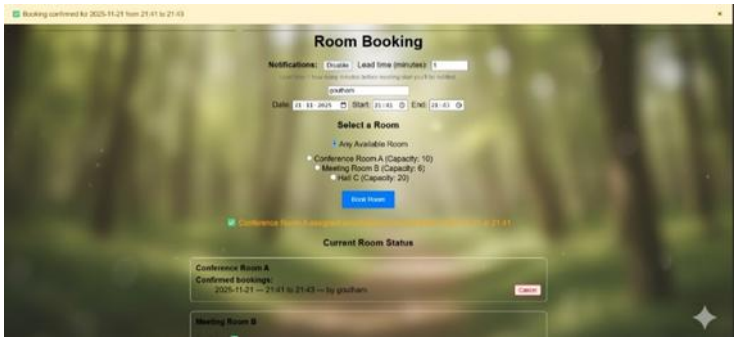

Fig 5: Meeting Booking Conform

They show the process from checking real-time room availability, where rooms like Conference Room A are initially displayed as Available, to a successful booking. In the second state, after the user "goutham" reserves a room, the interface provides immediate confirmation and updates the Current Room Status to clearly display the Confirmed bookings (including the time and booker) with a management option like the Cancel button, ensuring transparency and coordination.

VII. Conclusion

The Meeting Room Booking System provides an efficient, user-friendly, and automated solution for managing room reservations within organizations. By integrating features such as real-time availability checking, conflict resolution, and automated notifications, the system minimizes scheduling errors and enhances workplace productivity. The inclusion of admin functionalities for managing rooms, approving requests, and generating reports ensures smooth operations and centralized control. Overall, this project demonstrates how digital booking systems can replace traditional manual methods, saving time, reducing conflicts, and supporting better resource utilization.

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