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## International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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# HotelTech Service Platform for Smart Hotel Management

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**ABSTRACT:** The HotelTech Service Platform addresses long-standing inefficiencies in conventional hotel and restaurant operations by delivering a fully digital, contactless dining environment. Traditional setups depend on manual order-taking, physical menus, and verbal kitchen communication — all of which introduce delays, errors, and poor customer experiences. In the proposed system, each table is assigned a unique QR code that guests scan using their smartphones to browse a dynamic digital menu, place food orders, execute secure payments, and monitor order progress in real time. Beyond basic ordering, the platform incorporates an AI-powered dish recommendation module based on cosine similarity, a voice-enabled ordering interface built on the Browser Speech Recognition API, support for multiple regional languages, dietary preference filters, and a responsive chatbot for guest queries and assistance. Kitchen staff interact with the system through a purpose-built dashboard that provides live order updates, while the hotel manager accesses a centralized control panel covering analytics, staff oversight, and transaction records. Developed using a three-tier architecture comprising React.js on the frontend, Node.js with Express.js on the backend, and MySQL as the database layer, the platform was validated through comprehensive testing across functional, integration, performance, and acceptance dimensions, confirming its readiness as a practical and scalable solution for modern hospitality operations.

**KEYWORDS:** Smart Hotel Management, QR Code, AI Recommendation, Voice Assistant, Real-Time Order Tracking, Digital Menu, Chatbot, Multilingual Support

### I. INTRODUCTION

The hospitality and food service industry is undergoing rapid digital transformation driven by changing customer expectations, growing demand for contactless services, and advancements in web technologies and artificial intelligence. Traditional hotel management systems depend on manual, labor-intensive processes that are inherently slow, error-prone, and unable to deliver the personalized, real-time service experience that modern customers expect [1].

In conventional hotel dining setups, waiters manually take orders, relay them verbally to the kitchen, and handle payments through slow cash or card-based processes. This workflow leads to frequent miscommunication, incorrect orders, delayed service, and poor real-time visibility into order status for both customers and management [2].

Furthermore, existing digital solutions in the market are either too basic — offering only menu display without ordering capabilities — or too expensive and complex for small and medium-sized hotel establishments. There is a clear and urgent need for an affordable, comprehensive, and intelligent hotel management platform that integrates the complete dining workflow into a single unified digital ecosystem [3].

The HotelTech Service Platform is proposed to address these challenges. By combining modern full-stack web technologies with artificial intelligence and real-time data communication, the platform automates the entire food ordering and hotel management lifecycle. Customers can scan a table-specific QR code to instantly access a dynamic digital menu enriched with AI-based personalized dish recommendations, voice assistant ordering, multilingual support, and diet filters. Orders are placed and paid for digitally, with real-time status updates delivered to both customers and kitchen staff [4].



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For hotel staff, the platform provides an intuitive kitchen dashboard for real-time order management. Hotel managers gain complete operational visibility through a centralized admin panel featuring live dashboards, transaction monitoring, staff management, and data-driven sales analytics.

### II. LITERATURE REVIEW

Jakhete and Mankar [1] proposed a smart restaurant system using a QR code-based digital e-menu implemented with PHP and MySQL. The system improved order accuracy and enabled contactless menu access but lacked AI-based personalization, real-time kitchen tracking, and payment integration.

Mishra et al. [2] developed a touch-based digital ordering system for restaurants using Android devices with GSM and Bluetooth communication. The system reduced manual ordering errors but did not support multilingual interfaces, voice ordering, or AI-driven recommendations.

Ghosh et al. [3] presented a Smart Restaurant system integrating digital menu display and order management. While operationally efficient, the system lacked AI dish recommendations, chatbot support, and centralized management analytics.

Katarya and Verma [4] proposed a mobile restaurant recommender system using psychographic and demographic customer profiling for personalized dish suggestions. However, the system did not integrate payment processing, real-time kitchen status updates, or multi-role staff management.

Habib et al. [5] introduced a location, time, and preference-aware restaurant recommendation approach that improved recommendation relevance through contextual factors. Integration with full hotel management operations and staff dashboards remained outside its scope.

Saeed et al. [6] designed an NFC sensor-based cloud restaurant management system with improved scalability through cloud integration. The system lacked voice assistant support, multilingual customer interfaces, and AI-based personalization features.

Raut and Dhonde [7] developed an Android-based intelligent e-restaurant ordering system that streamlined order placement but did not include AI recommendations, diet-based menu filtering, or comprehensive management dashboards.

Dhoke et al. [8] presented a QR code-enabled Smart Restaurant that improved hygiene and order accuracy through contactless menu access. Advanced analytics, chatbot integration, and real-time multi-role communication were not addressed.

Chorage et al. [9] developed a digital restaurant system covering basic menu access and billing without support for voice ordering, AI recommendations, or multi-role staff management dashboards.

### III. RESEARCH GAP

A systematic review of existing hotel and restaurant management systems reveals the following critical gaps that the proposed HotelTech platform specifically addresses:

- Most existing systems provide only basic menu display and ordering without AI-driven personalization or recommendations tailored to individual customer preferences and dietary requirements.
- Real-time order status visibility is largely absent from existing affordable solutions, leaving customers uninformed about the preparation progress of their orders.
- Voice assistant ordering and chatbot-based customer assistance are not available in existing budget-friendly hotel management systems.
- Multilingual support for regional language customers is rarely implemented in existing digital menu systems.
- No single affordable solution integrates the complete spectrum of functionalities — ordering, payment, kitchen management, and analytics — into a unified platform.



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- Centralized manager dashboards with real-time analytics, staff management, and reporting are largely absent from existing systems. The HotelTech Service Platform directly addresses all of these identified gaps through a fully integrated, AI-enhanced, and technologically advanced smart hotel management solution.

### IV. PROPOSED METHODOLOGY

The HotelTech Service Platform methodology encompasses a comprehensive, multi-layered approach to designing and implementing a fully digital hotel management ecosystem. This section elaborates upon the system architecture, workflow, mathematical models, AI algorithms, technology stack, security design, testing procedures, and deployment strategy adopted throughout the project.

#### A. System Architecture

The HotelTech Service Platform follows a three-tier layered architecture consisting of the Client Layer, Application Layer, and Database Layer. This architectural pattern ensures clear separation of concerns, modularity, scalability, and ease of maintenance.

The Client Layer encompasses three user roles — Customer, Chef, and Manager — each interacting through a dedicated, responsive web interface built with React.js. The Application Layer contains four core processing modules: the Order Management Module, Payment Module, AI Recommendation Engine, and Notification and Status Service, all implemented using Node.js with Express.js RESTful APIs. The Database Layer employs MySQL to securely store all order records, payment transactions, user profiles, menu data, and system metadata.

HotelTech Service Platform - System Architecture

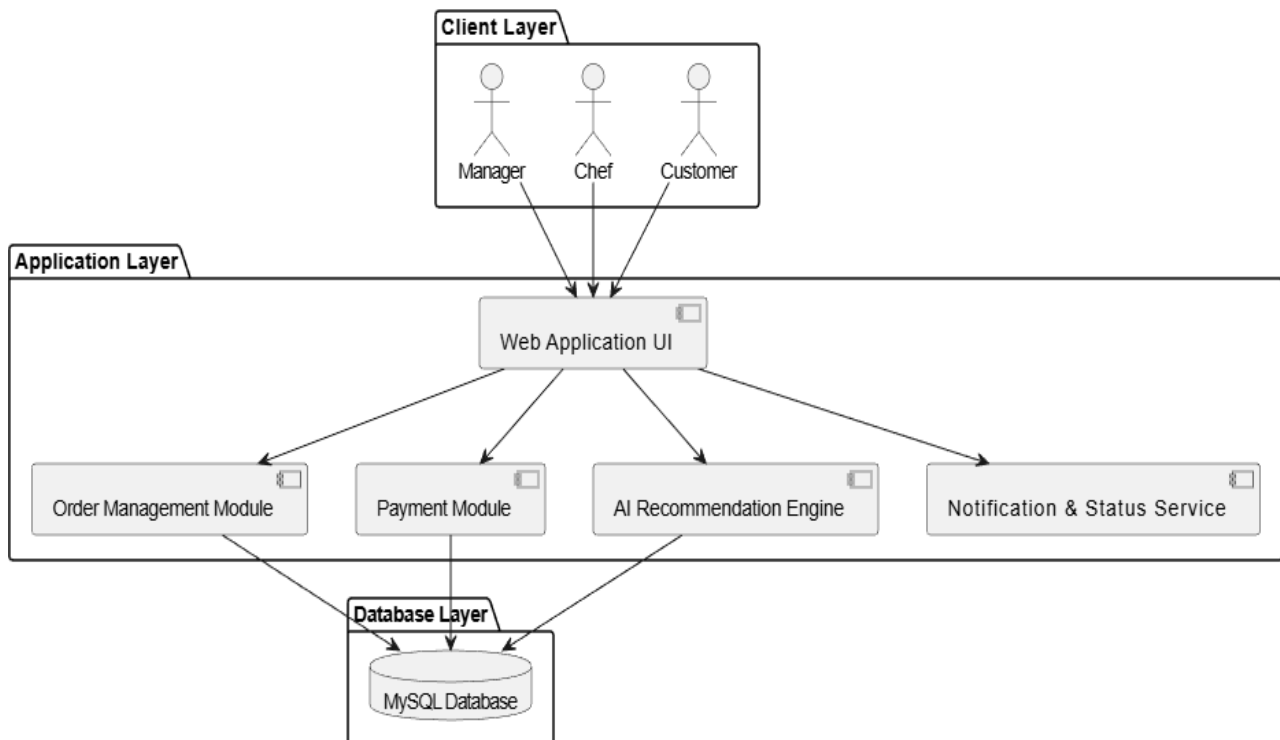


Table I. Three-Tier System Architecture

#### 1. Client Layer

The Client Layer serves as the presentation and user interaction tier. Three user roles are supported, each accessing a dedicated, role-specific interface:



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- **Customer Interface:** A responsive, mobile-first web interface built with React.js. Customers access the platform by scanning a table-specific QR code, after which the digital menu loads instantly in their smartphone browser — eliminating the need for app installation. The interface supports multilingual display, dietary preference filtering, voice-assisted ordering, AI-generated dish recommendations, and real-time order status tracking.
- **Kitchen Dashboard (Chef Interface):** A dedicated React.js dashboard that presents incoming orders to kitchen staff in real time. Orders are displayed with table numbers, item details, special instructions, and current status. Chefs can update the order status through clearly defined state transitions: Pending → Preparing → Ready → Served.
- **Manager Admin Panel:** A centralized management console that consolidates operational oversight. The manager can monitor live order flows, view transaction reports, manage staff accounts, access sales analytics visualizations, and configure the digital menu (add, edit, or remove items, update pricing, toggle item availability).

### 2. Application Layer

The Application Layer constitutes the business logic and API tier of the platform, implemented using Node.js with the Express.js framework. It exposes a set of RESTful APIs consumed by the Client Layer. The Application Layer houses four core processing modules:

- **Order Management Module:** Handles order creation, validation, routing to the kitchen, and status lifecycle management. It coordinates between the customer-facing interface and the kitchen dashboard using WebSocket-based real-time communication.
- **Payment Module:** Integrates with digital payment gateways supporting UPI, credit/debit cards, and digital wallets. The module performs payment initiation, verification, and confirmation, and only routes a confirmed order to the kitchen upon successful payment acknowledgment.
- **AI Recommendation Engine:** Implements content-based filtering using cosine similarity to compute personalized dish recommendations based on the customer's stated dietary preferences and past order history. This module processes feature vectors representing customer profiles and menu item attributes, and returns a ranked list of recommended dishes.
- **Notification and Status Service:** Manages real-time bidirectional communication using WebSocket (socket.io). Status updates from the kitchen dashboard are instantly pushed to the customer interface without requiring page refresh, ensuring continuous and transparent order visibility.

### 3. Database Layer

The Database Layer uses MySQL 8.x as the relational database management system. MySQL provides ACID-compliant transaction support, which is critical for reliable payment and order recording.

### B. System Workflow

The system operates through the following structured workflow:

1. A QR code unique to each hotel table is displayed for customer scanning.
2. Customer scans QR code → digital menu opens with AI recommendations, multilingual support, and diet filters.
3. Customer selects items via manual input, voice assistant, or chatbot assistance and adds to cart.
4. Customer confirms order and completes secure online payment (UPI / Card / Digital Wallet).
5. Payment verified → order stored in database → real-time notification sent to kitchen dashboard.
6. Chef accepts order and updates status: Pending → Preparing → Ready → Served.
7. Real-time status updates are pushed to customer interface via WebSocket.
8. Customer submits per-item feedback and star ratings after order completion.
9. Manager monitors all orders, payments, and analytics via the centralized admin panel.

### C. Mathematical Model

The system is formally defined as  $S = \{I, P, O\}$ , where:

Input  $I = \{\text{QR Code Scan, Menu Selection, Order Details, Payment Data}\}$

Process  $P = \{\text{Display Digital Menu, Order Processing, Payment Verification, Kitchen Notification}\}$  Output  $O = \{\text{Order Confirmation, Real-Time Status Update, Bill Generation}\}$

The order generation function is defined as:

$$O = f(U, M) \quad \dots(1)$$

where  $U$  = set of customers,  $M$  = set of menu items. Payment status  $P_s$  determines order routing: if  $P_s = \text{Success}$ , order is forwarded to the kitchen; if  $P_s = \text{Failure}$ , the order is cancelled. Real-time order state transition follows:



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{ Pending → Preparing → Ready → Served } ... (2)

The AI Recommendation Engine applies cosine similarity for content-based dish filtering. Let A represent the customer preference vector and B represent the feature vector of a menu item:

$$\text{Similarity}(A, B) = A \cdot B / (|A| \cdot |B|) \dots (3)$$

where A and B are feature vectors of customer preferences and dish attributes respectively. Dishes are ranked by similarity score to generate personalized recommendations.

### D. New Features Added Over Existing Systems

Feature	Existing Systems	HotelTech Platform
Menu Access	Physical / basic digital	QR Code contactless ✓
AI Recommendation	Not available	Cosine Similarity AI ✓
Voice Ordering	Not available	Speech Recognition API ✓
Multilingual Support	English only	Regional languages ✓
Diet / Health Filters	Not available	Veg / Vegan / Low-cal ✓
Real-Time Tracking	Not available	Live status updates ✓
Digital Payment	Cash / basic card	UPI / Card / Wallet ✓
Chatbot Assistance	Not available	24/7 chatbot ✓
Kitchen Dashboard	Manual / verbal	Real-time dashboard ✓
Manager Analytics	End-of-day reports	Real-time dashboard ✓

Table II. Comparison: Existing Systems vs HotelTech Platform

### E. Technologies Used

Category	Technology
Frontend	React.js, JavaScript ES6+, HTML5, CSS3
Build Tool	Vite
Voice Assistant	Browser Speech Recognition API
Backend	Node.js, Express.js (RESTful APIs)
Database	MySQL 8.x
Dev Tools	VS Code, Postman, GitHub

Table III. Technologies Used

## V. CONCLUSION

This paper presented the design, development, and evaluation of the HotelTech Service Platform — a web-based solution that brings together QR code-driven menu access, cosine similarity-based AI dish recommendations, voice-assisted ordering, multilingual interface support, live order tracking, integrated digital payments, a real-time kitchen dashboard, and a manager analytics panel within one cohesive system.

The work demonstrates that combining full-stack web technologies with artificial intelligence is not only technically feasible but practically beneficial for hospitality operations of varying scales. The adoption of a three-tier architecture separating client, application, and database concerns allowed for clean modularization, making the codebase maintainable and extensible.



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Rigorous testing — spanning unit, integration, functional, system, and user acceptance phases — confirmed that all modules operate correctly under realistic conditions. Looking ahead, the authors plan to explore AR-based menu previews, blockchain-secured payment flows, IoT-linked kitchen automation, dedicated mobile client applications, and machine learning-driven sales forecasting as directions for extending this work.

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