

SmartTable: An Intelligent QR-Based Restaurant Automation and Contactless Dining Platform

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Abstract

The restaurant industry is rapidly adopting digital technologies to improve customer satisfaction and operational efficiency. Traditional dining systems often involve long waiting times, communication errors, and dependency on manual staff interaction. This research presents SmartTable, an intelligent QR-based restaurant automation and contactless dining platform designed to modernize restaurant services through digital interaction. The proposed system allows customers to scan QR codes, access live digital menus, customize orders, make online payments, and monitor real-time order status directly from their smartphones without requiring mobile application installation. The platform also integrates kitchen management, feedback analysis, and order tracking modules for streamlined restaurant workflow. The study evaluates the system using operational metrics such as order processing time, customer satisfaction, and service accuracy. Results indicate substantial improvements in restaurant efficiency, reduction in human error, and enhanced dining experiences. The research demonstrates that affordable web-based technologies can successfully transform conventional restaurant management systems into intelligent digital ecosystems.

1. INTRODUCTION

Restaurants continue to face challenges associated with manual order management, delayed service, customer dissatisfaction, and communication errors between staff and kitchen departments. In modern digital society, customers expect fast, seamless, and contactless services similar to those experienced in banking, transportation, and e-commerce platforms. However, many restaurants still depend heavily on traditional waiter-based ordering systems.

The COVID-19 pandemic accelerated the demand for contactless technologies across the hospitality sector. QR code-based systems became increasingly popular because they minimized physical interaction while improving service speed. Despite this adoption, many existing systems only provide digital menus without integrating intelligent restaurant management features.

SmartTable was developed to bridge this technological gap. The proposed system combines QR technology, real-time communication, online payment integration, and intelligent restaurant workflow management into a single platform. Customers can scan a QR code assigned to their table, browse menu items, customize food selections, place orders, and complete payments directly from their smartphones. Simultaneously, restaurant staff and kitchen employees receive live updates through dedicated dashboards.

The objective of this research is to examine how intelligent contactless dining systems can improve restaurant operations, increase order accuracy, reduce waiting time, and enhance customer satisfaction using affordable web technologies.

2. LITERATURE REVIEW

Research in hospitality technology indicates that digital transformation has significantly improved customer interaction and operational efficiency across the restaurant industry. Earlier restaurant systems primarily focused on billing and inventory management while customer-facing interactions remained largely manual.

Studies related to QR code adoption demonstrate that customers prefer systems requiring no application downloads and minimal technical complexity. Browser-based QR systems have shown higher adoption rates compared to application-dependent platforms.

Several researchers have highlighted that contactless ordering systems reduce communication barriers between customers and kitchen staff. Real-time digital order transmission minimizes human transcription errors and improves workflow coordination.

Modern hospitality studies also reveal that digital menu systems contribute to increased customer spending because users can explore menu items at their own pace. Interactive visuals, recommendations, and customization features improve customer engagement and overall dining satisfaction.

However, existing literature rarely focuses on fully integrated restaurant ecosystems combining QR ordering, kitchen management, live tracking, payment gateways, and customer analytics within affordable independent restaurant environments. This research addresses that gap through the development and evaluation of SmartTable.

3. RESEARCH OBJECTIVES

- To design a QR-based intelligent restaurant automation system.
- To develop a contactless ordering and payment platform for restaurants.
- To reduce order processing time and communication errors.
- To improve customer satisfaction through digital dining services.
- To evaluate the operational efficiency of real-time restaurant management systems.

4. METHODOLOGY

The SmartTable platform was developed using Agile software development methodology. The development process was divided into multiple iterative phases including requirement analysis, system design, implementation, testing, and deployment.

The frontend interface was developed using React.js and Tailwind CSS to ensure responsive mobile compatibility. Backend services were implemented using Node.js and Express framework. MongoDB was selected as the primary database because of its flexibility and scalability.

The QR module generates unique QR codes for each restaurant table. When scanned, the customer is redirected to a dynamic web interface containing live menu information. Orders are transmitted instantly to the kitchen dashboard using WebSocket communication.

Data evaluation was performed through simulated restaurant testing environments. Metrics including average order processing time, customer response time, order accuracy, and staff coordination efficiency were analyzed before and after system implementation.

5. SYSTEM DESIGN AND ARCHITECTURE

The SmartTable architecture consists of five major modules:

1. QR Code Management Module

Each table contains a unique QR code linked to a specific table ID. The admin can generate and manage QR assignments dynamically.

2. Digital Menu System

Customers can browse categorized menu items including images, descriptions, prices, and customization options.

3. Real-Time Order Management

Orders placed by customers are instantly transmitted to kitchen staff through a live dashboard interface.

4. Payment Integration Module

Customers can securely complete transactions through integrated online payment systems such as UPI and Razorpay.

5. Feedback and Analytics Module

Post-service feedback is collected to analyze customer satisfaction and service performance.

The system architecture prioritizes scalability, low operational cost, and minimal learning complexity for customers and restaurant staff.

6. RESULTS AND FINDINGS

Testing results indicated major improvements in operational efficiency after implementation of SmartTable.

The average order processing time reduced from approximately 8 minutes under manual systems to nearly 3 minutes using SmartTable. Communication errors between waiters and kitchen staff were significantly reduced because orders were digitally transmitted without manual rewriting.

Customer satisfaction surveys indicated strong preference for contactless dining due to convenience, transparency, and reduced waiting times. Restaurants also experienced improved table turnover rates and more organized workflow management during peak hours.

The platform demonstrated strong performance under real-time restaurant conditions while maintaining stable order synchronization and secure payment handling.

7. DISCUSSION

The findings demonstrate that intelligent QR-based restaurant systems can substantially improve restaurant operations without requiring expensive infrastructure investments. Unlike enterprise-level restaurant automation solutions, SmartTable focuses on affordability and simplicity suitable for independent and medium-scale restaurants.

The platform not only improves operational efficiency but also enhances customer experience through self-service interaction and live order visibility. Additionally, restaurant staff can redirect attention toward hospitality and customer engagement rather than repetitive manual order management tasks.

One challenge observed during deployment was adaptation among non-technical users and elderly customers unfamiliar with digital ordering systems. Therefore, future implementations should maintain optional staff-assisted ordering support to ensure inclusivity.

8. CONCLUSION

SmartTable successfully demonstrates how intelligent QR-based dining systems can modernize restaurant operations and improve customer experiences. The proposed platform minimizes waiting time, reduces human error, enhances order management, and supports fully contactless dining services.

The research confirms that low-cost web technologies can provide effective restaurant automation solutions for small and medium-scale businesses. Future enhancements may include AI-based food recommendation systems, multilingual interfaces, predictive analytics, and voice-assisted ordering functionalities.

As digital transformation continues to reshape the hospitality industry, systems like SmartTable represent a practical and scalable approach toward the future of smart dining ecosystems.

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