

QR-BASED UNIFIED SERVICE AND MANAGEMENT SYSTEM FOR RESTAURANTS

A. Bamila Rachel Assistant Professor Department of Computer Science and Engineering, Jayaraj Annapackiam CSI College of Engineering, Nazareth, India bamilarachel@gmail.com	Solomon Raja I UG Student Department of Computer Science and Engineering, Jayaraj Annapackiam CSI College of Engineering, Nazareth, India solomonraja332@gmail.com	Abishek Abraham M UG Student Department of Computer Science and Engineering, Jayaraj Annapackiam CSI College of Engineering, Nazareth, India abishek.m.abraham@gmail.com	Micheal Roshan A UG Student Department of Computer Science and Engineering, Jayaraj Annapackiam CSI College of Engineering, Nazareth, India antonyfelixraja599@gmail.com	Moses Jones Julion C UG Student Department of Computer Science and Engineering, Jayaraj Annapackiam CSI College of Engineering, Nazareth, India mosesjonesjulion91@gmail.com
---	--	---	--	--

Abstract - Restaurants often face operational challenges such as delayed order processing, communication gaps between customers and staff, billing errors, and inefficient service management. Traditional restaurant systems rely heavily on manual processes such as printed menus, handwritten orders, and verbal communication with waiters, which can lead to delays and mistakes.

This paper proposes a QR-Based Unified Service and Management System for Restaurants, a smart digital platform that improves restaurant service efficiency using QR code technology and real-time communication systems. Customers can scan a QR code placed on the table using their smartphones to access a digital menu, place food orders, request services, and make payments.

The system automatically sends orders to the kitchen dashboard, allowing chefs to track and manage food preparation in real time. The platform also provides a management dashboard for restaurant administrators to manage menu items, monitor orders, track sales analytics, and manage staff operations.

By automating restaurant workflows and providing real-time updates, the system improves service speed, reduces order errors, enhances customer experience, and increases operational efficiency.

Index Terms - QR Code System, Smart Restaurant System, Digital Menu, Order Management System, Real-Time Kitchen Dashboard, Restaurant Automation

I. INTRODUCTION

The restaurant industry is evolving rapidly with the integration of digital technologies to improve customer experience and operational efficiency. Traditional restaurant operations rely heavily on manual processes such as printed menus, handwritten order slips, and verbal communication between customers and waiters. These traditional methods often result in delays, incorrect orders, miscommunication, and inefficient service management.

During busy hours, restaurant staff may struggle to attend to every customer quickly, leading to missed requests and longer waiting times. In addition, manual billing processes may result in calculation errors and delayed payment processing.

The COVID-19 pandemic further accelerated the need for contactless service solutions in restaurants. Customers prefer safer and faster dining experiences where physical contact is minimized.

To address these challenges, many restaurants have started adopting QR-code-based digital menu systems. However, most existing systems only display a menu and do not provide full restaurant management capabilities.

This research proposes a QR-Based Unified Service and Management System for Restaurants, which integrates multiple restaurant services into one digital platform.

The system allows customers to:

- Scan QR codes to view a digital menu.
- Place food orders directly from their smartphones.
- Track order preparation status in real time.
- Request service from restaurant staff.
- Make digital payments.

Restaurant staff and administrators can manage orders, update menu items, monitor kitchen operations, and analyze sales data using a centralized dashboard.

By integrating these features into a unified system, the proposed solution improves restaurant efficiency, reduces service delays, and enhances customer satisfaction.

II. LITERATURE REVIEW

Several studies have explored the use of digital technologies to improve restaurant operations and customer experiences.

Early restaurant management systems mainly focused on Point-of-Sale (POS) systems, which allowed restaurants to process orders and manage billing digitally. However, these systems still required waiters to manually enter customer orders.

Yadav and Sharma (2020) studied the adoption of QR code technology in restaurants during the COVID-19 pandemic. Their research showed that QR codes were widely used to provide contactless digital menus, helping restaurants reduce physical contact between customers and staff.

Johnson and Wang (2023) proposed an advanced digital ordering system where customers could place orders directly from their smartphones. This system reduced order delays and improved communication between the kitchen and service staff.

Another area of research focuses on Kitchen Display Systems (KDS), which replace traditional printed order tickets with digital displays in the kitchen. These systems help chefs view and prioritize incoming orders more efficiently.

Despite these improvements, many existing restaurant systems still have several limitations:

- Limited integration between customer ordering and kitchen operations
- Lack of real-time order tracking for customers
- Inadequate communication between customers and restaurant staff
- Absence of centralized management dashboards for restaurant owners

Therefore, there is a need for a fully integrated restaurant management system that connects customers, kitchen staff, and administrators through a unified digital platform.

The proposed QR-Based Unified Service and Management System addresses these limitations by integrating digital menus, real-time order tracking, kitchen dashboards, service requests, and administrative management features into a single system.

III. METHODOLOGY

The proposed system follows a QR-based digital workflow that connects customers, kitchen staff, and restaurant administrators through a centralized web platform.

The development methodology includes several stages:

A. QR Code Table Identification

Each restaurant table is assigned a unique QR code. When customers scan the QR code using their smartphones, the system identifies the table number and displays the digital menu.

B. Digital Menu System

Customers can browse menu items categorized by food type such as appetizers, main courses, desserts, and beverages. Each item includes price, description, and image.

C. Order Placement

Customers can select menu items and place orders directly through the web application. The system sends the order to the kitchen dashboard instantly.

D. Kitchen Order Processing

Kitchen staff receive the orders through a Kitchen Display System (KDS).

They can update the order status as:

- Preparing
- Ready
- Served

E. Service Request System

Customers can request services such as water, table cleaning, or assistance through the system without calling a waiter verbally.

F. Billing and Payment

The system automatically calculates the total bill based on ordered items. Customers can pay through digital payment gateways or request the bill.

G. Admin Dashboard

Restaurant administrators can manage:

- Menu items
- Staff accounts
- Table management
- Sales reports and analytics

IV. SYSTEM ARCHITECTURE

The proposed QR-Based Unified Service and Management System for Restaurants is designed using a layered architecture to ensure scalability, reliability, and efficient communication between different system components. The architecture consists of three primary layers: the user interface layer, application layer, and database layer. Each layer performs specific functions that collectively enable smooth system operation and effective management of restaurant services.

A. User Interface Layer

The User Interface Layer serves as the interaction point between users and the system. Customers access the system by scanning a QR code placed on restaurant tables, which opens the digital menu on their smartphones. Through this interface, customers can browse available food items, place orders, request services, and track order status.

Kitchen staff and administrators access the system through dedicated dashboards that provide operational controls and monitoring tools.

Main functions of this layer include:

- Displaying digital menus to customers
- Allowing customers to place and manage orders
- Providing order tracking information
- Offering dashboards for kitchen staff and administrators

The frontend interface is developed using HTML, CSS, and JavaScript which provide responsive design and interactive user experience.

B. Application Layer

The Application Layer functions as the core processing component of the system. This layer handles business logic, manages communication between system modules, and processes user requests. Whenever a customer places an order, the application server processes the request and sends the order information to the kitchen dashboard.

The backend server ensures proper synchronization between customer orders, kitchen preparation, and administrative monitoring.

Key responsibilities include:

- Processing customer order requests
- Managing order workflow and updates
- Handling communication between system components
- Managing authentication and system control

The backend of the system is implemented using Node.js with the Express.js framework, which enables efficient request handling and scalable system development. Real-time updates are implemented using Socket.io, ensuring that order status updates are instantly reflected across the system.

C. Database Layer

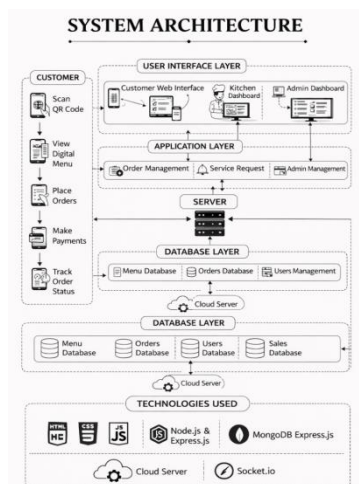
The Database Layer is responsible for storing and managing all system-related information. This layer ensures that data is stored securely and can be retrieved efficiently whenever required by the application server.

The system uses MongoDB, a NoSQL database that supports flexible data storage and scalability.

The database manages the following information:

- Menu item details including name, category, and price
- Customer order information and order status
- User account data for administrators and staff
- Transaction records and sales reports

By organizing data into structured collections, the database enables efficient retrieval and management of restaurant operations.



V. SYSTEM MODULES

The system is divided into multiple functional modules that support different user roles and responsibilities within the restaurant environment. These modules allow customers, kitchen staff, and administrators to perform their respective tasks efficiently.

A. Customer Module

The Customer Module enables customers to interact with the restaurant services digitally. Customers access the system by scanning a QR code placed at their table. This QR code directs them to a digital interface where they can explore the restaurant menu and place food orders.

The module provides several key functionalities including:

- QR code-based menu access
- Digital menu browsing
- Food order placement
- Order status tracking
- Online payment processing

This module reduces dependency on manual order-taking processes and improves the overall dining experience.

B. Kitchen Module

The Kitchen Module allows chefs and kitchen staff to monitor incoming orders and manage food preparation tasks. Orders placed by customers are automatically displayed on the kitchen dashboard in real time.

The kitchen interface provides features such as:

- Viewing newly received orders
- Organizing food preparation tasks
- Updating order status during preparation
- Communicating completion of orders

By providing real-time order updates, this module improves coordination between kitchen staff and customers.

C. Admin Module

The Admin Module provides restaurant administrators with tools to manage system operations and monitor restaurant performance. Administrators can update menu items, manage staff accounts, and analyze sales data through a centralized dashboard.

Key administrative functions include:

- Managing menu items and food categories
- Controlling staff accounts and permissions
- Monitoring restaurant tables and orders
- Viewing sales reports and performance analytics

This module helps restaurant owners make informed decisions regarding menu planning and business strategy.

VI. RESULT AND DISCUSSION

The implementation of the QR-Based Unified Service and Management System for Restaurants demonstrates

significant improvements in restaurant service efficiency and operational management. The system was designed to replace traditional manual processes such as printed menus, handwritten order slips, and verbal communication between customers and waiters. By introducing a digital ordering platform, the system simplifies the ordering process and enhances the overall dining experience.

During system testing, the digital platform showed noticeable improvements in order management and service speed. Customers were able to access the restaurant menu instantly by scanning QR codes placed on tables. This allowed them to browse menu items, place orders, and request services directly through their smartphones without waiting for staff assistance. As a result, the waiting time for placing orders was significantly reduced.

The integration of a real-time kitchen display system ensured that customer orders were immediately transmitted to the kitchen dashboard once they were placed. Kitchen staff could view order details, manage preparation tasks, and update order status in real time. These updates were automatically reflected on the customer interface, allowing customers to track the progress of their orders. This transparency improved communication between customers and restaurant staff and reduced uncertainty regarding food preparation time.

The administrative dashboard also contributed to improved restaurant management by providing access to order history, menu management tools, and sales analytics. Restaurant administrators could monitor daily sales performance, identify popular menu items, and analyze customer ordering patterns. These insights help restaurant owners make better operational and business decisions.

Overall, the results indicate that the proposed system improves service efficiency, reduces human errors, enhances communication between restaurant staff and customers, and provides better management control over restaurant operations.

VII. FUTURE WORK

Although the proposed system provides an efficient solution for digital restaurant service management, several enhancements can be introduced in the future to further improve its capabilities and functionality.

One potential improvement is the integration of artificial intelligence-based recommendation systems. By analyzing customer ordering patterns and preferences, the system could recommend menu items that are likely to interest customers, thereby improving customer engagement and increasing restaurant sales.

Another possible enhancement is the development of mobile applications for Android and iOS platforms. While the current system operates through a web-based interface, dedicated mobile applications could provide faster performance, improved user experience, and

additional features such as push notifications and personalized user accounts.

The system could also be expanded to support voice-based ordering functionality using speech recognition technology. This would allow customers to place orders through voice commands, making the system more accessible and user-friendly.

Integration with online food delivery platforms is another potential future improvement. This would allow the restaurant to manage both dine-in and online delivery orders through a single management system, simplifying restaurant operations and increasing business reach.

In addition, the integration of smart inventory management systems using Internet of Things (IoT) technology could help track ingredient stock levels automatically. Such systems could notify administrators when inventory levels are low, ensuring that restaurants maintain sufficient stock for food preparation.

With these improvements, the proposed system could evolve into a comprehensive smart restaurant management ecosystem capable of supporting modern digital restaurant operations.

VIII. CONCLUSION

This research presented a QR-Based Unified Service and Management System for Restaurants designed to improve the efficiency of restaurant operations through digital technology.

The system integrates QR-based menu access, real-time order management, kitchen coordination, and administrative monitoring into a unified platform. By reducing reliance on manual processes and introducing automation, the system minimizes ordering errors, reduces waiting times, and enhances communication between customers and restaurant staff.

The results demonstrate that the proposed system significantly improves service quality and operational efficiency while providing customers with a more convenient and interactive dining experience. With further enhancements such as artificial intelligence integration, mobile applications, and smart inventory systems, the platform can evolve into a comprehensive digital solution for modern restaurant management.

REFERENCES

- [1] R. Yadav and S. Sharma, "QR Code Based Restaurant Management System," *International Journal of Computer Applications*, vol. 176, no. 12, pp. 25–30, 2020.
- [2] P. Johnson and L. Wang, "Digital Ordering Systems for Smart Restaurants," *IEEE Conference on Hospitality and Service Technologies*, pp. 110–115, 2023.
- [3] J. Smith and L. Brown, "Automation in Restaurant Management Systems," *Journal of Hospitality Technology*, vol. 15, no. 2, pp. 45–52, 2019.
- [4] A. Gupta and M. Kumar, "Smart Restaurant Ordering System Using QR Codes," *International Journal of Advanced Research in Computer Science*, vol. 10, no. 3, pp. 134–139, 2019.

- [5] S. Patel and R. Mehta, "Web-Based Restaurant Management System," *International Journal of Computer Science and Mobile Computing*, vol. 8, no. 4, pp. 90–96, 2018.
- [6] K. Lee and H. Park, "Design of a Real-Time Restaurant Ordering System," *IEEE International Conference on Smart Computing*, pp. 210–215, 2021.
- [7] T. Anderson and J. Miller, "Improving Restaurant Service Through Digital Ordering Platforms," *Journal of Information Systems in Hospitality*, vol. 12, no. 1, pp. 33–41, 2020.
- [8] M. Chen and Y. Zhang, "Cloud-Based Restaurant Management Systems," *International Journal of Cloud Applications and Computing*, vol. 11, no. 2, pp. 54–65, 2021.
- [9] D. Kumar and S. Singh, "Mobile-Based Food Ordering Systems for Smart Restaurants," *International Journal of Engineering Research & Technology*, vol. 9, no. 6, pp. 721–725, 2020.
- [10] B. Wilson and R. Thomas, "Digital Transformation in the Hospitality Industry," *Journal of Hospitality Management*, vol. 18, no. 3, pp. 145–152, 2019.
- [11] Node.js Foundation, "Node.js Documentation," 2024. Available: <https://nodejs.org>
- [12] Express.js Foundation, "Express.js Web Framework Documentation," 2024. Available: <https://expressjs.com>
- [13] MongoDB Inc., "MongoDB Database Documentation," 2024. Available: <https://www.mongodb.com/docs>
- [14] Socket.IO Developers, "Socket.IO Real-Time Engine Documentation," 2024. Available: <https://socket.io/docs>
- [15] T. White, "Modern Web Application Development Using Node.js," *Software Engineering Journal*, vol. 22, no. 4, pp. 67–75, 2021.
- [16] L. Brown and K. Davis, "User Experience Design for Online Ordering Systems," *International Journal of Human Computer Interaction*, vol. 16, no. 2, pp. 85–93, 2019.
- [17] R. Singh and P. Verma, "QR Code Technology in Smart Service Systems," *International Journal of Computer Engineering & Technology*, vol. 11, no. 1, pp. 56–63, 2020.
- [18] H. Kim and J. Lee, "IoT-Based Smart Restaurant Management Framework," *IEEE Internet of Things Conference*, pp. 300–305, 2022.
- [19] A. Martin, "Data Analytics for Restaurant Business Intelligence," *Journal of Business Analytics*, vol. 9, no. 3, pp. 120–128, 2021.
- [20] S. Thompson and E. Clark, "Digital Payment Integration in Restaurant Systems," *International Journal of Financial Technology*, vol. 14, no. 2, pp. 70–78, 2022.