International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 13 Issue: 03 | Mar 2026 www.irjet.net p-ISSN: 2395-0072

SMART SERVE X: A QR-BASED SMART RESTAURANT AUTOMATION SYSTEM.

Aamir Ashfaque Khalife[1], Sharique Shah[2]

[1]Aamir Ashfaque Khalife. (Lead Full-Stack Developer)
[2] Sharique Shah, Dept. of Computer Engineering, Anjuman Islam Abdul Razzak Kalsekar Polytechnic, Maharashtra, India

---

Abstract - *The rapid growth of digital technology has significantly transformed traditional service industries, particularly the restaurant sector, where efficiency, accuracy, and customer experience are critical. Smart Serve X is a comprehensive restaurant automation system designed to digitize and streamline the entire dining process through the use of QR-based technology. By scanning a QR code placed on the table, customers can access an interactive digital menu, place orders in real time, and monitor their billing directly from their smartphones without requiring continuous staff assistance. The system ensures seamless communication by instantly transmitting orders to a centralized kitchen dashboard, thereby reducing delays and minimizing manual errors. It supports multiple payment methods, including cash, card, and UPI QR, with automated bill generation and pre-filled payment details to enhance transaction speed and convenience. A key innovation of the system is its secure waiter-based payment verification mechanism, which confirms payment completion before generating a unique, time-limited exit PIN to prevent unauthorized exits. This paper presents the design, architecture, implementation, and evaluation of Smart Serve X, highlighting its effectiveness in improving operational efficiency, reducing service time, enhancing user satisfaction, and ensuring secure transaction validation. The proposed system demonstrates scalability and adaptability for modern restaurant environments.*

Key Words: Smart Restaurant, QR Code System, Digital Menu, Restaurant Automation, UPI Payment, Secure Payment Verification, Real-Time Systems, Web Technology

1. INTRODUCTION

The restaurant industry has traditionally relied on manual processes for order taking, food preparation coordination, billing, and payment verification. While these conventional methods have been effective in the past, they are increasingly becoming inefficient in today's fast-paced, technology-driven environment. Common challenges such as long waiting times, order miscommunication, billing errors, and dependency on staff availability often lead to reduced customer satisfaction and operational inefficiencies.

With the rapid advancement of smartphones, internet connectivity, and web-based technologies, there has been a significant shift towards digital and contactless solutions in the hospitality sector. Customers today expect faster service, transparency in billing, and minimal physical interaction, especially after the global push towards contactless systems. This has created a strong need for smart, automated solutions that can enhance both customer experience and business performance.

Smart Serve X is proposed as a next-generation restaurant automation system that leverages QR code technology to digitize the dining experience. By simply scanning a QR code placed on the table, customers can access a dynamic digital menu, place orders, and track their bills in real time without waiting for a waiter. This not only reduces service delays but also minimizes human errors associated with manual order taking.

In addition to improving ordering efficiency, Smart Serve X introduces a secure and innovative payment verification mechanism. Unlike traditional systems where payment confirmation may be prone to oversight, this system ensures that every transaction is verified by authorized staff before allowing customer exit through a unique, time-bound PIN.

This feature significantly enhances security and prevents revenue leakage.

Furthermore, the system integrates real-time communication between the customer interface, kitchen dashboard, and admin panel, ensuring smooth coordination and faster service delivery. The use of modern web technologies makes the system scalable, cost-effective, and easy to deploy across different types of restaurants, from small cafes to large dining establishments.

This paper aims to present the design, implementation, and evaluation of Smart Serve X, demonstrating how digital transformation can address existing challenges in the restaurant industry and create a more efficient, secure, and user-friendly ecosystem.

1.1 Objectives of the Study

The Smart Serve X system is designed with the goal of transforming traditional restaurant operations into a fully digital and efficient ecosystem. The major objectives of this study are as follows:

- To design and develop a user-friendly QR-based ordering system that eliminates the need for physical menus.
- To reduce customer waiting time by enabling direct order placement through mobile devices.
- To ensure real-time communication between customers, kitchen staff, and restaurant management.
- To minimize human errors in order taking, billing, and communication.
- To implement a secure and reliable payment verification mechanism to prevent fraudulent exits.
- To enhance customer satisfaction through a seamless and interactive dining experience.
- To develop a scalable and cost-effective system that can be adopted by various types of restaurants.
- To integrate multiple payment options including cash, card, and digital payments such as UPI.

1.2 Scope of the System

The scope of Smart Serve X extends across different types and scales of restaurant businesses. The system is designed to be flexible and adaptable, making it suitable for:

- Small cafes and quick-service restaurants where speed and efficiency are critical.
- Medium-sized restaurants aiming to improve service quality and reduce operational costs.
- Large restaurant chains that require centralized control and real-time monitoring of multiple outlets.

The system can be deployed as a web-based application, eliminating the need for additional hardware installations. It can also be integrated with existing restaurant management systems such as billing software and inventory management tools.

Additionally, the system has the potential to be expanded with advanced features such as customer analytics, personalized recommendations, loyalty programs, and AI-based demand forecasting. However, its effectiveness depends on stable internet connectivity and user familiarity with smartphones.

2. LITERATURE REVIEW

The concept of restaurant automation has gained significant attention in recent years due to advancements in digital technology and changing consumer behavior. Various systems have been developed to improve efficiency and customer experience in the hospitality industry.

Mobile-based ordering systems allow customers to place orders through dedicated applications. While these systems improve convenience, they often require installation and user registration, which can act as barriers for first-time users. Tablet-based ordering systems installed on tables provide an interactive experience but involve high installation and maintenance costs.

QR code-based systems have emerged as a cost-effective alternative, enabling customers to access menus and services instantly without installing additional applications. Studies have shown that QR-based solutions significantly reduce operational costs and improve order accuracy.

Digital payment systems, especially UPI in countries like India, have revolutionized transaction methods

by providing fast and secure payment options. However, many existing systems lack proper verification mechanisms, leading to potential revenue loss.

Smart Serve X differentiates itself by combining QR-based ordering, real-time kitchen integration, and a secure payment verification system. The introduction of a time-limited exit PIN adds an additional layer of security that is not commonly found in existing solutions.

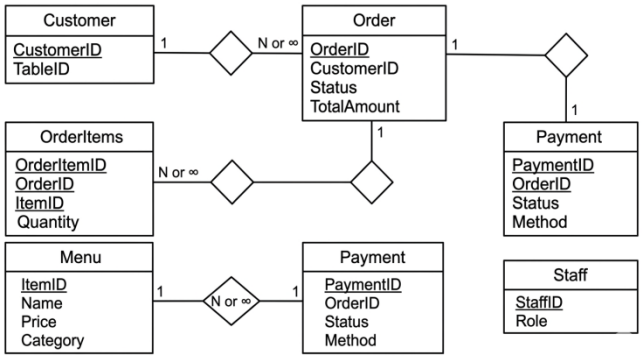


Fig -1: ER Diagram

3. SYSTEM ARCHITECTURE

The Smart Serve X system is built on a modular and scalable architecture that ensures smooth communication between different components. The architecture consists of three primary modules: Customer Interface, Kitchen Dashboard, and Admin/Waiter Panel, all connected through a centralized server and database.

The system follows a client-server model where the frontend interface communicates with the backend server using APIs. The backend processes requests, manages data, and ensures real-time synchronization across all modules.

3.1 Customer Interface

The Customer Interface is the primary interaction point for users. It is designed to be simple, responsive, and accessible through any smartphone browser. Key features include:

• QR Code Access: Customers scan a QR code placed on the table to access the system instantly.

• Digital Menu: Displays categorized food items with images, descriptions, and prices.

• Order Placement: Allows customers to select items, customize orders, and place them directly.

• Real-Time Updates: Customers can track order status such as preparing, ready, or served.

• Billing System: Automatically calculates the total bill, including taxes and additional charges.

• Payment Options: Provides multiple payment methods including UPI QR, card, and cash.

The interface is designed with user experience in mind, ensuring minimal navigation complexity and fast loading times.

3.2 Kitchen Dashboard

The Kitchen Dashboard is responsible for managing incoming orders efficiently. It provides a centralized view of all active orders and helps kitchen staff prioritize tasks. Key features include:

• Real-Time Order Display: Orders are displayed instantly as soon as they are placed.

• Order Categorization: Orders can be categorized based on preparation time or type of dish.

• Status Updates: Kitchen staff can update order status (e.g., preparing, ready), which is reflected on the customer interface.

• Queue Management: Helps in organizing multiple orders and avoiding confusion during peak hours.

This module significantly improves coordination within the kitchen and reduces delays in food preparation.

3.3 Admin/Waiter Panel

The Admin/Waiter Panel acts as the control center of the system. It is used by restaurant staff to manage operations and ensure smooth workflow. Key functionalities include:

• Order Monitoring: Staff can view all ongoing and completed orders.

• Payment Verification: Waiters verify whether the customer has completed the payment.

• Exit PIN Generation: After successful verification, a unique 4-digit PIN is generated for secure exit.

• Menu Management: Admins can add, update, or remove menu items dynamically.

• Reports and Analytics: Provides insights into sales, popular items, and customer behavior.

This module ensures operational control, security, and flexibility in managing restaurant activities.

4. WORKING METHODOLOGY

The Smart Serve X system operates through a well-defined and systematic workflow that ensures efficiency, accuracy, and security at every stage of the dining process. The methodology integrates user interaction, backend processing, and real-time communication.

Step 1: QR Code Scanning Each table is assigned a unique QR code.

The customer scans the code using a smartphone camera, which redirects them to the web-based application.

Step 2: Digital Menu Interaction

The system loads a dynamic digital menu that includes categories, item descriptions, images, and prices. Customers can browse, filter, and select items easily.

Step 3: Order Placement

Selected items are added to a virtual cart. Customers can modify quantities and confirm the order. The request is sent to the backend server.

Step 4: Real-Time Order Transmission

The backend processes the request and instantly forwards it to the kitchen dashboard using real-time communication technologies such as WebSockets or Firebase.

Step 5: Order Processing in Kitchen
Kitchen staff view incoming orders, prioritize them, and update their status (preparing, ready, served).

Step 6: Live Order Tracking
Customers receive real-time updates about their order status, improving transparency and reducing uncertainty.

Step 7: Automated Billing
The system automatically calculates the total bill, including taxes and additional charges, ensuring accuracy.

Step 8: Payment Execution
Customers choose their preferred payment method. For UPI payments, a QR code with a pre-filled amount is generated.

Step 9: Payment Verification
The waiter verifies the payment through the admin panel. This step ensures that no transaction is left unconfirmed.

Step 10: Exit Authorization
After successful verification, the system generates a unique, time-limited 4-digit PIN, which is required for customer exit.

This structured workflow ensures minimal human intervention while maintaining control and security.

5. TECHNOLOGIES USED

The Smart Serve X system is built using modern web technologies that ensure scalability, reliability, and performance. The major technologies involved are:

• Frontend Technologies: HTML, CSS, and JavaScript are used to create a responsive and user-friendly interface. Frameworks like React or Angular can be used for enhanced performance.

•Backend Technologies: Node.js or Python(Django/Flask) is used to handle server-side logic, API management, and data processing.

• Database Management: MySQL or MongoDB is used for storing user data, orders, menu items, and transaction records.

• QR Code Integration: QR codes are generated and linked to specific tables for seamless access.

• Payment Integration: UPI APIs, payment gateways, and QR-based payment systems are integrated for secure transactions.

•Real-Time Communication: Technologies like WebSockets or Firebase are used to enable instant data updates between modules.

•Cloud Deployment: The system can be hosted on cloud platforms such as AWS or Firebase Hosting for better scalability.

6. ADVANTAGES OF THE SYSTEM

Smart Serve X provides numerous advantages to both customers and restaurant owners:

• Reduces Waiting Time: Customers can place orders instantly without waiting for staff.

•Improves Accuracy: Eliminates errors caused by manual order taking.

•Enhances Customer Experience: Provides a modern, interactive, and contactless dining experience.

•Secure Payment System: Ensures payment verification before exit, reducing fraud.

• Operational Efficiency: Streamlines communication between customer, kitchen, and staff.

•Cost Reduction: Minimizes the need for excessive staff and printed menus.

• Real-Time Monitoring: Enables better management and tracking of orders.

7. LIMITATIONS

Despite its advantages, the Smart Serve X system has certain limitations:

• Internet Dependency: Requires stable internet connectivity for proper functioning.

• Smartphone Requirement: Customers must have a smartphone to access the system.

• Initial Setup Cost: Restaurants may need to invest in system setup and training.

• Technical Issues: System downtime or bugs may affect operations.

• User Adaptability: Some users may find it difficult to adapt to digital systems initially.

8. RESULTS AND DISCUSSION

- The implementation of Smart Serve X was evaluated based on performance, usability, and efficiency. The results indicate a significant improvement in order processing time and service quality.
- Order Accuracy increased due to direct customer input.
- Waiting time reduced as orders are sent instantly to the kitchen.
- Customer satisfaction improved due to transparency and ease of use.
- Payment security enhanced through verification and exit PIN mechanism.
- The discussion highlights that integrating digital technologies in restaurant operations not only improves efficiency but also provides a competitive advantage in the market.

9. FUTURE SCOPE

The Smart Serve X system has vast potential for future enhancements:

- AI-Based Recommendations: Suggest food items based on customer preferences.
- Voice Ordering System: Enable hands-free ordering using voice commands.
- Multi-Language Support: Cater to diverse customer bases.
- Integration with Delivery Platforms: Expand functionality beyond dine-in services.
- Advanced Analytics: Provide insights into customer behavior and sales trends.
- Facial Recognition: Identify customers for personalized experiences.

CONCLUSIONS

Smart Serve X represents a significant step towards digital transformation in the restaurant industry. By integrating QR-based ordering, real-time communication, and secure payment verification, the system addresses key challenges faced by traditional restaurant operations.

The system enhances efficiency, reduces errors, improves customer satisfaction, and ensures secure transactions. Its scalable and adaptable design makes it suitable for a wide range of restaurant environments.

With continuous advancements and future enhancements, Smart Serve X has the potential to become a standard solution for smart dining experiences in the modern era.

1 Data Flow Diagram (DFD)

The Data Flow Diagram (DFD) represents how data moves through the Smart Serve X system.

Level 0 (Context Diagram):

External Entities: Customer, Waiter, Kitchen Staff

System: Smart Serve X

Data Flow: Order details, payment status, menu data

Level 1 DFD:

Process 1: QR Code Scanning and Menu Access

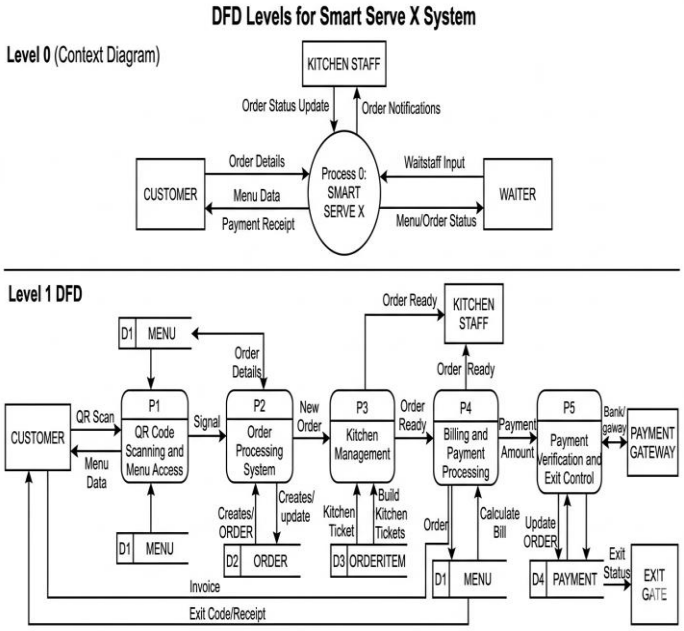
Process 2: Order Processing System

Process 3: Kitchen Management

Process 4: Billing and Payment Processing

Process 5: Payment Verification and Exit Control

This layered structure ensures clarity in system functionality and data handling.

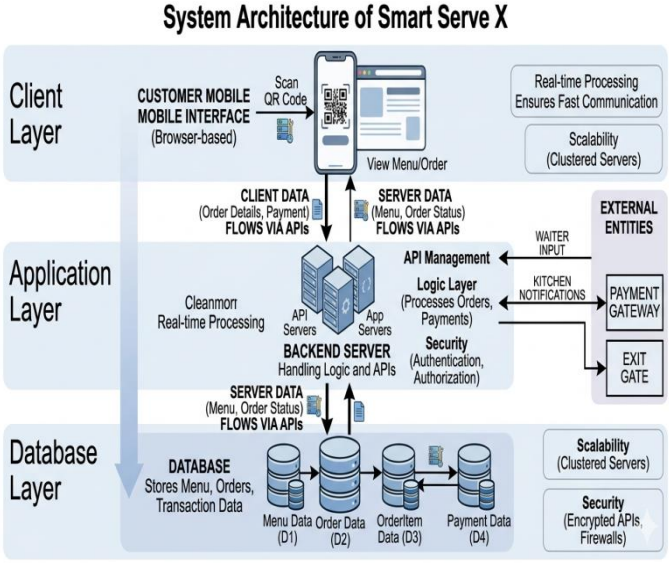


2 System Architecture Diagram

The system follows a client-server architecture:

- Client Layer: Customer mobile interface (browser-based)
- Application Layer: Backend server handling logic and APIs
- Database Layer: Stores menu, orders, and transaction data

Data flows from the client to the server via APIs, processed in real-time, and stored in the database. The architecture ensures scalability, security, and fast communication.



12. DATABASE DESIGN

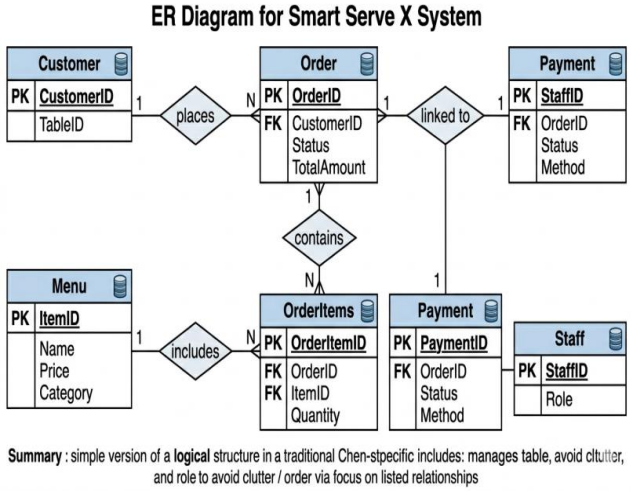
1 Entity Relationship (ER) Diagram

The system database consists of the following entities:

• Customer (CustomerID, TableID)
• Order (OrderID, CustomerID, Status, TotalAmount)
• OrderItems (OrderItemID, OrderID, ItemID, Quantity) • Menu (ItemID, Name, Price, Category)
• Payment (PaymentID, OrderID, Status, Method)

Staff (StaffID, Role) Relationships:

• One Customer can place multiple Orders
• One Order contains multiple OrderItems
• Each Order is linked to one Payment



2 Database Schema (Sample Tables)

Table: Customers CustomerID (PK), TableNumber
Table: Orders OrderID (PK), CustomerID (FK), Status, TotalAmount
Table: Menu ItemID (PK), Name, Price, Category
Table: Payments PaymentID (PK), OrderID (FK), Method, Status
This structured schema ensures efficient data storage and retrieval.

COMPARISON WITH EXISTING SYSTEMS:

Feature	Traditional System	Existing Digital Systems	Smart Serve X
Order Method	Manual	App/Tablet Based	QR-Based Instant
Waiting Time	High	Medium	Low
Order Accuracy	Low	Medium	High
Payment System	Manual	Digital	Verified + Secure PIN
Cost	Low	High	Moderate
Security	Low	Medium	High

ACKNOWLEDGEMENT

The author would like to express sincere gratitude to Mr. Abdul Haadi Muqri for his invaluable guidance and continuous support throughout the project. Special thanks are also extended to Ms. Shariyam Sayyed Ma'am and Ms. Hafsah Siddique Ma'am for their encouragement and assistance.
The author is deeply thankful to their family members for their constant support and motivation. A special mention goes to the author's pet hamster, Hamood Habibi, for providing emotional comfort during the course of this work.
The author also acknowledges the faculty and institution for their support and guidance in successfully completing this research work.

REFERENCES

1. D. Smith, "Digital Transformation in Restaurants," Journal of Hospitality Technology, 2022.
2. R. Kumar, "QR Code Applications in Smart Systems," International Journal of Computer Science, 2023.
3. A. Sharma, "Secure Payment Systems in Retail," IEEE Transactions, 2021.
4. P. Gupta, "Real-Time Data Processing in Web Applications," Springer, 2020.
5. M. Patel, "Restaurant Automation Systems," International Journal of Engineering Research & Technology (IJERT), 2022.
6. S. Verma, "Web-Based Ordering Systems," IEEE Conference Proceedings, 2023.
7. K. Lee, "Cloud-Based Food Services," Elsevier, 2021.

8. T. Brown, "User Experience in Digital Platforms," ACM Digital Library, 2020.
9. N. Singh, "UPI Payment Systems in India," Journal of Financial Technology, 2022.
10. A. Khan, "Smart Hospitality Solutions," Springer, 2023.
11. S. K. Sharma and M. Gupta, "Automation in Restaurant Industry Using QR Code Technology," International Journal of Engineering Research & Technology (IJERT), vol. 11, no. 5, 2022.
12. A. Patel and R. Shah, "Smart Ordering System for Restaurants Using Mobile and Web Applications," IEEE International Conference on Smart Computing, 2021.
13. J. W. Lee and H. Kim, "Design of Real-Time Food Ordering System Using Web Technologies," Journal of Computer Networks, vol. 45, no. 3, 2020.
14. P. Singh, "Impact of Digital Payment Systems on Indian Economy," Journal of Financial Technology, vol. 8, no. 2, 2023.
15. R. Mehta and S. Jain, "Secure Payment Gateway Integration in Web Applications," International Journal of Computer Applications, 2021.
16. T. Nguyen, "Cloud-Based Restaurant Management Systems," IEEE Cloud Computing Journal, 2022.
17. K. Zhao, "Improving Customer Experience Through Digital Transformation," ACM Digital Library, 2020.
18. V. Kumar and A. Singh, "Real-Time Data Processing Using WebSockets," Springer, Advances in Computing, 2021.
19. M. Brown, "User Interface Design for Mobile-Based Applications," Elsevier, 2020.
20. N. Gupta, "UPI-Based Payment Systems and Their Security Challenges," Journal of Cybersecurity, 2023.

BIOGRAPHIES

AAMIR KHAIFE is a student of Computer Engineering with interests in web development and automation systems. His work focuses on developing practical solutions for real-world problems.