SmartServe

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SmartServe: A Smart Bulk Food Ordering System with Bidding and QR-Based Feedback Integration

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***Abstract* —In the food service industry, bulk ordering from restaurants often lacks a structured and competitive pricing mechanism, leading to inefficiencies for both customers and restaurant owners. Existing systems primarily offer fixed-price models, limiting flexibility and failing to ensure the best price-to-quality ratio.To address these limitations, this paper proposes SmartServe, a dynamic restaurant bulk ordering system that integrates an AI-driven bidding process where restaurants compete based on price and quality. Additionally, a recommendation engine and chatbot enhance user experience by leveraging order history and customer preferences.The system incorporates a QR-based feedback mechanism, ensuring real-time quality assessment that further refines recommendations and bidding outcomes. Implementation results indicate that SmartServe optimizes order fulfillment efficiency while providing cost-effective solutions for customers and higher engagement opportunities for restaurants.**

Keywords: Bulk Food Ordering, AI-Based Bidding System, Restaurant Recommendation Engine, Chatbot Integration, QR Code Feedback, Customer Sentiment Analysis, Intelligent Restaurant Management, Order Optimization, Automated Food Service, Smart Engagement Solutions

I. Introduction

In the rapidly evolving landscape of the food industry, the global food market, valued at $56 billion in 2021, is projected to grow at a compound annual growth rate (CAGR) of 9% through 2025 [1]. This growth has been accompanied by rising customer expectations, especially in areas of personalization, convenience, and speed. With digital transformation reshaping operational models, several platforms like Zomato, Swiggy, and Uber Eats have emerged, focusing primarily on individual food orders and delivery logistics [2]. However, when it comes to bulk ordering for events, institutions, or group needs, most existing systems rely heavily on manual communication and negotiation with restaurants, lacking intelligent automation [3]. Platforms such as CaterNinja, which specialize in bulk food orders for corporate events or parties, offer basic menu selection and fixed pricing, but often miss out on dynamic features like real-time restaurant bidding, personalized recommendations, or intelligent feedback integration [4]. Users often express frustration due to non-transparent pricing, lack of comparative options, and limited personalization. Current QR-based systems in the market are primarily used for contactless payments or menu viewing, offering little to no value in terms of real-time service feedback or automated system learning [5].

Given the existing inefficiencies in the bulk ordering domain, there is an increasing demand for intelligent systems that ensure competitive pricing, transparency, and personalization. SmartServe addresses these gaps by introducing a dynamic and transformative approach to restaurant-customer interaction. It implements a real-time bidding mechanism wherein restaurants compete based on price and service quality, thus fostering healthy competition and providing customers with optimal choices [6]. To further enhance decision-making, SmartServe integrates an AI-powered recommendation engine that leverages historical order data and user feedback to suggest the most suitable options [7]. The platform also incorporates an interactive chatbot, offering real-time assistance, order-related guidance, and personalized recommendations, thereby improving overall user engagement [8]. Moreover, the use of a QR-based feedback system allows customers to share immediate responses post-order, which in turn feeds into SmartServe's analytics engine to refine future bidding outcomes and recommendation accuracy [9]. By synergizing these intelligent features, SmartServe positions itself as a next-generation platform for restaurant management and bulk order processing, offering a data-driven, user-centric, and automated solution to a traditionally underserved segment of the food service industry [10].

This paper is organized as section II provides a Literature Survey on existing bulk ordering systems and their limitations. Section III introduces the Proposed System, SmartServe, and discusses its key features and AI-driven mechanisms. The Methodology for system development is outlined next, followed by the Implementation and Results of the proposed system. The paper concludes with a summary of findings and recommendations.

II.Literature Survey

The digital transformation of the food industry is rapidly reshaping how restaurants operate and engage with customers. As consumer expectations grow for faster, smarter, and more personalized experiences, businesses are turning to advanced technologies to stay competitive. From QR code systems and AI chatbots to intelligent recommendation engines, these innovations are streamlining operations and enhancing service quality.

These advancements align with broader industry trends. Thomas and Patel [1] projected a 9% compound annual growth rate in the digital food services sector from 2021 to 2025, driven by demand for automation, convenience, and high-quality service. One notable innovation is the use of QR code-based systems, which have improved both customer engagement and data collection. Čović et al. [10] highlighted their effectiveness in electronic market research, enabling faster and more accurate feedback. Khan [2] extended this utility by developing a cloud-based expiry tracking system to enhance food safety and inventory control. Similarly, Wahsheh and Al-Zahrani [3] explored QR code security in healthcare, offering insights adaptable to secure restaurant feedback. Alkhayyat et al. [4] demonstrated real-time feedback collection through an online QR scanning platform, improving customer interaction and service response.Processing this feedback efficiently is key to personalization. Wu et al. [9] employed QR decomposition to summarize textual reviews, aiding recommendation systems in delivering tailored suggestions. This complements the rise of AI-driven customer support tools.Among these, AI-powered chatbots play a central role. Dutt et al. [5] introduced a chatbot for dynamic information retrieval, offering fast, personalized responses. Gupta et al. [6] applied AI chatbots to simplify restaurant ordering, while Garg et al. [8] developed an NLP-based chatbot capable of handling multiple orders with greater accuracy and satisfaction. These systems, built on Natural Language Processing and intent recognition, are redefining digital customer service.

At the operational level, systems like the real-time food booking platform developed by Ardiansyah et al. [7] have minimized wait times and streamlined service. These solutions reflect the shift toward real-time responsiveness that Thomas and Patel [1] identified as a key market driver.Beyond front-end systems, digital tools are transforming strategic operations. Wei and Guo [11] proposed a bid evaluation model to improve cost-efficiency and fairness in vendor selection—principles that apply directly to the competitive nature of the food service sector.

Unifying these innovations, V.N.A. et al. [12] introduced a prompt-based recommendation system that combines chatbot features with feedback summarization, exemplifying the industry's move toward intelligent, customer-centric automation.

Despite advancements, current systems have limitations that hinder optimal restaurant operations. Feedback mechanisms are often consumer-focused and lack actionable insights for restaurants. Additionally, personalized recommendations based on order history are missing, and there is no automated bidding or dynamic pricing for bulk orders. This prevents cost optimization and a win-win situation for both consumers and restaurants. These gaps highlight the need for an integrated system that addresses these challenges.

III.Proposed System

SmartServe is an AI-powered platform designed to streamline bulk restaurant orders. It features an automated bidding system that promotes competitive pricing among restaurants, ensuring customers get the best value. Additional modules, including a recommendation engine based on past orders, an interactive chatbot for order guidance, and a QR-based feedback system for real-time reviews, enhance customer satisfaction and operational efficiency.Fig. 1 shows the Architecture Diagram of SmartServe.

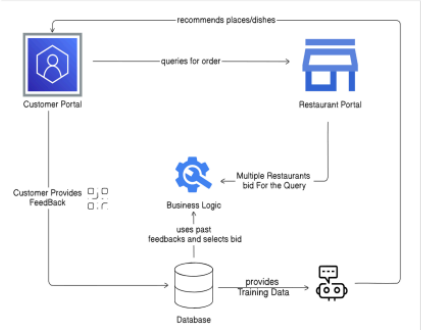


fig. 1 : Architecture Diagram of Smartserve

The process begins with Order Placement, where customers input their order details. The Bidding Process follows, allowing restaurants to submit bids based on price, quality, and delivery time. Bid Evaluation & Selection uses AI to rank bids and select the best option. After confirmation, Order Processing begins, with real-time tracking and Chatbot Assistance for customer updates and modifications.

After delivery, the QR-Based Feedback system allows customers to rate their experience, refining restaurant services and influencing future recommendations. SmartServe integrates AI to optimize pricing, enhance customer experience, and foster continuous improvements in the food service industry.

Feature	Swiggy & Zomato	CaterNinja	SmartServe
Ordering Process	Single-restaurant ordering, delivery logistics	Bulk ordering for events, manual negotiation	Automated bidding process for bulk orders
Pricing Model	Fixed pricing, dynamic pricing during promotions	Fixed pricing, negotiation with restaurants	Dynamic pricing through competitive bidding
Recommendation System	Basic recommendations based on user preferences	Basic recommendations based on menu options	AI-powered recommendation engine based on order history and preferences
Feedback Mechanism	Ratings and reviews after order delivery	No real-time feedback mechanism	QR-based feedback integrated for continuous improvement
Customer Interaction	Limited, via app or customer service	Limited, manual communication with restaurants	AI-driven chatbots for personalized interactions
Efficiency in Order Fulfillment	Standard delivery times, manual intervention	Time-consuming manual order handling	Optimized order fulfillment with automated system
Transparency	Transparent menu and pricing	Limited transparency in bulk pricing and options	Transparent bidding process with clear pricing options

A. Bidding-Based Bulk Ordering

Traditional restaurant ordering systems are often limited by fixed pricing and a narrow vendor selection, leading to inefficiencies in cost, quality, and delivery. SmartServe addresses these challenges through a dynamic, AI-powered bidding mechanism for bulk orders. When a customer submits an order with specific details such as cuisine, quantity, budget, and delivery timeline the request is broadcast to all registered restaurants on the platform. Restaurants evaluate the request and respond with competitive bids based on pricing, delivery time, and available resources.

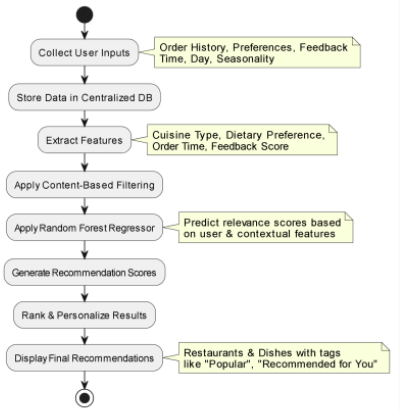
An AI-driven ranking algorithm then assesses these bids using a weighted scoring system that considers factors like cost-effectiveness, restaurant ratings, reliability, and customer feedback. The highest-ranked bid, offering the best balance of quality and value, is presented to the customer for confirmation or adjustment. This intelligent bidding process ensures competitive pricing, enhances service quality, and creates a fair, transparent marketplace where restaurants are incentivized to deliver their best. These bids are evaluated through a structured weighted scoring algorithm, designed to optimize for both quality and cost. Specifically, each bid Bi is assigned a score Si based on the formula:

$$S_i = w_1 \cdot \left(1 - \frac{P_i}{B}\right) + w_2 \cdot R_i + w_3 \cdot \left(1 - \frac{T_i}{T}\right) + w_4 \cdot F_i$$

In this formula,Pi denotes the price quoted by the restaurant, while B represents the customer's maximum budget.Ti is the estimated delivery time provided by the restaurant, and T is the customer-defined delivery deadline.Ri reflects the restaurant's average rating (on a scale of 1 to 5), and Fi is the normalized feedback score derived from previous customer reviews. The weights w1,w2,w3,w4 are tunable constants that determine the relative importance of price, delivery time, rating, and feedback respectively, with the constraint that w1+w2+w3+w4 = 1. This weighted scoring mechanism enables SmartServe to balance cost-effectiveness with service quality and reliability. Once all bids are scored, they are ranked in descending order, and the restaurant with the highest score is selected to fulfill the bulk order. This ensures that customers receive optimal service while promoting healthy competition among restaurants on the platform.

B . AI-Powered Recommendation Engine

To elevate user experience, SmartServe integrates a performance-based recommendation engine that prioritizes reliability and quality over speculative predictions. It analyzes historical reviews, order history, restaurant ratings, and satisfaction scores to suggest consistently high-performing vendors. The system highlights attributes like “best-rated for hygiene” or “frequent successful bidder,” helping users confidently choose trusted restaurants.The engine also factors in bid success rates, favoring restaurants with a track record of competitive pricing and service quality. By using weighted scoring and rule-based filtering, SmartServe ensures recommendations are grounded in real performance.



Built on a hybrid architecture, the SmartServe recommendation engine integrates content-based filtering with a supervised machine learning model Random Forest Regressor to deliver personalized and context-aware suggestions. The engine analyzes key user-specific inputs such as order history, cuisine preferences, and feedback, alongside contextual signals including time of day, day of the week, and seasonality. By learning from these multidimensional features, the Random Forest model predicts the relevance score of different restaurant options and dishes. Over time, as more data is collected, the system continues to retrain and refine its decision trees, allowing it to dynamically adapt to individual user behavior and broader consumption trends. This approach ensures not only accuracy in recommendations but also robustness against noise and anomalies in user data, promoting a consistent and high-quality user experience.

C. Chatbot for Customer Interaction

SmartServe integrates an advanced AI-powered chatbot that leverages Natural Language Processing (NLP) and Reinforcement Learning (RL) techniques to facilitate dynamic, context-aware interactions within the bulk ordering workflow. Utilizing intent recognition and entity extraction methodologies, the chatbot is capable of interpreting and processing user queries concerning order details, bid statuses, restaurant attributes, and order modifications. This functionality transcends the limitations of traditional, rule-based user interfaces, enabling more fluid and personalized exchanges between users and the system.

The chatbot is seamlessly integrated with SmartServe’s recommendation engine, which employs collaborative filtering and content-based recommendation algorithms to provide personalized restaurant and menu suggestions based on historical user data, preferences, and feedback. Moreover, the chatbot assists in the bid comparison process by elucidating variations in pricing, estimated delivery times, and restaurant performance metrics, thereby enhancing the user's decision-making capabilities within a competitive marketplace.

To ensure robust natural language understanding, the system leverages state-of-the-art NLP models, such as spaCy for efficient entity recognition and transformer-based architectures like BERT for semantic analysis. Additionally, Reinforcement Learning algorithms are employed to optimize the chatbot’s interactions by continuously adapting its response strategies based on user feedback and historical interaction data. This iterative learning process facilitates the chatbot’s incremental improvement over time, resulting in a progressively more accurate and user-centric experience. Through this synergy of NLP and RL, SmartServe enhances both operational efficiency and the overall user experience, contributing to a more effective and intelligent bulk ordering system.

D. QR-Based Feedback Collection

SmartServe features an advanced QR-based feedback system designed to collect real-time customer reviews seamlessly. After each bulk order is completed, a unique QR code is automatically generated—either printed on the receipt or delivered digitally through the app or email. When scanned, this code directs customers to a feedback form linked specifically to their order, allowing them to rate aspects such as food quality, delivery time, and overall satisfaction.This structured approach ensures that feedback is directly tied to individual orders, enhancing relevance and ease of submission. The responses are then analyzed using Natural Language Processing (NLP) and sentiment analysis

to extract actionable insights, such as customer satisfaction levels or service issues.

Collected data is securely stored and continuously fed into SmartServe's recommendation and bidding systems. High-performing restaurants are prioritized in future suggestions, while those receiving lower ratings receive targeted improvement prompts. By leveraging AI, data mining, and sentiment analysis, SmartServe fosters a transparent, data-driven ecosystem—empowering restaurants to refine services and strengthening customer loyalty through a responsive feedback loop.

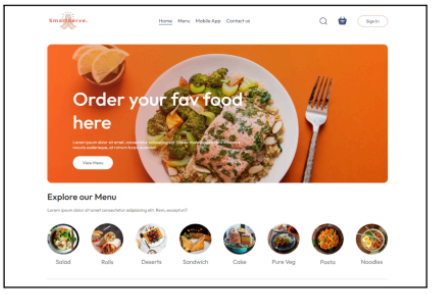


Fig. 2: Home Page

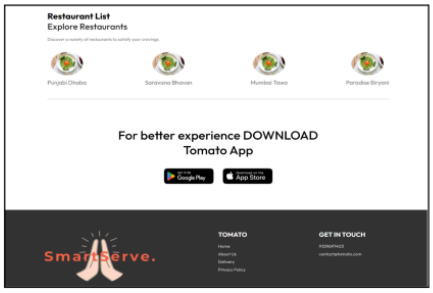


Fig. 3: Home Page

IV.Implementation and Results

The "Place Order" section of the SmartServe platform is designed to offer a seamless and intuitive experience for users. This section features a clean, user-friendly interface where customers can browse through various restaurants, select multiple items from the menu, and easily add them to their bulk orders. Users can view real-time order summaries and receive quotes from different restaurants, simplifying the process of choosing the best options for their needs. Additionally, this section integrates advanced filtering options to help users navigate through the menu based on cuisine, restaurant location, or pricing.

The home page serves as the central hub for all user activities. It offers quick access to key features such as bulk order placement, viewing past orders, and scanning QR codes for feedback submission. The interface is designed with simplicity in mind, providing users with easy navigation through the platform's core functionalities. Bold visuals and clear call-to-action buttons ensure that customers can quickly access the "Place Order" feature, explore restaurant options, and manage their interactions smoothly.

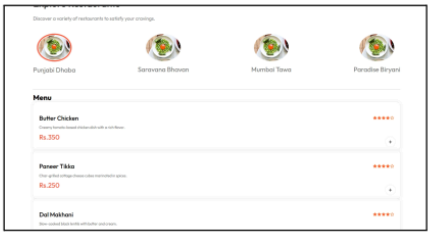


Fig. 4: Place Order Section

Fig. 5: Cart

The cart section of SmartServe provides a concise and organized summary of the user's selected items. It displays the total number of items, price breakdowns, and an option to modify the order before finalizing it. Users can review their choices, remove or adjust quantities, and proceed to request quotations from multiple restaurants, ensuring a smooth checkout experience. The cart is designed to offer clarity and convenience, helping users make informed decisions with ease.

Fig. 6: Login UI

Fig. 7: Admin Panel UI

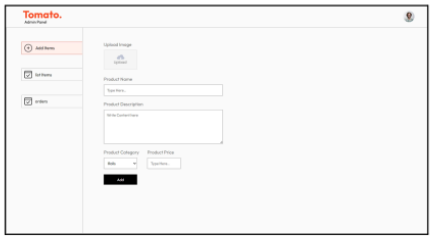


Fig. 8: Admin Features

The admin panel UI of SmartServe is designed for ease of use and efficient management of restaurant operations. Upon logging in, administrators are greeted with a clean, intuitive dashboard that provides an overview of key metrics, such as total orders, customer feedback, and active promotions. The panel features navigation tabs for managing bulk orders, monitoring customer interactions, and analyzing feedback data. Administrators can easily access tools for generating reports, managing restaurant listings, and responding to customer inquiries through the AI chatbot. The streamlined interface ensures that admins can perform their tasks quickly and effectively, enhancing operational efficiency and supporting data-driven decision-making.

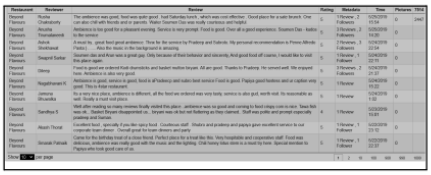


Fig. 9:Preview of dataset

The dataset consists of 10,000 rows and 8 columns, each capturing essential information related to restaurant reviews. Among these columns, the most critical for our sentiment analysis are "Review" and "Rating." The "Review" column contains customer feedback in textual form, while the "Rating" column holds numerical ratings that range from 1 to 5. To perform sentiment analysis, we will employ Natural Language Processing (NLP) techniques specifically on the "Review" column, enabling us to extract meaningful insights from the textual data.z

Our categorization strategy will utilize the ratings to determine sentiment polarity. Reviews assigned a rating above 3 will be classified as "Positive," indicating a satisfactory or favorable experience, while those with a rating below 3 will be categorized as "Negative," reflecting dissatisfaction or issues encountered by customers. This systematic approach not only provides a clear view of overall customer sentiment but also highlights key areas where restaurants can enhance their services, thereby driving improvements and elevating customer satisfaction levels. The insights gained from this analysis will be invaluable for restaurant management in making data-driven decisions to optimize their operations and better meet customer expectations.

Fig. 10: Chatbot Implementation

The implementation of the AI-powered chatbot in SmartServe is a pivotal feature that leverages Natural Language Processing (NLP) to automate customer interactions and deliver personalized recommendations effectively. Integrated seamlessly within the user interface, the chatbot acts as a virtual assistant, adeptly handling a wide range of common queries, including menu inquiries, order status updates, and restaurant suggestions. By employing advanced machine learning algorithms, the chatbot continuously learns from user interactions, allowing it to refine its responses and enhance its accuracy over time.

One of the key aspects of the chatbot's functionality is its use of reinforcement learning, which enables it to tailor its recommendations based on individual user behavior and preferences. As customers engage with the chatbot, it analyzes their past interactions to understand their likes and dislikes, ensuring that the suggestions it provides are relevant and personalized. This personalized approach not only enhances customer engagement by making users feel understood and valued but also streamlines the support process. As a result, the chatbot significantly reduces the need for human intervention in routine tasks, allowing

restaurant staff to focus on more complex customer needs and improves overall service efficiency. The AI chatbot ultimately plays a crucial role in creating a more responsive and user-friendly experience within SmartServe, driving higher customer satisfaction and loyalty.

Conclusion and future work

In conclusion, the proposed enhancements for SmartServe aim to revolutionize the food ordering experience, creating a more efficient and customer-centric system. By establishing a streamlined order management system, we are setting up a centralized portal that allows customers to easily place both individual and group orders. This innovation significantly enhances convenience and accessibility, making it simpler for customers to manage their dining needs, whether for casual meals or large-scale events.

The introduction of a flexible quotation system is another critical improvement that empowers customers to inquire about and receive tailored quotes from multiple restaurants. This feature promotes greater flexibility in purchasing decisions, enabling customers to compare options and choose the one that best fits their preferences and budget. By facilitating a transparent quoting process, we aim to eliminate the uncertainty often associated with bulk ordering.

Moreover, integrating QR codes for real-time feedback collection is essential for maintaining a responsive and customer-focused approach. This mechanism enables us to promptly gather customer concerns and suggestions, allowing for continuous improvements to our offerings. By actively listening to our customers, we can adapt our services to better meet their needs, enhancing overall satisfaction and loyalty.

Additionally, our loyalty points program is strategically designed to boost customer retention by rewarding repeat business. This program will not only encourage customers to return but also foster a strong sense of community and loyalty among our clientele. By recognizing and valuing their engagement, we aim to build lasting relationships that contribute to the long-term success of our platform.

Finally, the implementation of a sophisticated recommendation engine will further personalize the dining experience. By analyzing previous orders and customer preferences, this feature will suggest menu items tailored to individual tastes, making it easier for customers to discover new favorites and enhancing their overall experience.

Collectively, these enhancements will not only elevate customer satisfaction but also drive long-term business success for both SmartServe and our restaurant partners. By embracing innovation and prioritizing customer needs, SmartServe is poised to set a new standard in the food ordering industry, fostering a dynamic and engaging environment for all users.

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SmartServe

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