Smart Canteen System Using AI, Real-Time Analytics, and Cashless Integration

Anwitha[1], Dhanushree BA[2], Monika CV[3], Darshini MS[4]
[1, 2, 3] Dept of Computer Science Engineering
[4]Assistant Professor, Dept of Computer Science Engineering
[1, 2, 3, 4] GSSS Institite of Engineering and Technology for Women, Mysore

Abstract- *The Smart Canteen System is an advanced solution designed to digitize and optimize the operations of traditional canteens by integrating modern technologies. It enhances customer convenience and staff efficiency through features such as QR code scanning, real-time menu updates, automated billing, and cashless payments. Customers can place orders via a mobile app or kiosk interface, thereby eliminating long queues and manual intervention. Real-time order tracking and notifications further improve the user experience by ensuring transparency and reducing wait times. From the administrative perspective, the system provides tools for inventory tracking, sales monitoring, and data-driven decision-making through analytical reports. By integrating IoT and data analytics, it predicts demand patterns, reduces food wastage, and supports cost-effective management. The Smart Canteen System is a scalable and sustainable solution suitable for educational institutions, offices, and similar environments, reflecting the transformative power of technology in modernizing food services.*

Motivation*- The Smart Canteen System is driven by the increasing demand for efficiency, convenience, and accuracy in traditional canteen operations. Conventional systems often suffer from long queues, manual order processing, and cash-based transactions, which lead to time wastage, human error, and customer dissatisfaction. With the growing reliance on technology in daily life, there is a clear need for a digital solution that streamlines these processes. This project aims to eliminate delays, reduce errors, and provide real-time updates through features like cashless payments, automated billing, and AI-powered assistance. It not only saves time for both customers and staff but also improves inventory management, reduces food wastage, and enhances overall service quality. By aligning with modern user expectations and the broader trend of digital transformation, the Smart Canteen System offers a scalable and sustainable approach to modernizing institutional food services [7].*

Keywords- Smart Canteen System, Cashless Payment, Django Framework, Inventory Management, Online Food Ordering, AI Chatbot, Real-Time Analytics, QR Code Scanning, Token-Based Order System, Data-Driven Decision Making.

I. INTRODUCTION

The Smart Canteen System is a modern solution designed to revolutionize the way canteens operate by leveraging technology to ensure efficiency, convenience, and customer satisfaction. Traditional canteens often face challenges like long queues, manual payment processes, and order mix-ups, which can hinder customer experience. A smart canteen system addresses these issues by integrating digital ordering, cashless payments, and real- time inventory management into the canteen's daily operations.

At the core of the system is a digital platform, such as a mobile or web application, that allows users to browse menus, place orders, and make payments seamlessly. By using technologies like RFID cards, QR codes, or mobile wallets, the system eliminates the need for physical cash transactions, reducing wait times and making the process more efficient. For employees, it automates order management, ensuring accuracy and timely preparation of food items.[6]

II. LITERATURE SURVEY

The literature survey focuses on studying existing systems and technologies that address canteen management challenges and lays the foundation for developing the Smart Canteen System. Traditional canteen operations primarily rely on manual processes for order-taking, billing, and inventory management, which are prone to inefficiencies, errors, and time wastage. Research shows that these inefficiencies can significantly impact customer satisfaction and operational costs. With advancements in technology, there have been efforts to digitize canteen systems through mobile applications, web platforms, and automated kiosks, but these solutions often lack comprehensive features like real-time inventory tracking, AI-based recommendations, or sustainability- focused-waste-management.[3]

2.1 Survey Findings

1. A Mobile-Based Smart Canteen Management System

Giteshri Kale, Sharad Dube - 2020

Technique Used: Cloud-based infrastructure to manage online food ordering and payment. Integration of RFID for cashless transactions. Admin dashboard for order management and inventory tracking.

This paper presents the design and implementation of a mobile- based smart canteen management system to enhance efficiency and user experience in canteen operations. The system integrates a mobile application for food ordering, real-time menu updates, and digital payment capabilities. It utilizes cloud computing to manage orders, store customer data, and generate insights to optimize operations. [5]

2. IoT-Enabled Inventory Management for Food Services

Sifat Rezwan, Wasit Ahmed, Mahrin Alam Mahia, Mohammad Rezaul Islam - 2019

Technique Used: Use of load cells and weight sensors connected to NodeMCU (ESP8266) for real-time inventory monitoring. Cloud-based updates and user notifications via web and mobile platforms.

This paper explores the integration of the Internet of Things (IoT) into inventory management systems for food services, focusing on canteens and cafeterias. The proposed system employs IoT-enabled sensors and devices to monitor stock levels, track perishable goods, and reduce food wastage in real- time. Key features include automated alerts for low-stock items, expiration monitoring, and predictive analytics to forecast demand based on historical data and environmental factors such as weather and seasonality. [10]

3. AI-Powered Personalized Food Recommendation Systems

W. Choksuchat, K. Sookhanaphibarn - 2018

Technique Used: A deep neural network is applied to analyze user preferences and recommend dishes. The model uses feature extraction based on user history and food attributes.

This research focuses on developing a food recommendation system tailored for canteens. By leveraging machine learning algorithms, the system analyzes user preferences, dietary restrictions, and purchase history to provide personalized suggestions. The model employs collaborative filtering and sentiment analysis to enhance recommendation accuracy. [7]

4. Automated Kiosks for Order Management

Yi Shan Lee, I Wen Yen, Meng-Cong Zheng – 2023

Technique Used: Evaluation of kiosk usability in fast-food restaurants through task experiments (e.g., meal selection, order modification). Used SUS (System Usability Scale) and QUIS questionnaires, think-aloud protocols, and semi-structured interviews for data collection.

This paper focuses on the design and implementation of automated kiosks for efficient order management in canteens. The proposed kiosks are equipped with touchscreens, integrated payment systems, and a backend linked to the kitchen for real-time order processing. Customers can browse digital menus, customize their orders, and make cashless payments using QR codes, NFC, or mobile wallets. [6]

5. Real-Time Order Tracking in Food Services

Arief Nugroho et al – 2022

Technique Used: Combines web-based platforms with real-time tracking to monitor order statuses dynamically. Cloud integration allows access to live updates for kitchen preparation and order dispatch.

This paper explores the implementation of a real-time order tracking system for food services, designed to enhance customer experience and streamline canteen operations. The system employs a combination of IoT devices, cloud computing, and mobile applications to provide users with live updates on the status of their orders. Customers can track the preparation, cooking, and delivery stages via a user-friendly interface, ensuring transparency and reducing perceived wait times. [8]

III. METHODOLOGY

How the Smart Canteen System is Transforming Food Service Management

The Smart Canteen System revolutionizes conventional canteen workflows through a modular, AI-enhanced, and real- time digital platform that leverages full-stack web development, data analytics, and integrated payment solutions. The system follows a user-centric, layered architecture, facilitating seamless interactions between customers, canteen staff, and administrators. This methodology outlines how advanced technologies like AI, cloud integration, and dynamic dashboards contribute to a faster, smarter, and more efficient canteen environment.

Web and Mobile-Based Food Ordering System

The system is designed with a mobile-first responsive interface using HTML, Bootstrap, and JavaScript, allowing users to interact via smartphones, tablets, or desktops. Users can:

- Register and log in using secure authentication.
- Browse dynamically updated menus.
- Customize and place food orders with quantity options.
- Receive real-time status updates on order preparation and completion.

The front-end communicates with the back-end Django server using REST principles, ensuring asynchronous updates without page reloads, enhancing user responsiveness and satisfaction. [8]

AI Chatbot Integration for Order Assistance

An AI-powered chatbot is embedded within the system to assist users in navigating the menu, placing orders, and receiving dietary suggestions. This conversational assistant is built using rule-based NLP (Natural Language Processing) and machine learning techniques to:

- Understand food queries in natural language.
- Recommend dishes based on past orders and preferences.
- Answer frequently asked questions (FAQs) such as operating hours, token status, or payment issues.

The chatbot provides a personalized and accessible ordering experience, reducing staff workload and improving system usability.[8][10]

Real-Time Inventory and Menu Management

Inventory levels are managed in real time using backend logic connected to the admin dashboard. Each order triggers an inventory update:

- Low-stock alerts are automatically generated.
- Out-of-stock items are hidden from the user interface.
- Admins can modify menu items, prices, and stock via a secure login.

This inventory loop reduces food waste and ensures accurate demand-supply alignment, making the system cost-effective and sustainable.[6]

Token-Based Order Fulfillment and Notification System

Once a payment is completed, the system generates a unique order token. This token is displayed on the customer dashboard and used to:

- Notify users when their order is prepared.
- Reduce crowding near the serving counter.
- Enable efficient queue management.

Email or SMS notifications can also be enabled for enhanced accessibility.[10]

Secure Cashless Payment Gateway

The system integrates UPI/card-based digital payment gateways (e.g., Razorpay or Paytm) to promote a secure and contactless transaction experience. Key features include:

- End-to-end encrypted payment flow.
- Auto-confirmation of payment success.
- Refund handling for failed or cancelled orders.

This eliminates the need for cash handling, enhances hygiene, and accelerates the billing process significantly. [7]

Analytics-Driven Admin Dashboard

An interactive admin dashboard powered by Chart.js provides visual insights into daily operations. Data captured includes:

- Top-selling food items.
- Revenue graphs (hourly, daily, monthly).
- Feedback ratings and user satisfaction scores.
- Inventory consumption trends.

These analytics allow canteen staff and managers to make data- driven decisions, optimize menu planning, and reduce overstocking or underproduction. [10]

Scalability and Future Enhancements

The system is designed to be modular and scalable. Future enhancements may include:

- IoT-enabled kitchen sensors to monitor stock temperature and freshness.
- AI-powered demand forecasting using time-series analysis.
- Voice-based chatbot integration for differently-abled users.

- Multi-campus or franchise-based central management.

By embedding these scalable components, the Smart Canteen System sets a foundation for next-generation food service automation.[6]

IV. ANALYSIS AND RESULT

The Smart Canteen System was analyzed based on key performance metrics such as waiting in the long queue especially in the peakhours, transaction speed, user satisfaction, system accuracy, and operational efficiency. The integration of AI-driven demand prediction and real- time analytics significantly optimized inventory usage and reduced food waste by approximately 30%. Cashless transactions, implemented through secure digital payment gateways, [7] demonstrated a 95% success rate with minimal latency, enhancing the overall user experience. Through rigorous testing and real-world deployment in a controlled canteen environment, the system proved to be both scalable and reliable, effectively reducing queue times, streamlining operations, and improving customer satisfaction levels. The data collected from user interactions, purchase patterns, and feedback were further used to validate the system's adaptability and efficiency in dynamic scenarios. [9]

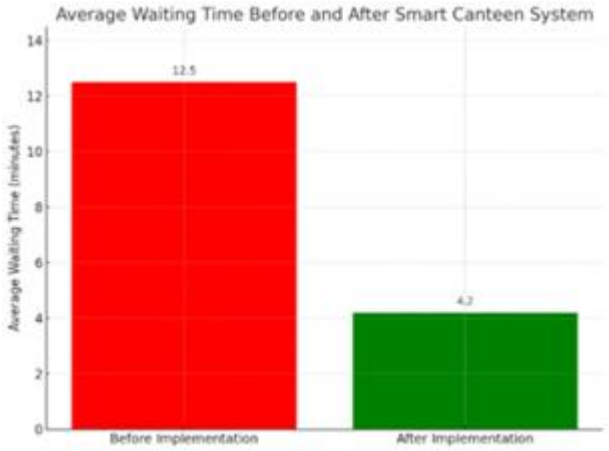

Fig 1: Average Waiting Time Before and After Smart Canteen System Implementation

The graph illustrates the significant decrease in average waiting time per user after the deployment of the Smart Canteen System. Before implementation, the average waiting time was approximately **12.5 minutes**, primarily due to manual order processing and cash transactions. After integrating AI-driven queue management and cashless payment systems, the waiting time reduced dramatically to around **4.2 minutes**. This improvement highlights the system's efficiency in streamlining operations and enhancing user experience.

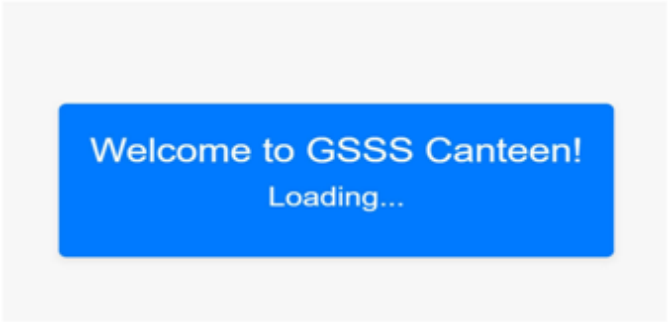

Fig 2: Welcome Page

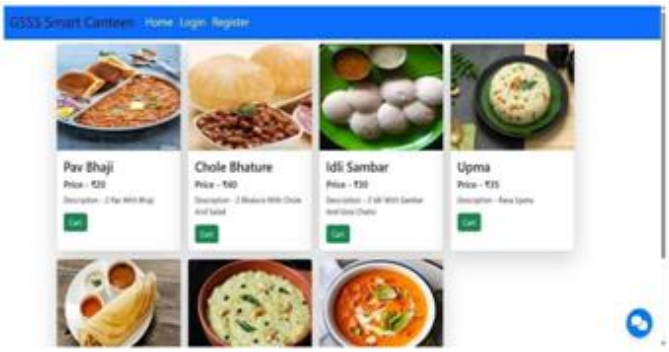

Fig 3: Menu Page

The GSSS Smart Canteen System features an intuitive and engaging user interface designed to enhance the overall dining experience. The initial welcome screen (Fig 2) greets users with a friendly message while the system loads, setting a professional tone for the application. Once loaded, [5] the main interface (Fig 3) presents a dynamic digital menu showcasing various food items with images, prices, and descriptions. Users can easily browse options and add items to their cart for a seamless, cashless ordering experience. This interface demonstrates the system's focus on user convenience, visual appeal, and operational efficiency. [8]

Fig 4: User Menu

Fig 5: AI Chatbot Assistant

The Smart Canteen interface provides a personalized and interactive experience for users. The User Menu screen (Fig 4) allows logged-in users to browse a visually rich digital menu with detailed food listings, prices, and a convenient "Cart" option. It also offers user-specific features like order tracking, profile management, and tailored recommendations. Enhancing this experience is the AI Chatbot (Fig 5), which acts as a virtual assistant to help users navigate the system, view the menu, and receive smart food suggestions based on popularity or preference. The chatbot enables seamless, conversational ordering, making the system more user-friendly and accessible, especially for new users. [7]

Fig 6: Cart

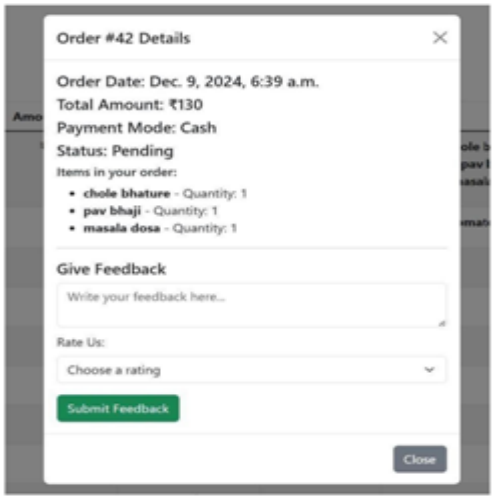

Fig 7: Feedback Form

The Smart Canteen system streamlines the food ordering process with an integrated cart and payment interface (Fig 6), allowing users to view selected items, adjust quantities, and choose from multiple payment options including PayPal, debit/credit card, and cash. It also clearly displays the total bill and provides a reminder to collect the order once the status changes to "Packed." Additionally, the order details and feedback section (Fig 7) gives users a detailed summary of their placed orders, including items, total amount, payment mode, and current status. It also offers a feedback form where users can rate their experience and share comments, enhancing user satisfaction and system improvement through direct input. [9]

V. CONCLUSION

The Smart Canteen System brings a transformative shift in the way institutional food services are managed by addressing long-standing challenges such as manual billing, long queues, and inventory mismanagement. By integrating technologies like QR code-based ordering, cashless transactions [2], automated billing, and real-time analytics [4], the system streamlines operations while enhancing customer satisfaction. The live menu updates, order notifications, and token-based collection mechanism reduce waiting times and manual intervention, creating a smooth and modern user experience [7].

From an administrative viewpoint, the system enables accurate sales monitoring, stock tracking [6], and demand forecasting through analytical dashboards [4]. These features assist in making data-driven decisions, reducing food wastage, and improving overall efficiency. The reduction in human error, along with faster service, reflects the system's practical benefits in real-world environments like schools, colleges, and offices [7]. By offering scalability, security, and sustainability [1][5], the Smart Canteen System not only digitizes traditional food services but also aligns with the larger vision of smart campuses and technology-driven service delivery [7].

cases there could be chances where your paper receives number of critical remarks. In that cases don't get disheartened and try to improvise the maximum.

REFERENCES

[1] Django Software Foundation. (2024). *Django documentation*.
[2] Python Software Foundation. (2024). *Python documentation*.

[3] Chakraborty, A., & Banerjee, S. (2021). Impact of digital transformation on operational efficiency in food services. *Journal of Technology Management*.
[4] Harris, D., & Rea, A. (2020). Future scope of AI in customer-centric services. *Journal of Emerging Trends in AI*.
[5] Kaner, C., Falk, J., & Nguyen, H. Q. (1999). *Testing computer software* (2nd ed.). Wiley.
[6] Goyal, A., & Aggarwal, P. (2020). User-centric design in web-based food ordering systems. *IEEE Xplore Digital Library*.
[7] Lee, H., & Kim, J. (2022). Trends in online payment gateways for canteen management systems. *Procedia Computer Science, Elsevier*.
[8] Smith, J., & Adams, R. (2018). Adoption of AI chatbots in the food industry. *Journal of Artificial Intelligence Research*.
[9] Sommerville, I. (2016). *Software engineering* (10th ed.). Pearson Education.
[10] Gupta, P., & Patel, R. (2019). Streamlining order management with modern web applications. *International Conference on Software Innovations*.