

GATserve: Reducing Campus Food Waste through a Smart Engagement App for Students and Staff

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Abstract: Food waste is a global concern, and educational campuses are major contributors owing to overproduction, miscalculation of demand, and inefficiency in canteens. This paper introduces GatServe, a smart canteen engagement platform catering to students, staff, and administrators, which utilizes artificial intelligence and machine learning for minimizing food waste and achieving higher dining service efficiency. GatServe combines a role-based login facility separating user and admin functionality into a single platform. The user app offers convenient food ordering via text or voice search, pre-order scheduling, cart and wallet integration, and real-time seasonal suggestions. The admin app authorizes canteen managers to control menu items, track live orders, tag order completion, and access food demand driven AI-based suggestions on food demand, inventory, and customer satisfaction. Innovations include food demand forecasting employing Random Forest, inventory optimization by K Means clustering, sentiment analysis of feedback by Transformers, and weather-driven suggestions by Decision Tree-based models. Integrating operational ease with green centric functionality such as waste reporting, smart procurement, and eco-points, GatServe offers a scalable platform for minimizing food wastage and promoting campus sustainability

Keywords: Smart Canteen Management, Artificial Intelligence, Machine Learning, Food Waste Reduction, Sustainability

I. INTRODUCTION

Food wastage is a significant issue in college canteens, where volatile demand, low forecasting, and manual handling make either oversupply or undersupply of meals. This not only hinders service efficiency but also results in wasteful disposal of food and other resources. Conventional canteen systems are concerned only with placing orders and settling payments but lack smart functionality like forecasting demand, optimally managing inventory, or driving sustainability. Modern solutions, like electronic ordering systems and virtual queues, have tried reducing congestion and increasing ease of use. Yet, they generally do not include sophisticated machine learning or sustainability systems. They do not include actionable analytics for managers, change menus with climate, nor examine patron feedback to enhance service. To transcend such limitations, we suggest GatServe: A Smart Engagement Application for Staff and Students. GatServe combines role-based access in a single platform—where staff and students access a user app of ordering, payments, preordering, and customized suggestions, and administrators track orders, inventory, and menu changes via an admin app. The system also incorporates AI and ML algorithms for demand forecasting, inventory purchase recommendation, climate sensitive meal suggestions, and sentiment analysis of feedback. With a combination of convenience, smart information, and sustainably oriented functionality like waste reporting and eco-points, GatServe presents a pragmatic solution both to minimizing food waste on campuses and enriching overall user experience

II. SCOPE OF THE PROJECT

The goal of GatServe is to design and implement a canteen smart management system which not only automates food ordering but reduces food wastages by offering data-driven decision-making. Contrary to conventional systems which



are focused on electronic ordering and payments only, GatServe merges the application of artificial intelligence and sustainability elements in a win-win partnership between canteen administrators and employees/students.

For students, the scope includes:

- A mobile app interface with text and voice-based search, cart, wallet, and multiple payment options.
- Pre-ordering with smart slot selection, allowing students and staff to avoid overcrowding and long queues.
- Individualized suggestions considering seasonal and climatic conditions.
- A feedback system which gauges user feelings to facilitate better service.

For administrators, it ranges from:

- One dashboard to see real-time orders, mark them completed, and manage menu items.
- AI-driven such insights as demand forecasting, purchase recommendation of inventory, sentiment reports on feedback.
- Waste reduction mechanisms by aligning preparation and procurement with projected demand forecasts.
- Waste reporting modules which gather information of leftover and rejected waste to fine-tune forecasts.

Thus, the project is scoped to serve as a comprehensive smart engagement platform that addresses overcrowding, food wastage, operational inefficiencies, and sustainability challenges in campus canteens. It is scalable to other institutional environments such as corporate cafeterias and hostel mess facilities.

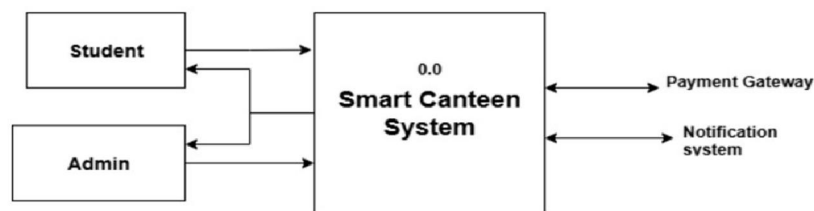


Fig. 1 Outline of the proposed project

III. EXISTING SYSTEM

The current canteen management systems are mostly concerned with fundamental digital ordering and billing. Typically, people order their food items via a static e-menu, order, and pay via cash or minimal online gateways. Once they order, their order directly goes to the kitchen or counter for preparation and processing. Such systems may eliminate manual paperwork and hasten order placement versus conventional systems; they are nonetheless subject to a variety of shortcomings.

Key elements of contemporary systems:

- E-Menu and Internet Ordering: Individuals can choose food from a virtual menu and order via the internet.
- Payment Integration: Few options of digital payments like UPI or a debit/credit card are offered.
- Order Forwarding: Orders are sent straight to the kitchen.
- Basic Admin Dashboard: Admins can see placed orders and do billing-related operations.

Limitations of existing systems:

- No role-based login; the same application does not make a difference between user and admin.
- Absence of demand forecasting utilizing AI, resulting in excess output or meal deficiency.
- No mechanism for inventory optimization or procurement planning.
- Lack of customized suggestions or weather-inspired menu options.
- Feedback collection is limited to text entry, with no sentiment analysis or intelligent reporting.
- Sustainability aspects such as waste tracking and eco-points rewards are not addressed.
- Congestion during peak hours remains unresolved due to lack of pre-order slot allocation.



Therefore, although such systems are better than all-manual systems in terms of convenience, they do not tackle the fundamental concerns of food waste, sustainability, and smart decision-making. Such shortcomings inspire the design of GatServe, a more intelligent, AI-based system for smart canteens on campuses.

IV. PROPOSED SYSTEM

The intended system, GatServe, is a smart, sustainable canteen management system developed to address the shortcomings of current systems. It combines role-based access, decision-making facilitated by the power of Artificial Intelligence, and sustainability-oriented functions within a single-campus-wide ecosystem both for the student/staff community and administrators.

Role-Based Login

- Single Login Page: Both the user and the administrator use one login page only.
- Credential-Based Redirection: Users will be automatically sent to the User App or the Admin App depending on login credentials.
- Simplified Access Control: This eliminates the need for separate login system maintenance and offers easy management for access.
- Secure Authentication: Role-based authentication offers information privacy and system security for both the communities.

User App Features

- Menu Search: Customers can search the virtual menu via text or voice search.
- Ordering & Payments: A cart system with multiple payment gateways (UPI, cards, wallet) is integrated.
- Pre-Ordering: Users can schedule their meals and select smart pickup slots to avoid crowding.
- Customized Suggestions: Season and weather-sensitive culinary options make the user experience better.
- Submission of Feedback: Users provide feedback, which is put through NLP-based sentiment analysis.

Admin Features

- Order Management: Admins can look at real-time orders, change their status, and flag finished orders.
- Menu Management: Menu items could be dynamically added, edited or deleted.
- Inventory Management: AI-driven inventory suggestions help reduce over-purchasing and wastage.
- Feedback Insights: Sentiment analysis reports can give service improvement initiatives actionable insights.

AI/ML Integration

The system utilizes various machine learning models to facilitate smart decision-making:

- Random Forest Classifier: Predicts daily food demand based on past data, holiday events, and weather.
- KMeans Clustering: Provides raw material procurement amounts based on consumption patterns.
- Transformers (NLP): It identifies user reviews and classifies them into positive, negative, or neutral.
- Decision Tree: Provides climate-dependent food products based on current weather information.

Sustainability Features

- Waste Reporting: Consumers can track leftover products, and such data can be used to adjust demand and inventory predictions.
- Smart Procurement: Synchronizes stock purchases with estimated demand in order to cut wastages.

Benefits of Proposed System

- Minimizes food waste by achieving proper demand forecasting and optimal inventory management.



- Reduces congestion by offering slot allocation and pre-order scheduling.
- Increases user satisfaction by providing climate-adaptive, personal recommendations.
- Improves administrative decision-making with dashboards powered by AI.
- Promotes ecological responsibility and green behaviour among students and employees.

The proposed GatServe system thus provides a holistic solution by combining operational efficiency, intelligent insights, and sustainability, making it suitable for implementation in universities, corporate cafeterias, and large-scale dining facilities.

V. SYSTEM ARCHITECTURE

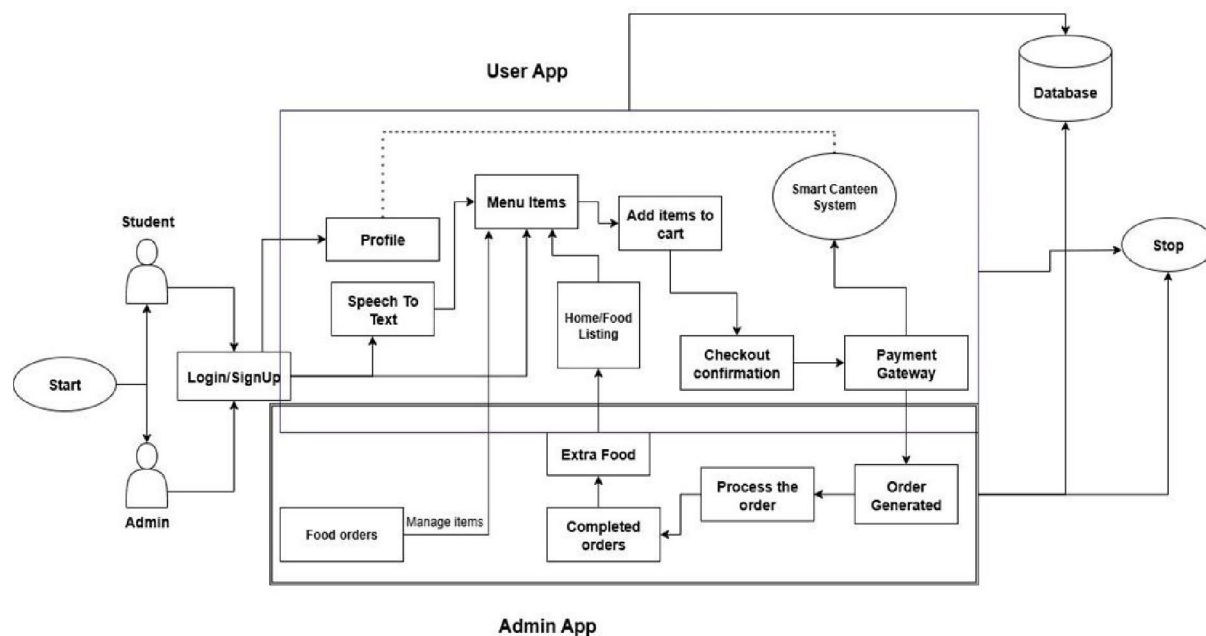


Fig. 2 Architecture of the proposed system

This diagram illustrates the architecture of a Smart Canteen Management System that seamlessly connects students and canteen administrators through a unified platform. The process starts with users, whether students or administrators, logging into the system via the login/signup module, which authenticates their access. On the User App side, students can manage 5 their profiles, browse menu items, or use a speech-to-text feature for easier ordering. They can add items to the cart, confirm their selection during checkout, and complete payments through the integrated payment gateway. Additionally, the user application integrates smart features such as season-based food recommendations, sentiment analysis on feedback, and eco points rewards to encourage sustainable dining practices. On the Admin App side, canteen administrators handle key operations, including inventory management, menu updates, and real-time monitoring of orders. The system leverages demand prediction models to forecast food requirements, ensuring optimized procurement and smooth order processing that ultimately generates completed orders. Throughout the workflow, all critical data—such as profiles, orders, inventory, and feedback—is stored and managed within the central database to maintain consistency and efficiency. The entire process flows from the start node to the stop node, representing a complete cycle from order placement to fulfillment.

VI. MODULES

A. Login and Authentication: This part allows the users to enter the app. Here users refer to student and staff. And admin has the privileged access to manage the audit logs and other entries of the user data. The verification of the



credentials is done through JWT (Json Web Tokens) to prevent unauthorized access. This provides a role-based throughout the app.

B. This module handles the successful login and enables routing of the users based on roles. The students and staff are navigated to User app, which allows them to access the menu, handle payments, their orders, profile and feedback. Admins are navigated to admin app instead, where they can manage the orders being processed, update the menu, manage audit logs and track inventory. Role-based access enables smooth functioning of the app.

C. Order Management: In this module, the students and staff(users) can view the menu, add their items desired to their cart and their favourite dishes to the wishlist and proceed to the orders page. For each order made, it is stored in the database and gets updated on the admin dashboard. Overall, this module helps in making the workflow efficient and reducing delays.

D. Payments and Wallet: This module handles the financial transactions in the system. It provides multiple options to proceed to payment gateway for e.g. through UPI, Razorpay and Stripe according to option desired by the user. Apart from this, a digital wallet provides option for users to add their credit or debit card details to enable faster checkouts.

E. Pre-order and Scheduling: It allows the users to preorder and select the slot for their pickup time. This scheduling avoids the long queues and excess of crowd during lunch hours. It allows to handle the workflow functioning efficiently which in turn leads to better service provided to users.

F. Feedback and Sentiment analysis: In this module once the order is successfully completed the users can provide their review on the quality of service, food quality, overall experience and so on. This review or the feedback provided is analysed using NLP. Based on this, the system generates an overall insight for the admin dashboard and helps to quickly identify the issues and improvise both quality and user satisfaction.

G. Demand Prediction: This module uses machine learning algorithms like Random Forest to find out the highly sold dish based on the past orders stored in the database. This feature helps the cook to prepare the right quantity of food based for each day which avoids the wastage of food. Also helps in maintain the logs of food orders based on the quantity.

H. Inventory Suggestion Module: This module uses machine learning algorithms like KMeans to handle the quantity of ingredients required to prepare the food. It also helps in stock management in backend which allows the admins to generate the reports and keep track of the ingredients quantity to be purchased and the overall expenditure.

I. Food Recommendation: This module offers personalized food recommendations based on their previous orders, feedback and wishlist items, also provides season-based recommendations of food using weather api's . This feature has been implemented to provide an excellent user experience. Overall, this module also uses machine learning models to implement the recommendation feature.

VII. FUTURE WORK

Enhancements are possible in the future by adding IoT-based smart bins for real-time monitoring of waste, deep learning-based models for higher-order recommendations, and cloud scalability for deployment of the solution on a multi-campus basis and in corporate cafeteria sites.

VIII. CONCLUSION

The newly proposed system GatServe is a brilliant, AI-based campus canteen management system with a high emphasis on sustainability. While traditional systems simply electronize ordering and payments, GatServe combines role-based access, smart machine learning algorithms, and green-oriented functionality all into one cohesive platform. For users, the system ensures a seamless food ordering experience with features such as voice-based search, multiple payment options, preordering with pickup slots, and personalized recommendations. For administrators, the system delivers real-time order monitoring, menu management, and AI-driven insights for demand forecasting, inventory optimization, and service improvement. By introducing Random Forest demand prediction, KMeans inventory suggestion, Transformers-based sentiment analysis, and Decision Tree weather recommendations, the system not only improves operational efficiency but also significantly reduces food wastage. Additionally, sustainability features like eco-points rewards and waste reporting modules encourage students and staff to adopt environmentally responsible behaviors. Overall,



GatServe demonstrates the potential of integrating technology, machine learning, and sustainability ideals, such that canteen management can be a better, simpler, and earth-friendly system.

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REFERENCES

- [1]. M. M. Krishnan, S. Avudaiappan, S. Mohamed Anees, and L. Thirumaran, "Canteen Food Ordering System and Management," International Research Journal of Engineering and Technology (IRJET), vol. 8, no. 03, Mar. 2021. 7
- [2]. Z. Xu, X. Zhao, Z. Tian, Z. Zhuang, and J. Wang, "The Design of Nutrition Ordering System Without Queuing in the College Canteen," Proc. 2020 Int. Conf. Comput. Inf. Big Data Appl. (CIBDA), pp. 381–386, 2020.
- [3]. M. M. Krishnan, S. Avudaiappan, S. M. Anees, and L. Thirumaran, "Canteen Food Ordering System and Management," Dept. Comput. Sci. Eng., Francis Xavier Eng. College, Tirunelveli, India, 2021.
- [4]. T. Raibagi, A. Vishwakarma, J. Naik, R. Chaudhari, and G. Kalme, "Orderista – AI-Based Food Ordering Application," in Proc. 2021 Int. Conf. Artif. Intell. Smart Syst. (ICAIS), Coimbatore, India, 2021, pp. 34–37.
- [5]. H. Zhang, "The research and design of college catering information service system," in Proc. 2022 Int. Conf. Inf. Syst., Comput. Educ. Technol. (ICISCET), Montreal, QC, Canada, 2022, pp. 142–146.
- [6]. V. L., M. K., S. A., and K. G., "E-Canteen Management System Based on Web Application," in Proc. 2022 Int. Conf. Commun., Comput. Internet Things (IC3IoT), Chennai, India, 2022, pp. 1–4.
- [7]. T. Bagayatkar, S. Pawar, V. Salvi, and K. Gawande, "Virtual Smart Canteen System," in Proc. 2022 IEEE Int. Conf. Signal Process., Informat., Commun. Energy Syst. (SPICES), 2022, pp. 503–508.
- [8]. H. B. Patil, M. M. Rathi, V. G. Wankhade, M. Darokar, Y. Wankhade, and N. Dharmale, "Elevating Canteen Management with a Modern Web Solution," in Proc. 2024 IEEE Int. Students' Conf. Elect., Electron. Comput. Sci. (SCEECS), Bhopal, India, 2024, pp. 1–6.
- [9]. S. E. Moore, C. Rooney, C. E. Neville, et al., "The Feasibility and Acceptability of a Rewards System Based on Food Purchasing Behaviour in Secondary School Cashless Canteens: The Eat4Treats (E4T) Cluster Feasibility, Non-Randomised, Controlled Intervention Study," Pilot Feasibility Stud., vol. 10, no. 4, 2024.

