International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

UniBites: A Design Framework of ID Card Based Canteen Food Ordering System for Universities with Collaborative Filtering Techniques and Voice Assistance

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Abstract
The Canteen Food Ordering System is an online platform designed for college students, teachers, and staff, aimed at streamlining canteen operations to reduce long lines and overcrowding. Accessible via an app and website, users can easily order food by scanning their ID cards. The platform offers diverse payment options, including credit/debit cards, UPIs, and cash on demand, ensuring a flexible payment experience. Key features include instant ordering to minimize waiting times and centralized admin controls for monitoring or- der completion. Additionally, a voice/chat assistant and a recommendation system enhance user navigation, ultimately improving service quality and efficiency. Frequent feedback sessions and real-time reports ensure the proper working of our system.

Keywords: Barcode Scanning, Canteen Management, Collaborative Filtering, Live Reports, Mobile Application, Online System, Recommendation System, Voice Assistant

1. Introduction

Many college canteens in India and similar countries rely on manual paperwork and a token system for order transactions. The Canteen Food Ordering System allows customers to browse and order food, eliminating the hassle of waiting in crowded queues.

Logging in is made easy using university ID cards for both customers and admins. Once an order is placed through the mobile or web app, it is stored in the database and accessed in real-time by admins, removing the need for physical tokens. The order tracking feature keeps customers informed about their order status, enhancing convenience. Additionally, a recommendation system suggests options based on previous orders and user behavior, while a feedback mechanism helps analyze sales and improve services. To ensure accessibility, a voice/chat assistant is available to assist users with navigation, guidance, and app-related tasks.

2. Related Works

[9] and [2] talk about web-based order automation and the shift from university websites to mobile apps increasing user accessibility and convenience.

[4] examines increasing reliability of e-commerce web apps with online payment systems with secure and efficient transactions directly applicable to our system which includes multiple digital payment options.

[7] highlights the role of web apps in improving dining via data driven decision making, for our recommendations, and the impact of real time data analysis, for our feedback mechanisms.

[3] uses cloud technology to emphasize data centralization.

[5] and [10] use image quality and computational power of modern smartphones for analysis and pattern recognition of 1D barcodes. [8] a localization algorithm, as a preprocessing step, using OpenCV (CPU) and OpenGL (GPU) for speed, accuracy, and optimization.

[6] examines content-based and collaborative filtering techniques for menu recommendations. [11] highlights customer service using chatbots and [1] explores smart voice assistants recognizing user needs in an academic environment.

3. Proposed System

a. Login

Default The web app can be accessed via the University website for easy navigation. The primary method of login for both admins and customers is using their university ID number and password. Customers can also navigate to the option of "reset password" to create a new password through a safe recovery process and can update their password.

ID Card Based To eliminate manual credential entry for admins, IoT card scanners will be installed for canteen staff to tap their ID cards. The mobile app will also allow customers to scan the barcode on their university ID cards using their phone camera. Using mobiles for barcode scanning has been available since the Nokia N78 and iPhone 3GS, but has not been effectively utilized due to a lack of suitable applications. The barcode can be scanned even with distortions, rotations, or if the card is upside down. It will be cached in the case of sudden network failure no need to rescan it.

b. Admins

Menu Management After admin login, the dashboard will display menu item management through a form-based interface for adding new items, including fields for the name, description, category, price, quantity, and image. Admins can also edit existing items and perform bulk updates. Features include soft deletion to retain order history, permanent deletion, and backup of deleted item details. The menu will update in real-time based on item availability. If a database connection fails during updates, an error message will be shown to the admin to retry or contact technical support. It also validates inputs to avoid invalid or incomplete data, allowing re-entry when needed. To handle simultaneous edits, a locking mechanism will notify the second admin if another admin is making changes, allowing them to retry after the first admin is done.

Order Management The canteen employees will be able to manage customer orders, view order information, and update order status. The system will provide real-time notifications to the cus- tomers on the status of the order such as "Order received", "Food is being prepared", and "Ready for pickup".

Reports After ordering, customers can provide feedback on service and food quality, which will be used to generate reports for improving canteen services. Reports will be created using a real-time streaming process in Power BI, employing a "Push Semantic Model" that pushes data into the Power BI service, automatically creating a database to store it. Visuals will update in real-time with any data changes, allowing users to query live data for up-to-date insights.

c. Customers

Menu Browsing By default, a list of items in the menu is displayed to the customer. The customer can also navigate to the search bar and enter keywords for the item they want to search for. The system either retrieves and displays a list of products matching the search criteria or displays a message informing no products were found otherwise. Items can be filtered by various parameters such as price, rating, category etc. The customer can click on an item to view its details and add it to their cart. A functionality for food recommendations is also provided to the customer based on two techniques: Content-Based and Collaborative filtering.

1. Content-Based Filtering: Recommends items based on attributes of previously selected items such as itemID, category, veg or non-veg status using string-matching for textual comparisons and cosine similarity for vectorized data comparisons. This method will not recommend new items as they are different from their preferences and will not recommend an item if no data is available.
2. Collaborative Filtering: Predicts based on similarities in customers' order histories. For example, if the order histories of customer 1 and customer 2 strongly overlap then there is a high chance that if customer 1 buys an item, then customer 2 will also buy the same or similar item. Cosine similarity identifies "nearest neighbors" with similar interests, and recommendations are based on aggregated ratings from these neighbors. This method recommends even for items a customer has not previously encountered.

Cart The button next to each item can be clicked to add that item cart. Customers can navigate to view the cart where the items will be displayed and modify the cart items' quantity.

Payment On checking out from the cart, the user will then pay for his food using either online or offline payment. In the basic functionality the payment is of offline mode, this means that the order will be received by the admin at the canteen's cash counter, the customer will pay offline to the admin, the admin will update the status in the application that the payment has been done, the order summary with payment details will be provided on the customer's interface of the application. In the online payment option, the customers will be directed to the payment gateway with multiple options (Credit/Debit cards, UPI, net banking).

Feedback After completing payment, the customer will be asked for feedback which can be used to improve both the application services and the canteen management services as well.

d. Voice Assistance

The incorporation of a voice assistant increases the reachability of our audience simplifying the navigation. Users can request menu items by voice like "Show me vegetarian items" or "Show me most popular items". They can use it to manage their cart, track orders, help with payment options, and be the go-to guide for any application related task.

4. Design

a. Data Flow Diagrams

DFDs are the graphical representation of data flow of our system at different levels of abstraction. We have provided levels 0, 1, and 2.

Level 0 (Context Diagram) It is the highest level abstraction view providing an overview of our entire system. In our system, we have Customer and Admin as our external entity whereas "Canteen Food Ordering System" is the main process. These external entities interact with the process with incoming and outgoing arrows providing a visualization of basic system flow.

Level-1 (Overview Diagram) It focuses on a detailed view of our system. It break downs the major processes in level-0 into various sub-processes. In our system, we have "Menu Browsing", "Account Management", "Menu Management", "Payment Management", and "Order Management" with "Admin" and "Customer" as our entities. To store our data we have "Item", "Customer", "Admin", "Feedback", and "Orders" Data as the database.

Level-2 (Detailed Diagram) It is the further breakdown of sub-processes in level-1, each being a separate process in level-2.

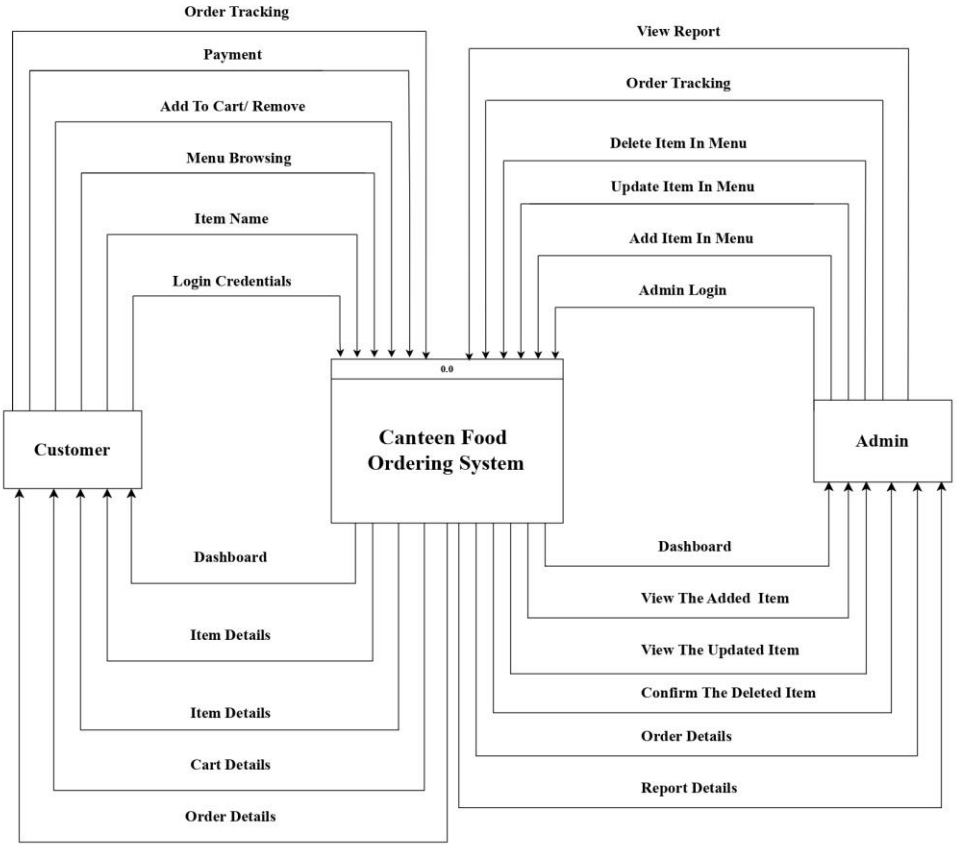

Fig. 1: DFD Level-0

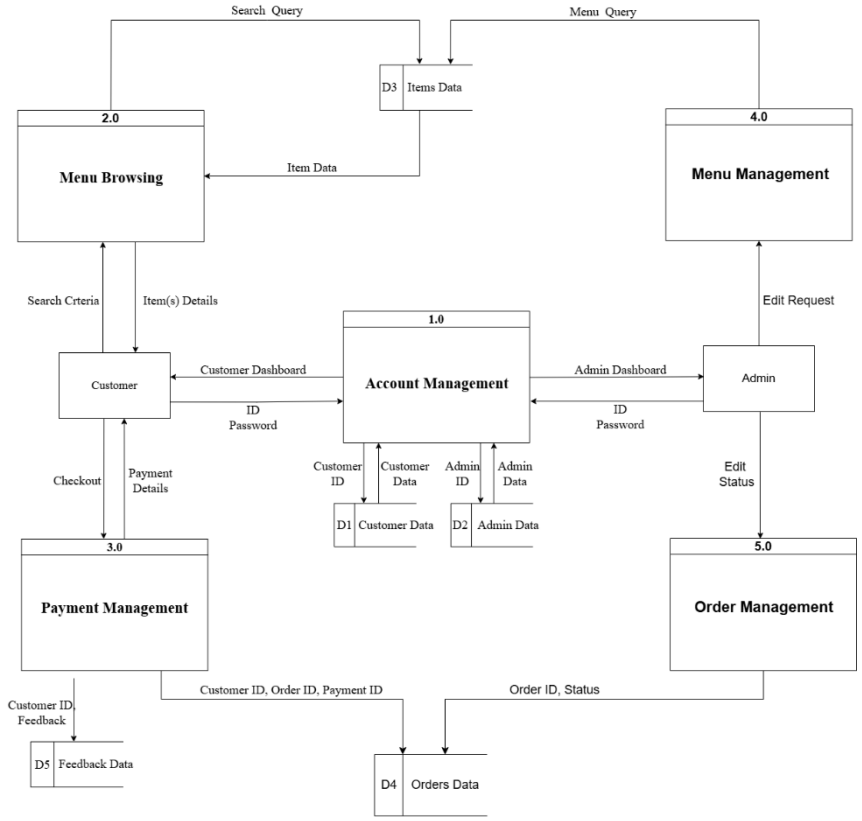

Fig. 2: DFD Level-1

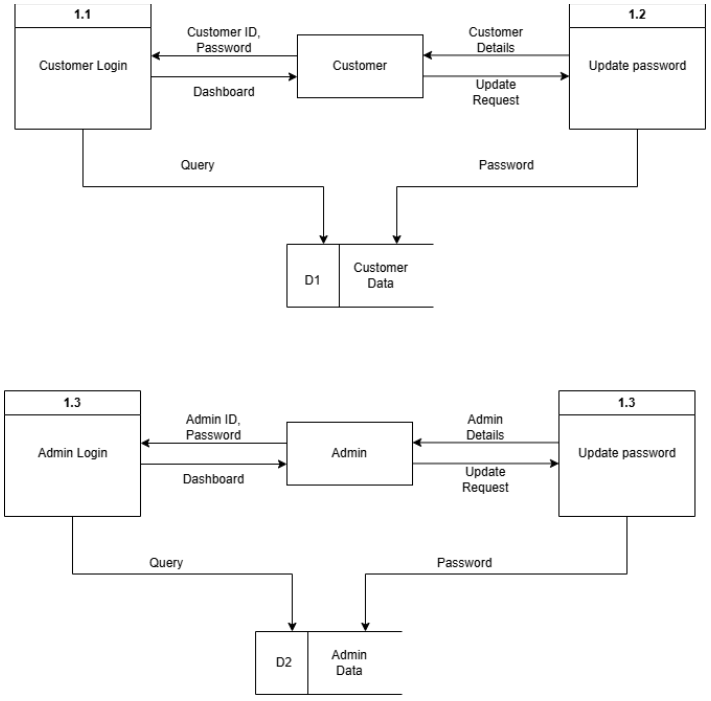

Fig. 3: DFD Level-2 Module-1: Account Management

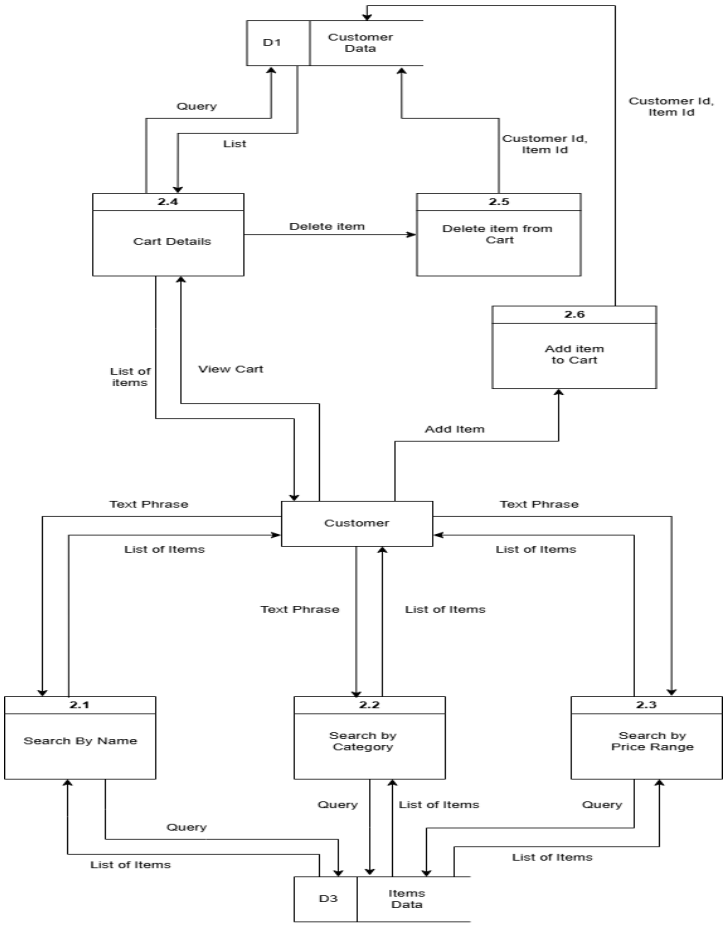

Fig. 4: DFD Level-2 Module-2: Menu Browsing

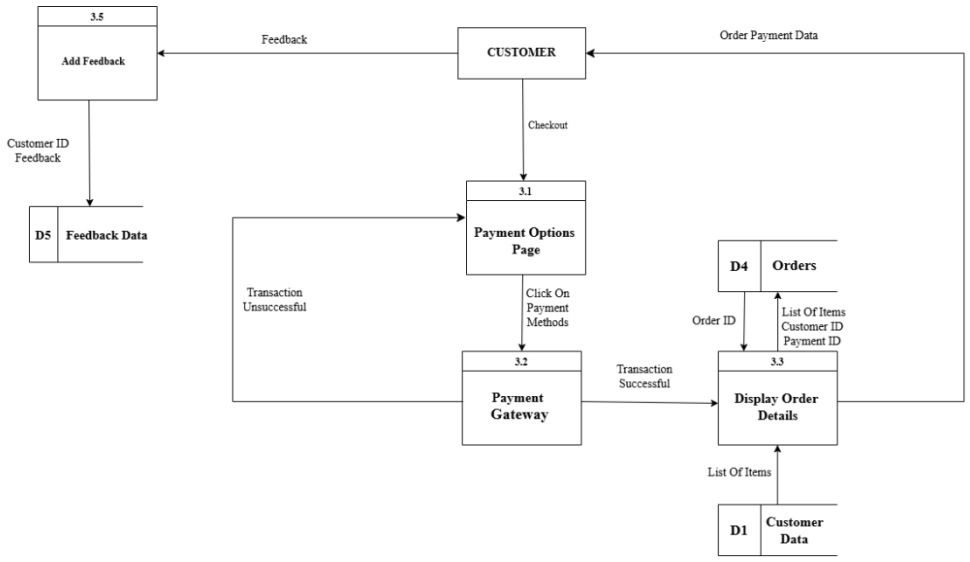

Fig. 5: DFD Level-2 Module-3: Payment Management

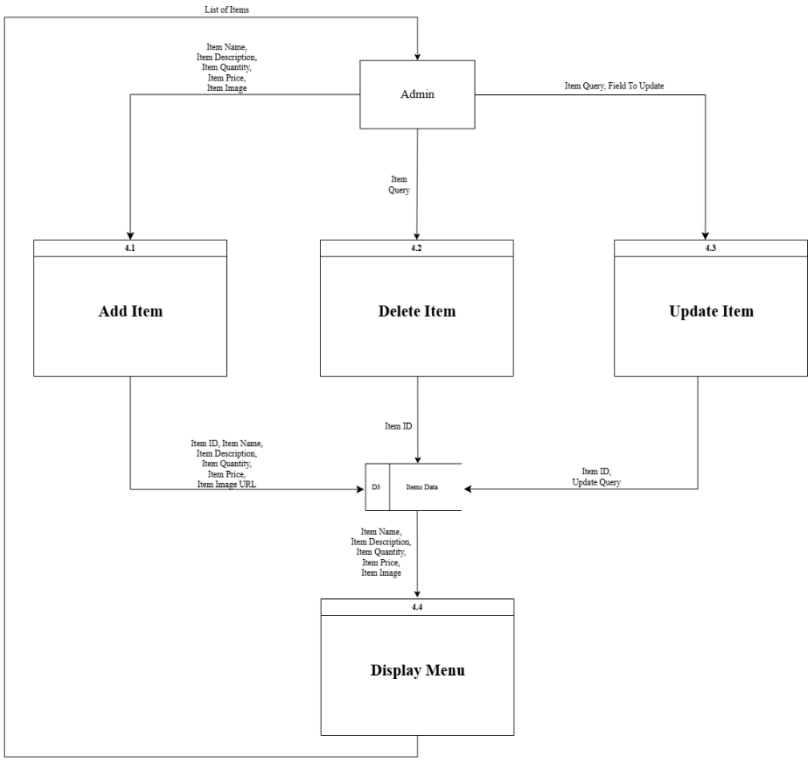

Fig. 6: DFD Level-2 Module-4: Menu Management

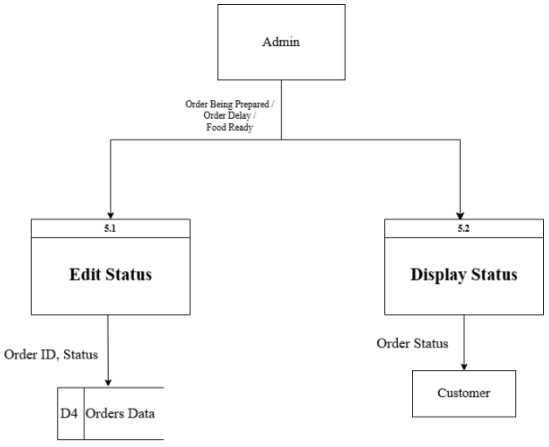

Fig. 7: DFD Level-2 Module-5: Order Management

b. Class Diagram

A Unified Modeling Language Diagram (UML) represents the system's structure based on the Object Oriented Programming (OOPs) concept, displaying the classes, attributes, and methods.

c. Use Case Diagram

The use case diagram represents user interactions with the system.

Actors Primary actors are customers and admin, who directly interact with the system. A secondary actor is the payment gateway, managed by a third party.

Use Cases A use case represents a system action. The diagram shows customer login and admin login as generalized versions of a login use case. After logging in, customers can browse the menu (connected via an 'include' relationship) and search for items by name or category (generalization relationship). Customers can then add items to their cart and optionally delete items (an 'extend' relationship). Checkout requires viewing the cart first (an 'include' relationship). After checkout, payment leads to feedback. Admins handle order and menu management actions like updating items and tracking order statuses.

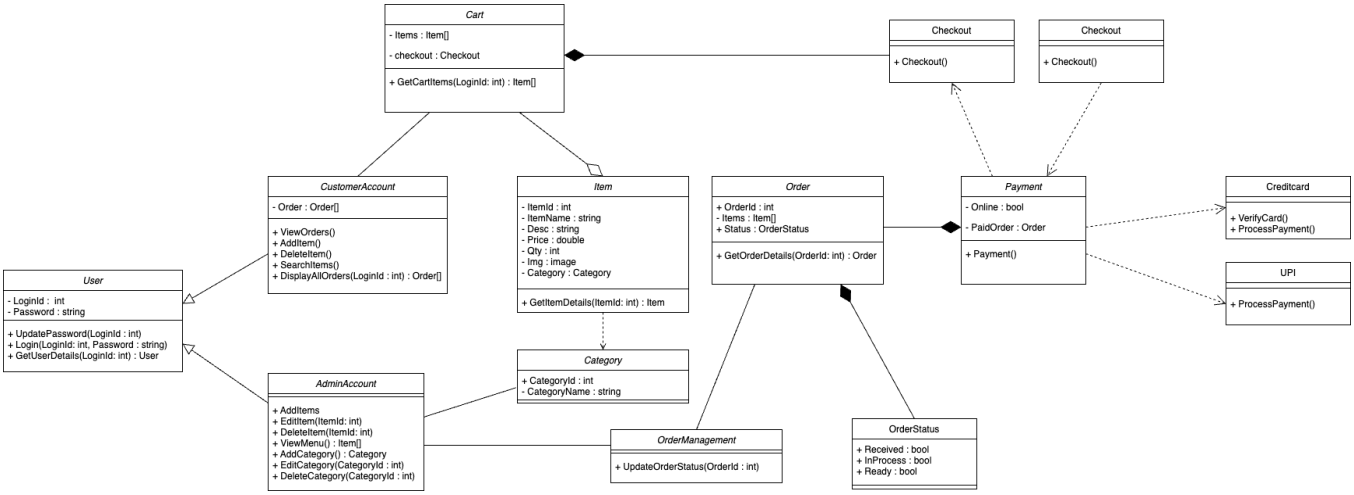

Fig. 8: Class Diagram

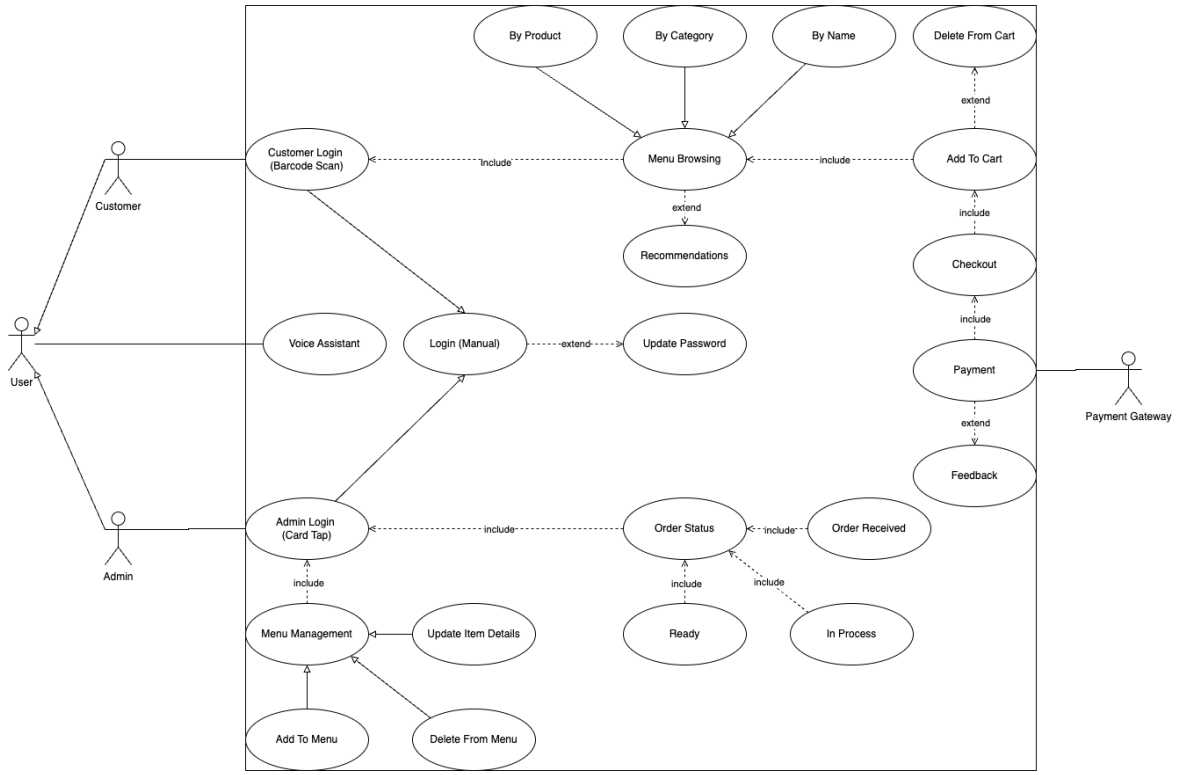

Fig. 9: UseCase Diagram

5. Conclusion

The Canteen Food Ordering System is a modern solution to make ordering food at university canteens

easier and more efficient. It solves common problems like long queues and overcrowding by letting students and staff order food using their ID cards through a mobile app or website. The system includes helpful features like easy login using university ID card scanning, multiple payment options (cash, cards, and UPI), voice assistant to help users navigate the app, recommendations based on what users usually order, order tracking, feedback system to improve service. These features make the canteen experience better for everyone - students can order food quickly without waiting in line, and canteen staff can manage orders more efficiently. This system can be implemented on small as well as large scale canteen business in all areas like Educational Institution such as Colleges, IT Sectors, etc.

6. Future Scope

In universities, annual fests takes place and different sellers from outside come to the universities to sell their food. We can provide a functionality of registering those vendors on the application and customers can order their food. This would make university fests more organized for everyone involved - students can spend less time waiting in lines, and vendors can manage their orders more efficiently.

7. Acknowledgement

The project was designed by Kallam Raga Ramya Sree, Lalitha Taruna Vishalakshi Mulugur, and Srishti Turki under the guidance of Smt. G. Shanmukhi Rama to whom we would like to express our gratitude for giving us a supportive hand along with valuable insights throughout the project. The copyright for this work is held by Chaitanya Bharathi Institute of Technology (A), Hyderabad, India.

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