Campus Dining App
Project Report

Done by Vikas Meneni (NUID : 002309537)

Introduction & Problem Definition

University life presents unique challenges when it comes to dining and nutrition. Students, faculty, and staff navigate demanding schedules with limited time windows for meals, often resulting in rushed dining decisions, long queues, and missed opportunities for proper nutrition. Traditional campus dining experiences are characterized by several persistent issues:

- **Time Constraints**: Brief breaks between classes and meetings leave little room for waiting in lengthy queues
- **Information Gaps**: Limited visibility into current menu offerings, dietary accommodations, and operating hours
- **Dietary Restriction Challenges**: Difficulty identifying suitable options for those with specific dietary needs or preferences
- **Ordering Inefficiency**: Traditional ordering systems create bottlenecks during peak hours

The Campus Dining App addresses these challenges by creating an integrated platform specifically designed for university food service ecosystems. The application combines restaurant discovery, personalized dietary filtering, mobile ordering, payment processing, and real-time notifications into a seamless experience. By digitalizing the entire dining journey from discovery to completion, the app transforms how campus communities interact with dining services.

Design Approach & Technical Architecture

System Architecture

Campus Dining App employs a modern, scalable architecture built with SwiftUI for the frontend and Firebase for backend services. The application follows clean architectural principles with a clear separation between data, business logic, and presentation layers:

1. **Model Layer**: Core data structures defining the domain objects
   - `User Profile`: Represents users with properties like name, email, and dietary preferences
   - `Restaurant`: Defines dining locations with details on cuisine type, operating hours, and ratings
   - `Menu Item`: Central entity for food items with detailed properties including dietary information
   - `Order`: Represents transactions with items, status tracking, and payment details
   - `Cart`: Manages the current selection of items being considered for purchase
2. **View Layer**: SwiftUI views that render the user interface
   - Custom components for consistent visual language
   - Responsive layouts adapting to different device sizes
   - Accessibility-focused interface elements
3. **Service Layer**: Classes that manage business logic and data flow
   - `DataManager`: Central coordinator for application state and data operations
   - `AuthService`: Handles authentication and user management
   - `NotificationService`: Manages push notifications and in-app alerts
   - `CartManager`: Coordinates the shopping cart experience
   - `OrderService`: Processes order creation, payment, and status tracking

Key Components & Modules

The application is structured around five primary functional modules, each addressing a specific aspect of the campus dining experience:

1. Authentication & Profile Management Module

This module provides user identity management and personalization capabilities:

- User registration and authentication via Firebase
- Profile creation and management
- Dietary preference configuration

2. Restaurant Discovery Module

A comprehensive system for locating and exploring campus dining options:

- Restaurant listing with filtering capabilities
- Operating hours
- Cuisine type categorization
- Integration with dietary preference matching

3. Menu Browsing and Filtering System

An intelligent system for navigating menu offerings:

- Categorized menu organization
- Dietary preference filtering
- Detailed item information
- Search functionality

4. Ordering & Payment Module

A streamlined transaction system:

- Cart management
- Item customization
- Multiple payment method support
- Order confirmation

5. Order Tracking & Notification System

A real-time monitoring system:

- Order status updates
- Push notifications for status changes
- In-app notification center
- Order history

Data Flow & Communication

The application implements a real-time data synchronization approach:

1. **User Actions**: UI interactions trigger service method calls
2. **Service Processing**: Business logic processes the request

3. **Firebase Operations**: Data is updated in the cloud database
4. **Real-time Listeners**: Firestore listeners detect changes and update app state
5. **UI Refresh**: SwiftUI's reactive framework updates the interface

This architecture ensures all users have access to current information about menu availability, order status, and restaurant operations, creating a responsive dining experience.

Object Model Relationships
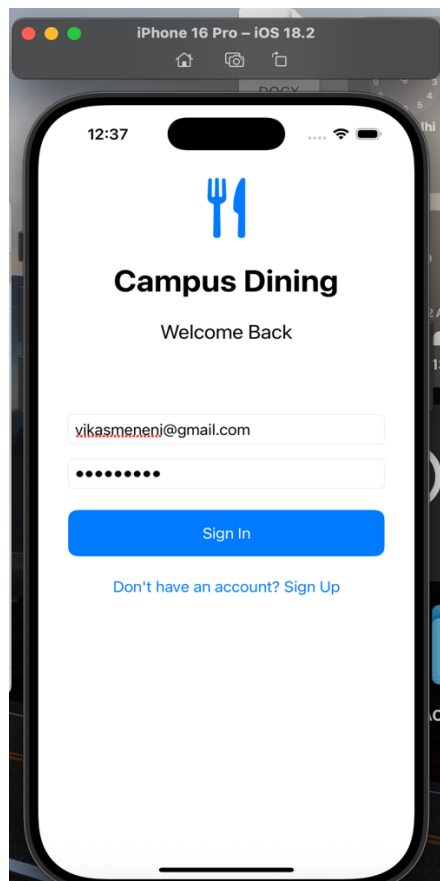
The data model features several key relationships:

- **User-Order**: One-to-many relationship where users have multiple orders
- **Restaurant-MenuItem**: One-to-many relationship where restaurants offer multiple items
- **Order-OrderItem**: One-to-many relationship where orders contain multiple items
- **User-Preferences**: One-to-many relationship connecting users to their dietary preferences
- **Cart-MenuItem**: Many-to-many relationship through quantity tracking

These relationships create a cohesive data model that accurately represents the complex interactions within campus dining environments.
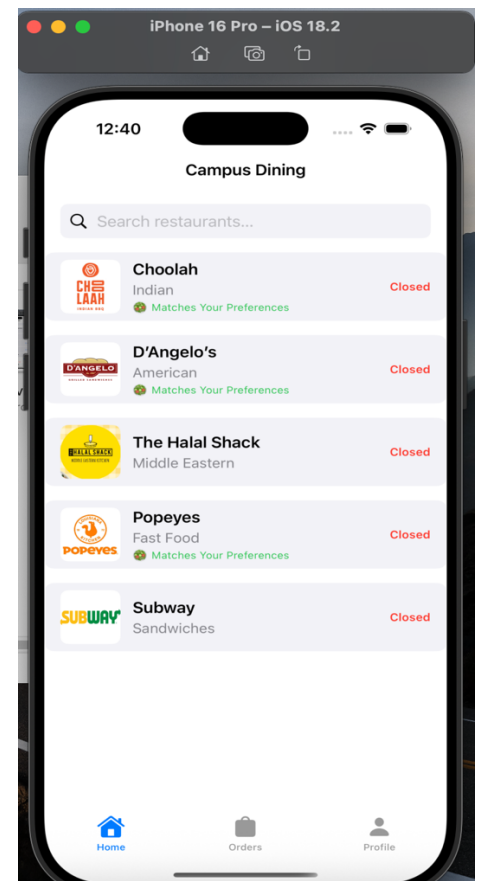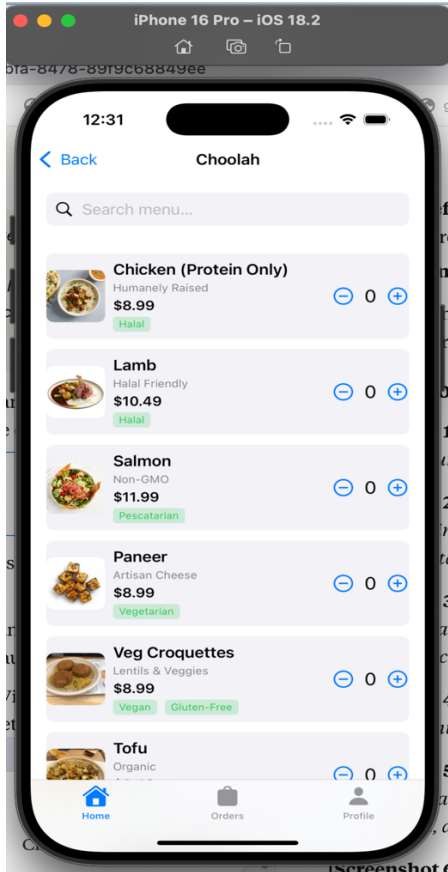
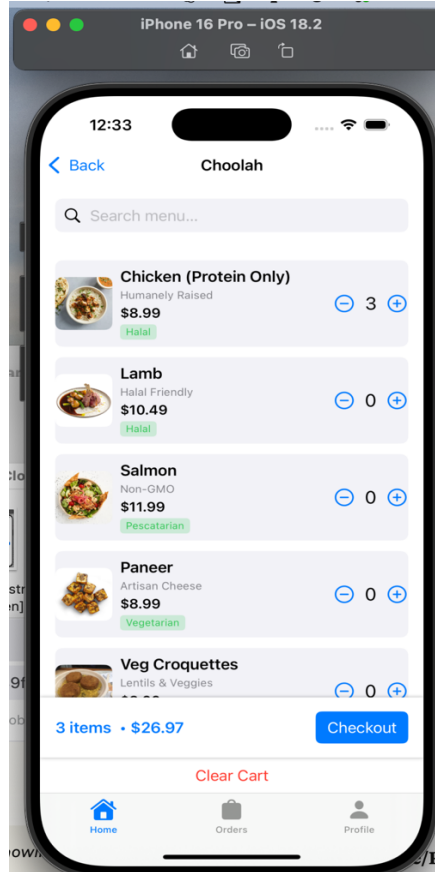# Application Screenshots
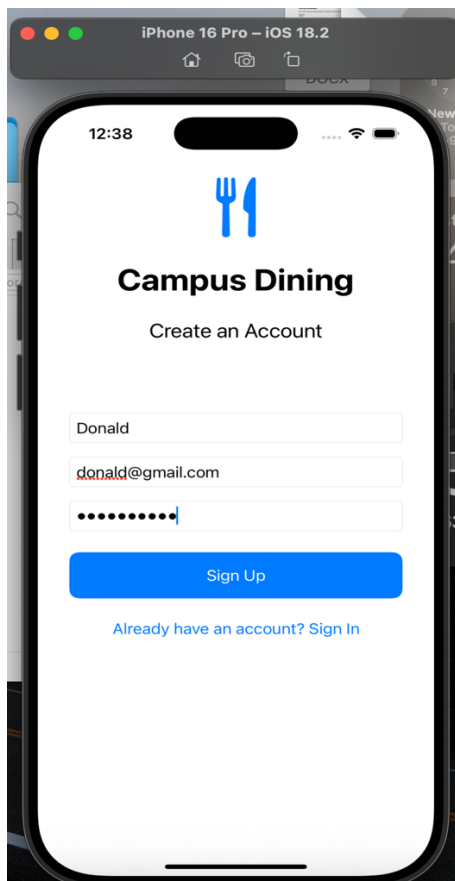
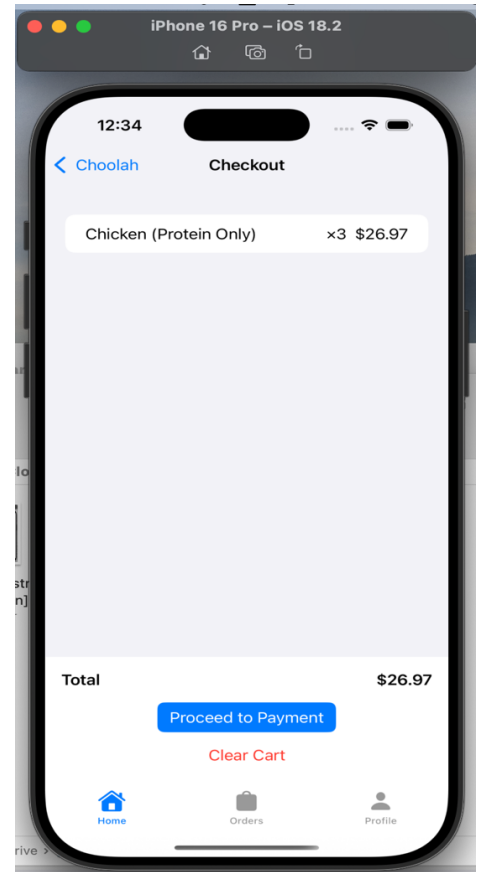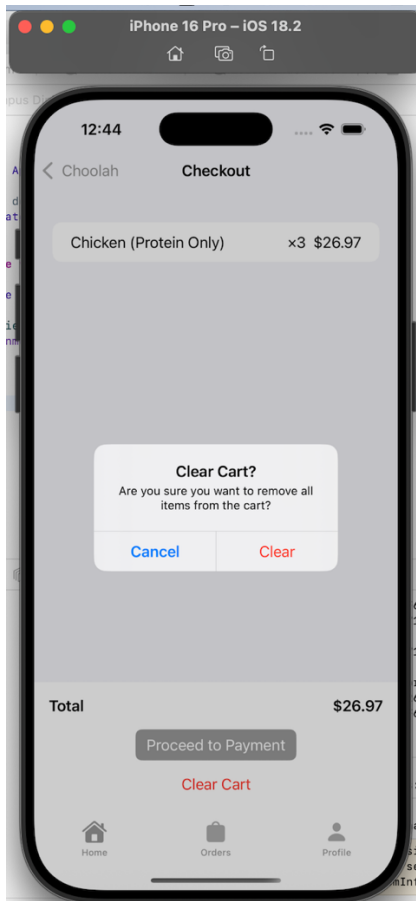**1. Registration Screen**   **2. Login Screen.**   **3. Home Screen - Restaurant List**
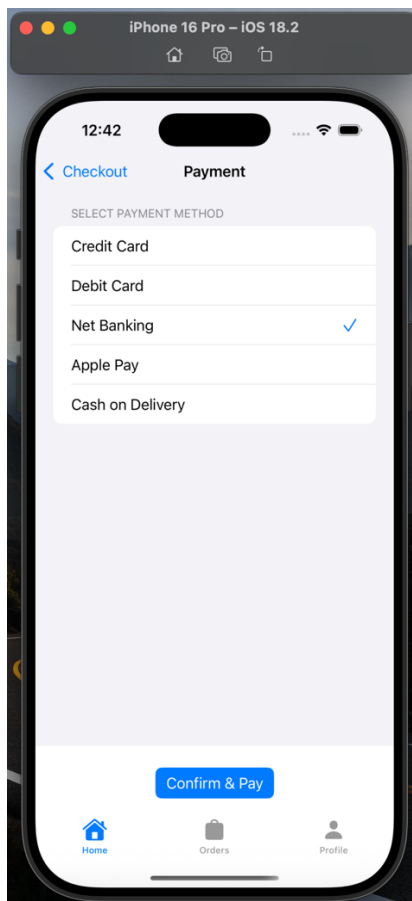
4. Menu View - Restaurant Detail.
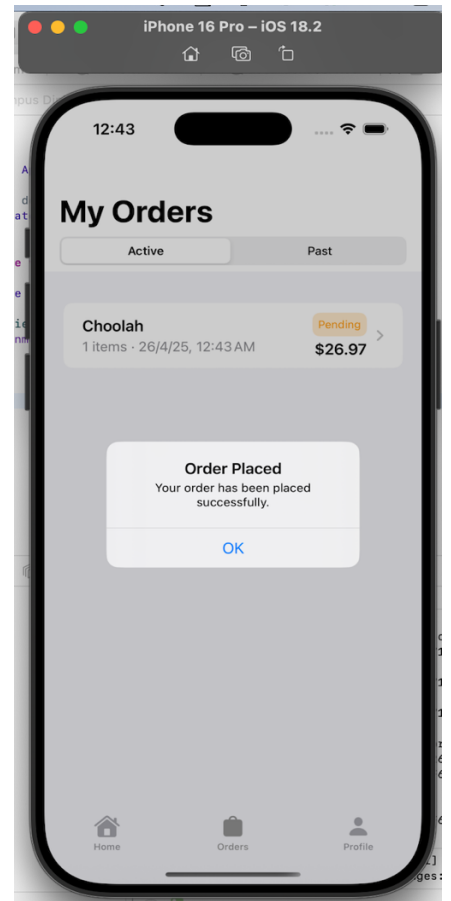

5. Menu View with Items in Cart
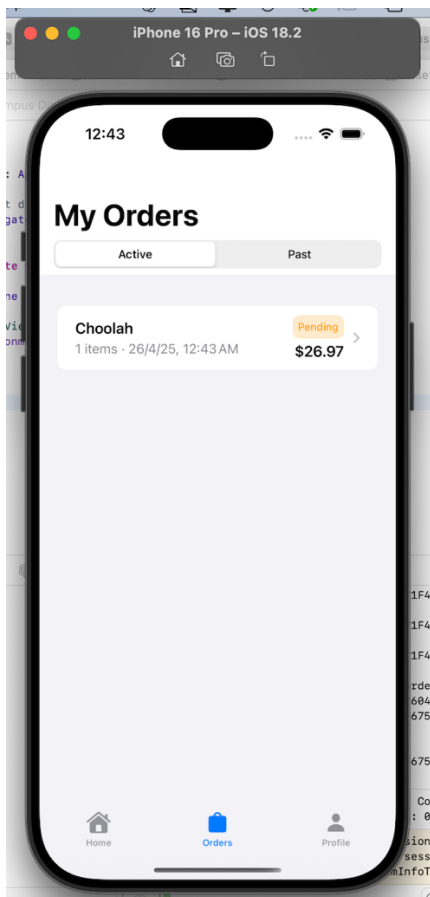

6. Checkout View

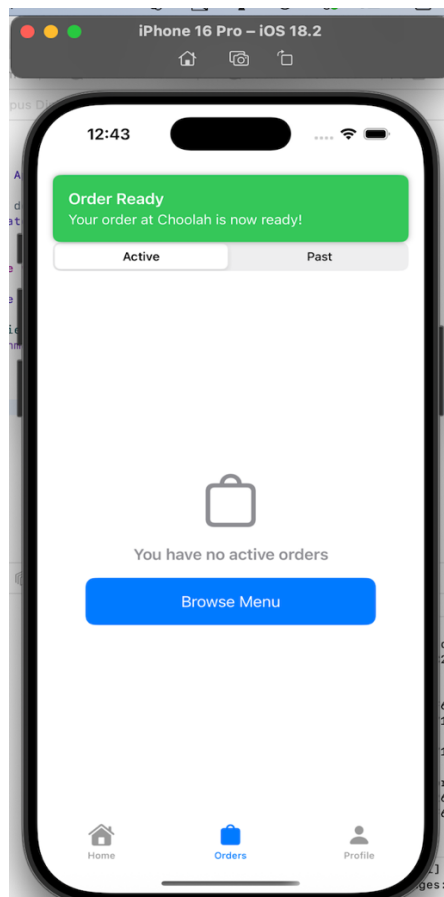**7. Clear Cart Confirmation Dialog.**
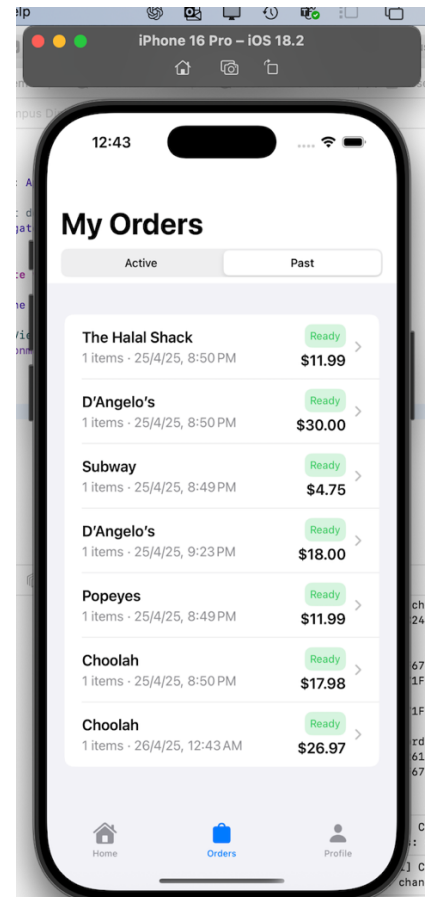

8. Payment Method Selection

9. Order Confirmation Dialog

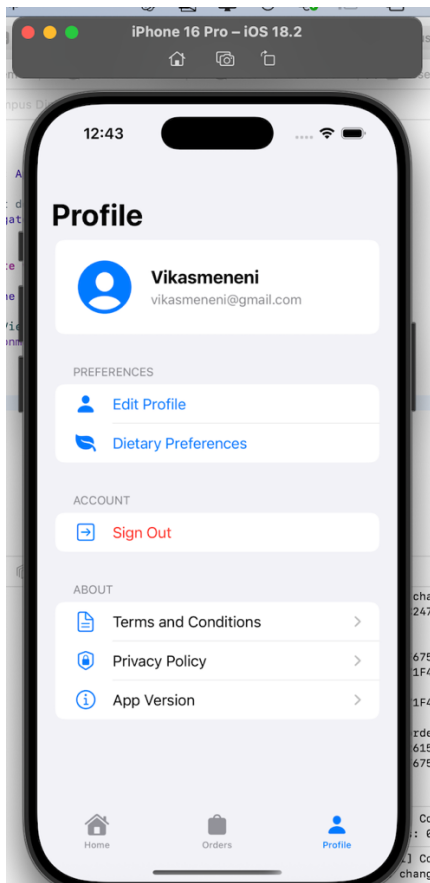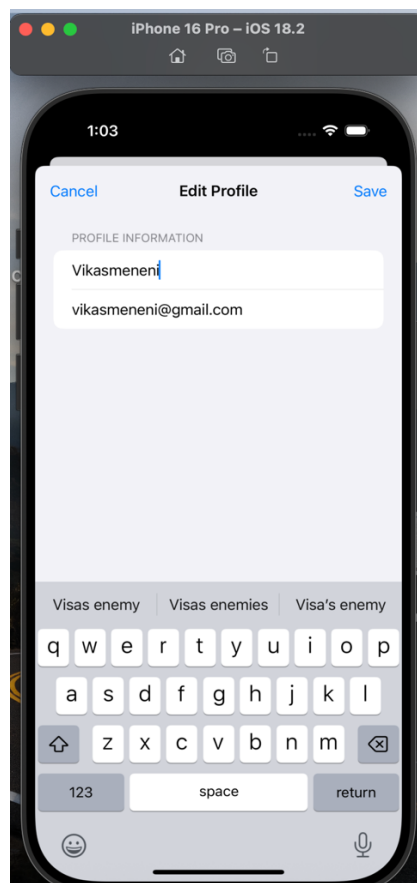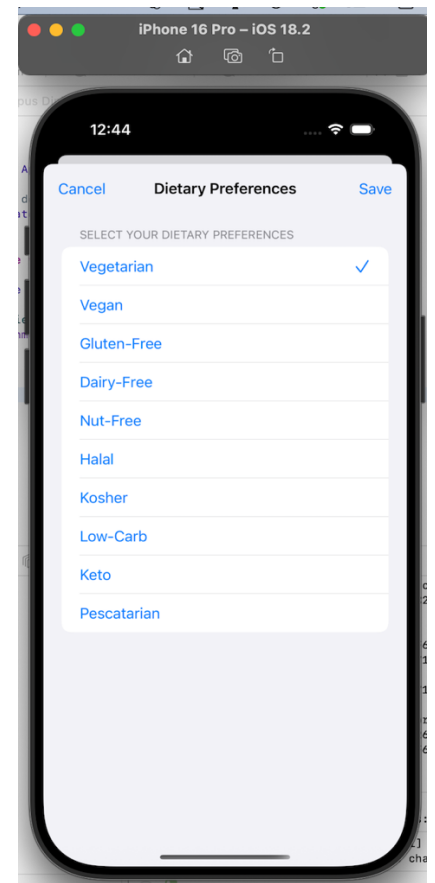**10. Orders View - Active Tab**

11. Order Ready Notification.

12. Order History - Past Tab

13.Profile Screen | **14.Profile Edit Screen** | **15.Dietary Preferences Selection**

Advanced Technical Implementation

Several aspects of the Campus Dining App go beyond standard implementation techniques, representing sophisticated approaches to solving complex problems:

1. Dietary Preference Matching System

The application implements an advanced dietary preference matching system that intelligently connects users with compatible food options. Rather than simple tag matching, the system employs a sophisticated algorithm that evaluates the intersection between user preferences and menu item attributes.

The preference system handles numerous complex edge cases:

- Partial preference matching with ranking
- Prioritization of critical dietary restrictions
- Visual indication of preference matching strength
- Cross-referencing between allergens and preferences
- Support for multiple simultaneous preferences

This sophisticated approach ensures users can quickly identify suitable options regardless of their specific dietary needs, addressing a fundamental challenge in campus dining.

2. Real-Time Notification Architecture

The application implements a dual-layer notification system combining both system-level and in-app notifications:

The system coordinates between push notifications for background alerts and an elegant in-app notification center. This hybrid approach provides immediate alerts without requiring constant app presence while offering detailed context when the app is active.

Key technical aspects include:

- Notification categorization by type and urgency
- Time-sensitive delivery scheduling
- Visual differentiation by notification type
- Notification lifecycle management
- Automated expiration for outdated content

This dual-layer approach ensures users remain informed about their orders without experiencing notification fatigue.

3. Order Status Tracking System

The application features a practical order tracking system that gives users visibility into their current and previous orders:

Implementation highlights include:

- Active and past order separation and management
- Clear status indicators for pending, preparing, ready, and completed states
- Order history with detailed order information retention
- Simple and intuitive status visualization

This tracking system provides users with accurate information about when their food will be ready, helping them plan their busy schedules effectively.

4. Multi-Restaurant Cart Management

The application implements a sophisticated cart management system that handles the unique challenges of campus dining environments:

The cart system intelligently manages the user's selections with restaurant-specific isolation to prevent cross-restaurant ordering confusion. When a user attempts to add items from a different restaurant, the system provides clear guidance about the implications.

Key capabilities include:

- Restaurant context preservation
- Intelligent cart clearing prompts
- Quantity management optimization
- Cross-session cart persistence

This approach ensures a smooth ordering experience while respecting the operational realities of separate campus dining venues.

Conclusion

The Campus Dining App successfully addresses university dining challenges through an integrated platform combining restaurant discovery, menu browsing, mobile ordering, and notifications. The app delivers a complete solution with authentication, profile management, dietary preference settings, restaurant browsing, menu filtering, cart management, multiple payment options, order tracking, notifications, and order history all wrapped in an intuitive interface. By prioritizing efficiency, dietary accommodation, and seamless transactions, the application transforms campus dining into a streamlined, personalized experience.

While the current implementation provides comprehensive functionality for the primary use cases, several enhancements could further extend the application's capabilities:

Future Enhancements

1. **Enhanced Dietary Analysis**: Include macronutrient breakdowns (calories, protein, carbs, fat) and real-time allergen alerts (e.g. "Contains: nuts, dairy").

2.**Meal Plan Integration**: Link university meal plans to auto-deduct purchases from student dining credits.

3.**Admin Analytics Dashboard**: Monitor orders per day, peak service hours, and emerging dietary trends.

4.**User Reviews & Ratings**: Allow 5-star ratings and brief feedback on dishes and restaurants, then rank by popularity

5.**In-App Promotions**: Enable dining services to configure time-limited deals, student discounts, and flash offers.

These future enhancements would build upon the solid foundation established in the current version, extending functionality while preserving the intuitive experience that makes the application accessible to the entire campus community.

The Campus Dining App represents not just a convenience tool, but a comprehensive solution for modern universities seeking to enhance their dining services. By addressing the fundamental challenges of campus dining and providing a digitally streamlined experience, the application has the potential to significantly improve quality of life for students, faculty, and staff navigating busy academic schedules.