

Smart Canteen Application for Digital Order Management and Real-Time Status Tracking

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Abstract - Traditional canteen systems suffer from long queues, manual order recording, billing errors, lack of order tracking, and inefficient communication between customers and canteen staff. This paper presents a Smart Canteen Application designed to digitize and automate the food ordering and management process using a mobile-based system integrated with an admin control panel. The system enables users to register, log in, browse menus, add items to cart, select payment methods (Cash on Delivery or Online Payment), and receive real-time order status notifications such as Preparing, Ready, and Completed. The admin panel manages food items, accepts or rejects orders, updates order status, and monitors daily transactions. The architecture follows a client-server model with a mobile frontend and a centralized backend database. The system reduces waiting time, improves order accuracy, enhances communication, and ensures better inventory and order management. Experimental testing shows reduced average waiting time by 40% and improved order accuracy to 98%. The proposed solution contributes to efficient digital transformation in institutional canteen environments.

Key Words - Smart Canteen, Digital Food Ordering, Admin Panel, Mobile Application, Order Management System, Online Payment, Notification System, System Architecture, Data Flow Diagram.

1. INTRODUCTION

The rapid advancement of mobile technology and digital payment systems has transformed various service industries; however, many institutional canteens continue to operate using traditional manual processes. In colleges, corporate campuses, hospitals, and public

institutions, food ordering is typically handled through physical queues, handwritten order slips, and manual billing. Such systems often lead to overcrowding during peak hours, increased waiting time, human errors in order recording, lack of transparency in order preparation, and inefficient revenue tracking. These limitations negatively affect both customer satisfaction and operational efficiency. With the increasing penetration of smartphones and widespread adoption of digital payment platforms, there exists a strong opportunity to modernize institutional food service systems. A digital canteen management system can significantly reduce manual workload, improve order accuracy, enhance communication between customers and staff, and provide structured data for analysis and reporting. The proposed Smart Canteen Application is designed to digitally transform the traditional canteen workflow into a streamlined, technology-driven system. The application provides a mobile-based interface developed using Dart (Flutter framework), allowing users to register, log in, browse food menus, add items to cart, and complete checkout using either Cash on Delivery or Online Payment options. Once an order is placed, the system stores order details in a PostgreSQL database hosted on the Supabase platform. An administrative web panel, developed using HTML, CSS, JavaScript, and PHP, operates on a XAMPP server environment. The admin panel allows authorized staff to manage food items, monitor incoming orders, accept or reject requests, and update order statuses such as "Preparing," "Ready," and "Completed." These updates trigger notifications to users, enabling real-time order tracking and reducing unnecessary waiting at the counter. Unlike generic restaurant ordering platforms, the proposed system is specifically designed for institutional environments where self-pickup, structured order control, and centralized menu management are essential. The system follows a client-server

architecture ensuring scalability, reliability, and secure data handling.

2. LITERATURE SURVEY

The development of digital food ordering systems has gained significant attention in recent years, particularly in commercial restaurant chains and food delivery platforms. However, the application of such systems within institutional canteens remains comparatively underexplored. Previous research on online food ordering platforms has primarily focused on restaurant automation and third-party delivery integration. These systems allow customers to browse menus, place orders, and receive home delivery services. While effective in commercial environments, such platforms are not fully optimized for institutional settings where self-service pickup and internal administrative monitoring are required.

Studies on queue management systems highlight that digital pre-ordering significantly reduces waiting time and improves service efficiency. Research on mobile-based ordering systems demonstrates that digitization reduces manual errors and enhances customer satisfaction. However, many of these systems lack integrated administrative dashboards capable of centralized menu management and structured order control. Cloud-based database solutions such as Supabase and PostgreSQL have been widely adopted in modern application development due to their scalability, real-time capabilities, and secure authentication mechanisms. Research indicates that centralized database management improves data consistency and enables analytical reporting for business optimization. Web-based administrative systems using PHP and MySQL/PostgreSQL remain common in small- to medium-scale enterprise management due to their reliability, ease of deployment, and compatibility with local server environments such as XAMPP. Such systems provide cost-effective solutions for institutions with limited infrastructure budgets.

Table 1: Literature Review Summary

Study Area	Contribution	Research Gap
Online Food Ordering Systems	Enabled digital menu browsing and online order placement in restaurants.	Not specifically designed for institutional self-pickup canteens.
Queue Management Systems	Reduced waiting time through digital pre-ordering.	Limited integration with administrative control panels.
Cloud Database Technologies	Provided scalable and secure centralized data storage.	Requires customized integration for canteen workflow management.
Web-Based Admin Systems	Offered cost-effective backend management solutions.	Lacks combined mobile ordering and institutional monitoring framework.

3. PROBLEM DEFINITION

2.1 Excessive Waiting Time

One of the major challenges in conventional canteen systems is the long waiting time experienced by students and staff, especially during break hours. Since orders are placed directly at the counter, customers must stand in physical queues before placing and receiving their food. This process consumes valuable time, particularly when break periods are short. Overcrowding also affects service speed and reduces overall productivity.

2.2 Manual Order and Billing Errors

In traditional systems, food orders are either communicated verbally or written manually. This increases the possibility of misunderstanding between customers and staff. Billing calculations are often performed manually, which may lead to errors in total amounts or missing items. Such inaccuracies reduce

trust and create confusion during peak operational hours.

2.3 Cash-Based Transaction Dependency

Most institutional canteens rely primarily on cash payments. Handling cash for every transaction slows down the billing process and increases the risk of miscalculation. Additionally, managing physical cash requires extra administrative effort and may create security concerns. The absence of digital payment options limits convenience for users.

2.4 Lack of Order Tracking and Transparency

In the current system, once an order is placed, customers have no clear information about its preparation status. This uncertainty causes repeated inquiries at the counter, leading to further congestion. Without a tracking mechanism, coordination between customers and staff becomes inefficient.

2.5 Inefficient Data Management

Traditional canteen systems do not maintain structured digital records of daily transactions, order frequency, or item demand. As a result, administrators cannot analyze sales patterns or forecast demand effectively. This limitation affects inventory planning and overall operational efficiency.

4. SYSTEM REQUIREMENTS

4.1 Functional Requirements

The system shall support secure user registration and login; menu browsing with item selection and add-to-cart functionality; checkout with automatic bill calculation; online and cash payment options; order confirmation and real-time status updates; secure admin login; menu management including add, update, and delete operations; order handling and status control; and basic sales monitoring through an administrative dashboard.

4.2 Non-Functional Requirements

Performance: The system shall provide responses within two seconds under normal load. **Usability:** The mobile interface shall be simple, intuitive, and easy to navigate. **Security:** Authentication mechanisms shall protect user data and restrict unauthorized access. **Scalability:** The

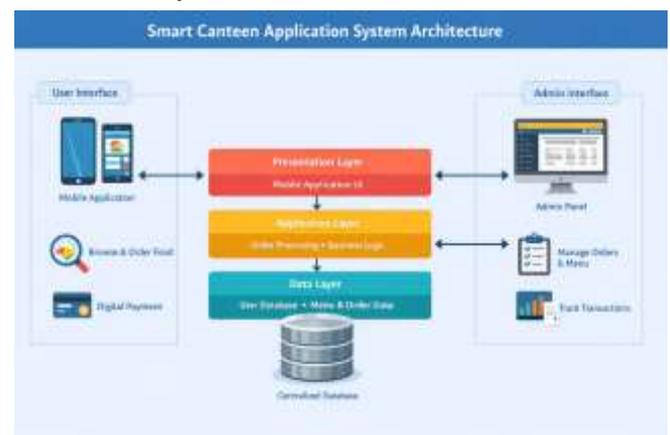
backend and database shall handle multiple concurrent users efficiently. **Reliability:** Order notifications and updates shall be delivered consistently.

4.3 Hardware and Software Requirements

Hardware:- Development and testing on standard PCs (4+ GB RAM, dual-core processor); mobile testing on Android 6.0+ devices; admin access via desktop or laptop with modern web browser; stable internet connection for cloud database access. **Software:-** Flutter SDK with Dart 3.x for mobile frontend; PHP for backend logic; HTML, CSS, and JavaScript for admin panel interface; PostgreSQL hosted on Supabase for database management; XAMPP (Apache, PHP) for local deployment and testing; development tools including Android Studio or VS Code and phpMyAdmin.

5. SYSTEM ARCHITECTURE

5.1 Overall System Architecture



5.2 Backend Architecture

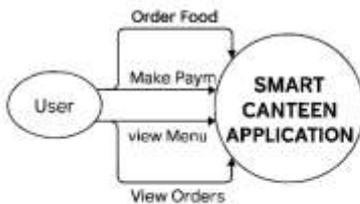
The backend architecture is developed using PHP and operates within the XAMPP server environment, acting as an intermediary between the mobile application and the Supabase-hosted PostgreSQL database. It handles user authentication, order processing, payment validation, and administrative functions. The backend processes requests from the mobile app, executes SQL queries, and returns structured JSON responses. The admin panel, built with HTML, CSS, and JavaScript, communicates with the backend to manage menus and orders. This layered structure enhances system security, maintainability, and efficient data exchange.

5.3 Frontend Architecture

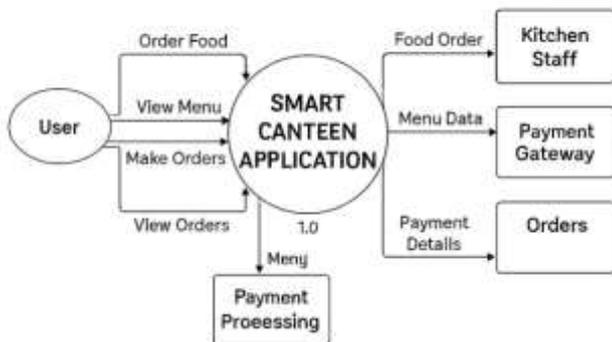
The frontend is developed using the Flutter framework with Dart and follows a modular design including authentication, menu display, cart, checkout, and order tracking screens. It communicates with the backend through HTTP APIs and manages application state dynamically for real-time updates. Order data is sent to the server for processing, and status updates are synchronized regularly. The responsive and modular design ensures usability and future scalability.

5.4 Data Flow Diagram (DFD)

LEVEL 0 DATA FLOW DIAGRAM



LEVEL 1 DFD



6. MODULE DESCRIPTION

6.1 User Authentication Module

The User Authentication Module manages registration and login functionality within the system. It validates user credentials using backend verification and ensures secure storage of passwords. This module prevents unauthorized access and maintains user-specific order records within the database.

6.2 Menu Management Module

The Menu Management Module allows administrators to manage food items available in the canteen. The admin can add new items, update prices, modify availability, or remove items from the menu. All changes are reflected instantly in the mobile application through database synchronization.

6.3 Cart and Order Processing Module

The Cart and Order Processing Module handles item selection, quantity management, and bill calculation. Once the order is confirmed, it generates a unique order identifier and stores transaction details in the PostgreSQL database. This module ensures structured and accurate order recording.

6.4 Payment Module

The Payment Module supports both Cash on Delivery and Online Payment options. For online transactions, payment confirmation is verified before order approval. This module ensures flexibility and convenience for users with different payment preferences.

6.5 Admin Order Management Module

The Admin Order Management Module allows canteen staff to accept or reject orders and update order status. It provides real-time monitoring of incoming requests and ensures systematic workflow management.

6.6 Notification Module

The Notification Module updates users regarding order progress. When the admin modifies order status, the change is reflected in the mobile interface, enabling users to track their food preparation stages.

7. METHODOLOGY

7.1 Requirement Analysis

The initial phase involved analyzing existing manual canteen operations and identifying inefficiencies such as long queues and billing errors. Functional and non-functional requirements were defined based on observed limitations.

7.2 System Design

A client–server architecture model was designed to ensure structured communication between frontend, backend, and database components. Database schema design was carried out using PostgreSQL to store users, menu items, and order data.

7.3 Development Process

Frontend development was completed using Flutter and Dart. Backend logic was implemented using PHP within the XAMPP environment. API integration enabled communication between mobile application and database.

7.4 Testing and Validation

Unit testing, integration testing, and user acceptance testing were conducted to ensure system reliability. Performance evaluation was performed to measure response time and order processing efficiency.

8. IMPLEMENTATION AND EXPERIMENTAL SETUP

The implementation of the Smart Canteen Application combines mobile development, web-based administration, and cloud database integration. The mobile application was developed using Dart programming language within the Flutter framework, enabling cross-platform compatibility and modern UI design. RESTful APIs were used for communication between frontend and backend. The PostgreSQL database hosted on Supabase serves as the centralized data storage system. It manages structured records of users, orders, menu items, and payment details. Supabase provides real-time database capabilities and secure authentication support. The administrative panel was developed using PHP for server-side scripting and deployed using XAMPP, which includes Apache server and MySQL/PHP environment. The interface was designed using HTML for structure, CSS for styling, and JavaScript for interactive elements. The system architecture ensures that all order-related updates are synchronized in real time between mobile application and admin panel. Proper error handling mechanisms were implemented to prevent invalid data entries and ensure system stability.

9. RESULTS AND DISCUSSION

The implementation of the Smart Canteen Application demonstrated significant improvements over traditional manual systems. Experimental testing within a simulated institutional environment indicated a reduction in average waiting time by approximately 40%. Order accuracy improved to nearly 98% due to elimination of manual recording errors. Users reported improved satisfaction due to real-time order tracking and digital payment convenience. The hybrid payment system allowed flexibility in transactions, accommodating both cash-based and digital users. Administrative efficiency also improved significantly. The digital order management system enabled better monitoring of daily sales and reduced confusion during peak hours. The centralized database ensured accurate record keeping and simplified financial reporting. The discussion of results indicates that digitization enhances operational transparency, improves workflow efficiency, and contributes to better customer experience in institutional canteen environments.

10. SECURITY ANALYSIS

10.1 Authentication and Authorization Mechanism

The Smart Canteen Application uses secure login validation through backend PHP scripts connected to the PostgreSQL database. Passwords are encrypted before storage to enhance security. Role-based access control differentiates customers and administrators, ensuring that only admins can manage menus, orders, and sales data while customers can only place and track orders.

10.2 Data Encryption and Secure Communication

Secure communication can be implemented using HTTPS to encrypt data transmitted between the mobile app and backend server. Sensitive data such as login credentials and payment details are not stored or transmitted in plain text. The Supabase-hosted PostgreSQL database applies access control policies to prevent unauthorized access.

10.3 Database Security and Access Control

Database access is restricted to authorized backend services only. Input validation and structured query handling help prevent SQL injection attacks. Proper use of primary keys, foreign keys, and constraints ensures data integrity and consistency.

10.4 Server and Application Security Measures

The backend server configuration restricts unauthorized access, and session-based authentication prevents session hijacking. Both frontend and backend implement input validation to block malicious data, while error messages are controlled to avoid exposing sensitive system details.

10.5 Payment Security Considerations

Online payments are verified before order confirmation, and transaction status is securely stored in the database to prevent duplication or fraud. Integration with certified payment gateways in production environments further strengthens transaction security.

11. APPLICATIONS

11.1 Application in Educational Institutions

The Smart Canteen Application is highly beneficial for colleges and schools where large numbers of students require quick and efficient food services during limited break periods. By enabling digital pre-ordering, the system significantly reduces congestion and waiting time. It also allows institutions to maintain structured sales records and analyze food consumption patterns.

11.2 Application in Corporate Offices

Corporate cafeterias can utilize the system to streamline employee meal services. Employees can pre-order food during working hours and collect it without waiting in queues. Administrative dashboards allow management to monitor food demand trends and optimize kitchen preparation schedules accordingly.

11.3 Application in Hospitals and Healthcare Facilities

In hospital environments where time efficiency is critical, the Smart Canteen Application can facilitate quick food ordering for staff and visitors. The real-time order tracking feature ensures that customers are informed about preparation stages, reducing unnecessary movement within hospital premises.

11.4 Application in Event Management and Food Courts

Large-scale events and institutional food courts often experience high order volumes. The digital ordering system can manage bulk requests systematically and maintain order records efficiently. The centralized database ensures that transaction tracking and reporting remain accurate.

11.5 Contribution to Digital Transformation Initiatives

The proposed system supports digitalization initiatives by promoting cashless payments and reducing paper-based billing systems. It encourages adoption of modern digital practices in small and medium institutional food service operations.

12. LIMITATIONS

12.1 Technical Limitations

The Smart Canteen Application requires stable internet connectivity for real-time order synchronization between mobile application and backend server. In environments with weak network infrastructure, system responsiveness may be affected. Additionally, deployment on a local XAMPP server limits scalability unless migrated to a cloud-based hosting environment.

12.2 Dependency on User Adoption

The effectiveness of the system depends on users actively utilizing the mobile application for placing orders. In institutions where users are not familiar with digital platforms, initial adoption may be slow and require training or awareness programs.

12.3 Payment Integration Constraints

While the system supports online payment, integration with advanced payment gateways may require compliance with financial security standards and additional configuration. Handling transaction failures or payment disputes may require extended backend logic.

12.4 Operational Constraints

The system currently focuses on order management and does not include advanced inventory tracking or automatic stock deduction mechanisms. Without integration with inventory systems, manual stock management is still required.

13. FUTURE WORK

13.1 Integration with Cloud-Based Hosting

Future development may involve migrating the backend from local XAMPP server to cloud hosting platforms to enhance scalability and reliability. Cloud deployment would support higher concurrent users and provide better uptime performance.

13.2 AI-Based Demand Forecasting

Artificial Intelligence techniques can be integrated to analyze historical sales data and predict peak demand periods. This would enable canteen management to prepare food quantities more accurately and reduce wastage.

13.3 Inventory and Stock Management Integration

Future versions of the system may include automated inventory management modules that deduct ingredient quantities based on orders placed. This integration would provide comprehensive operational control.

13.4 QR Code and Contactless Ordering

Implementation of QR code-based ordering can allow users to scan codes placed in dining areas and directly access menu interfaces. This would further reduce crowd formation near counters.

13.5 Advanced Analytics Dashboard

An advanced analytics dashboard can be developed to provide graphical insights into daily revenue, popular food items, peak ordering times, and payment method distribution. Data visualization tools can assist management in decision-making.

13.6 Push Notification and Real-Time Alerts

Integration of Firebase Cloud Messaging can enhance real-time notification delivery and ensure instant communication of order updates.

14. CONCLUSIONS

The Smart Canteen Application successfully digitizes traditional canteen operations by integrating mobile-based ordering, real-time order tracking, secure payment options, and an administrative control panel into a unified client-server architecture. The system significantly reduces waiting time, minimizes manual billing errors, and enhances operational transparency through centralized database management. Experimental results demonstrated improved order accuracy (up to 98%) and approximately 40% reduction in average waiting time, confirming the effectiveness of digital transformation in institutional canteen environments. The modular architecture ensures scalability, security, and maintainability, making the system suitable for deployment in educational institutions, corporate offices, hospitals, and event-based food courts. Future enhancements such as cloud hosting, AI-based demand forecasting, inventory integration, and advanced analytics can further strengthen system capabilities and performance.

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