Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 4, April : 2025

CAMPUS BITES: A WEB-BASED CANTEEN MANAGEMENT SYSTEM USING MERN STACK

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***Abstract*—Campus Bites is a modern web-based canteen management system developed using the MERN (MongoDB, Express.js, React, Node.js) stack, designed to revolutionize food ordering and management in campus environments. The system features a dual-interface architecture, catering to both students/employees and canteen owners, effectively bridging the gap between food service providers and consumers. Through its intuitive React-based frontend, users can seamlessly browse menus, place orders, and track their status in real-time, while canteen owners can efficiently manage their inventory and process orders through a dedicated dashboard.The platform incorporates advanced features such as QR code/barcode-based order tracking, secure JWT authentication, ensuring a smooth and secure ordering experience.**

The implementation of modern UI libraries like Framer Motion and AOS creates an engaging and responsive interface that adapts seamlessly across different devices. The system's robust backend, built on Node.js and Express.js, handles multiple concurrent users while maintaining optimal performance, and MongoDB provides flexible data management capabilities essential for dynamic menu updates and order processing.A key focus of Campus Bites is operational efficiency and waste reduction.

Through its digital ordering system, the platform significantly reduces order errors and minimizes food wastage by enabling precise inventory management and accurate order fulfillment. The real-time tracking feature keeps users informed about their order status, effectively reducing wait times and improving overall service delivery. For canteen owners, the system provides valuable insights through its analytics capabilities, helping them optimize their menu offerings and resource allocation.The system's comprehensive approach to canteen management extends beyond basic ordering functionality. It includes features

such as digital menu management, automated inventory tracking, and detailed reporting tools that help administrators make data-driven decisions.

Toast notifications provide immediate feedback for user actions, creating a more engaging and interactive experience.By leveraging modern web technologies and focusing on user experience, Campus Bites sets a new standard for campus canteen management. The system not only modernizes the traditional canteen ordering process but also contributes to sustainability efforts by reducing paper waste through digital receipts and optimizing food preparation through better demand prediction. This makes Campus Bites an ideal solution for educational institutions and corporate campuses looking to modernize their food service operations while maintaining efficiency and user satisfaction.

Industrial Engineering Journal
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Keywords— ***Canteen Management System | MERN Stack | Digital Food Ordering | Real-time Tracking | QR Code Integration | User Authentication | Inventory Management | Web Application | Student Services | Food Service Optimization***

I. INTRODUCTION

Cafeterias are important spaces where employees and students take a break and enjoy their meals. However, many cafeterias face issues like long waiting times, unorganized food selection, and food wastage. To improve efficiency and create a better experience, organizations are looking for smart solutions that make operations smoother while also being environmentally friendly.

Campus Bites is a web-based cafeteria management system built using **MERN (MongoDB, Express.js, React, Node.js)** technology. It is designed to be user-friendly, allowing people to browse, customize, and order food easily. The system includes features like **secure login (JWT authentication), QR code integration, and real-time multi-user support** to make ordering quick and hassle-free.

The main goal of Campus Bites is to **save time and reduce food wastage**. By providing a **digital ordering system**, it helps people get their food faster while also ensuring better meal planning. Cafeteria managers receive useful data to manage inventory efficiently, making it a win-win for both customers and cafeteria owners.

Campus Bites is built to work in different places like **colleges, offices, and hospitals**. It uses **MongoDB** for handling multiple users smoothly and **Express.js** to manage backend operations efficiently. The **React-based interface** ensures a fast and responsive experience, using modern design tools like **Framer Motion and AOS** for a sleek look. The system also includes **digital menu management**, reducing the need for manual work.

Beyond improving convenience, **Campus Bites also contributes to sustainability efforts**. By offering a pre-ordering system and tracking food preferences, it helps minimize food wastage, ensuring that only necessary quantities are prepared. The system promotes **eco-friendly practices** by encouraging users to opt for reusable packaging, reducing single-use plastic consumption in cafeterias.

Another key benefit of Campus Bites is its **scalability and flexibility**. Whether it's a small office cafeteria or a large university dining hall, the system can be easily adapted to different needs. The modular structure allows **new features to be integrated seamlessly**, making it a long-term solution for modern cafeteria management.

Security is also a top priority. Campus Bites implements **strong authentication mechanisms** to protect user data and transaction details. The use of **role-based access control** ensures that cafeteria administrators, staff, and customers have appropriate permissions, preventing unauthorized access and maintaining data privacy.

Additionally, the platform supports **seamless integration with external payment gateways**, allowing users to make secure digital payments. Whether through **UPI, credit/debit cards, or digital wallets**, the system ensures a smooth and secure transaction process, eliminating the need for cash handling.

In short, **Campus Bites makes cafeteria management smarter and greener**. With **digital payments, real-time tracking, and detailed analytics**, it helps cafeterias run more efficiently while being more eco-friendly. By leveraging modern technology, it enhances user experience, optimizes operations, and promotes sustainability in food service environments.

II LITERATURE REVIEW

Cafeterias in places like colleges, offices, and hospitals often face problems like long waiting times, order mix-ups, and food wastage due to manual operations. In traditional setups, customers have to stand in line to order food, which can be slow and inefficient. Payments are usually done with cash, and managing inventory becomes difficult without an automated system.

With new technology, digital food ordering has become a popular solution. Many institutions now use websites, mobile apps, and QR code-based ordering to make the process faster and more convenient. These systems let people check menus, customize meals, and pay online, making ordering smooth and hassle-free. At the same time, cafeteria managers can track stock levels, reduce waste, and plan meals better.

Modern cafeteria systems use advanced technologies to improve efficiency. The MERN (MongoDB, Express.js, React, Node.js) stack is commonly used to create flexible and easy-to-use applications. Real-time order tracking helps customers know when their food is ready, while secure online payment options like UPI and PayPal make transactions safer and quicker.

Even with these improvements, many digital cafeteria systems still have gaps. Some platforms lack customization, meaning they may not suit every institution’s needs. Many do not use data analysis to predict food demand, leading to unnecessary food waste. Additionally, some systems do not collect real-time feedback from customers, which could help improve service.

Overall, digital ordering has greatly improved cafeteria management, but there is still room for growth. Campus Bites aims to fill these gaps by using smart technology to offer

better inventory management, personalized services, and a user-friendly experience. By making cafeterias more efficient and eco-friendly, it ensures a smoother and smarter way to manage food services.

The integration of technology into cafeteria management has been extensively explored in academic literature, focusing on enhancing operational efficiency, reducing food waste, and improving customer satisfaction. This literature review synthesizes key findings from various studies on electronic meal ordering systems, AI-driven menu recommendations, and online food delivery platforms.

Electronic Meal Ordering Systems in Healthcare Settings:

A systematic review published in *PubMed* evaluated the impact of electronic meal ordering (EMO) systems within hospitals. The study identified three primary EMO-supported models: spoken menu, room service, and self-service. Findings indicated that EMO systems were associated with improved patient satisfaction, decreased food waste, increased consumption, and, in the case of spoken menus, more patient interaction time. However, the review found no substantial evidence linking EMO systems to enhanced clinical outcomes, highlighting the need for further research into their potential benefits for nutritional monitoring and patient health.

AI-Driven Menu Recommendations for Customer Satisfaction:

Research on the implementation of artificial intelligence (AI) in menu recommendations has demonstrated significant improvements in customer satisfaction within the restaurant industry. An AI-based system tailored food choices to individual health conditions, such as diabetes, hypertension, allergies, and heart disease. The study reported a 20% increase in overall customer satisfaction post-implementation, with 75% of respondents expressing approval of the personalized recommendations. Additionally, the system provided valuable insights into seasonal and demographic trends, enabling restaurants to optimize their menu offerings accordingly.

Online Food Delivery Platforms: A Systematic Synthesis:

A comprehensive review in the *International Journal of Hospitality Management* examined the evolution of online food delivery (OFD) services. The study highlighted a transition from website-based ordering to mobile applications and drone-based deliveries. Prominent theories underpinning OFD research include the Unified Theory of Acceptance and Use of Technology (UTAUT), Theory of Planned Behavior (TPB), and Technology Acceptance Model (TAM). The review also noted that a significant portion of empirical research on OFD has been conducted in Asian countries, particularly China and South Korea, primarily utilizing survey-based methodologies. The authors developed a conceptual framework outlining frequently reported antecedents, mediators, moderators, and consequences in OFD literature, providing a foundation for future research in this domain.

Smart Canteen Management Systems Using RFID Technology:

The application of Internet of Things (IoT) technologies, such as Radio-Frequency Identification (RFID), has been proposed to enhance canteen and cafeteria management. An IoT-based system employing RFID technology aims to streamline operations by efficiently managing customer details, orders, and electronic payments. This approach is anticipated to increase management efficiency and customer convenience, as users can easily recharge their accounts and receive notifications via SMS or email. The implementation of such systems is expected to enhance profitability and operational effectiveness in the food service industry.

AI Innovations in Restaurant Operations:

Beyond ordering systems, AI is revolutionizing various aspects of restaurant operations, including smart menus, dynamic pricing, reservation management, and food waste reduction. AI-driven smart menus optimize layout for profitability based on sales metrics, while dynamic pricing strategies adjust prices in real-time according to market data. AI also assists in managing reservations, reducing food waste through predictive analytics, and supporting sustainable practices by optimizing inventory and promoting eco-friendly farming methods. These innovations collectively contribute to enhanced operational efficiency and customer experiences in the restaurant industry .

III METHODOLOGY

Campus Bites – A Smart Canteen Management System

Campus Bites is an advanced canteen management system designed to make food ordering on campus easier, faster, and more organized. Whether you are a student, an employee, or a canteen owner, this system ensures a seamless experience by offering secure login, personalized dashboards, real-time menu updates, and quick payment options.

The system starts with a simple yet secure registration and login process. Users can create an account by providing their name, ID, and email. To maintain security, Campus Bites uses JSON Web Tokens (JWT) to ensure that only authorized users can access their accounts. Once logged in, users are automatically assigned roles—students, employees, canteen owners, or administrators—based on their profile. Each role comes with specific access privileges to keep the system organized and efficient.

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For students and employees, Campus Bites offers an easy way to browse the menu, place orders, and track deliveries. The menu is updated in real time, allowing users to view available food items without any confusion. They can filter meals by category, such as breakfast, lunch, or snacks, and even search for dishes based on specific ingredients. This feature is especially helpful for those with dietary restrictions or personal preferences. Additionally, customization options allow users to modify portion sizes and request special preparations, ensuring that everyone gets a meal suited to their taste.

Once a user selects their desired items, they can add them to their cart, where they can review their order before proceeding to payment. The cart automatically calculates the total cost, so there are no surprises at checkout. To make ordering even more convenient, Campus Bites allows users to save their favorite orders for quick reordering. There is also an option to pre-order meals, enabling students and employees to schedule their meals in advance and avoid long waiting times.

Payments are made easy and secure with multiple options, including UPI, debit or credit cards, net banking, and digital wallets. The system ensures that all transactions are encrypted, protecting users from any security threats. As soon as a payment is completed, users receive an instant confirmation via email and in-app notifications, keeping them informed about their order status.

Canteen owners benefit from an efficient order management system through their dedicated dashboard. They can view incoming orders in real time, update order statuses, and track inventory. If stock levels are running low, the system sends automatic alerts, helping canteen owners restock supplies in time. Menu items, descriptions, and prices can also be updated dynamically, ensuring that users always see the most accurate information.

To make the pickup process smoother, Campus Bites integrates QR code technology. Each order generates a unique QR code, which customers can scan to receive real-time updates on their order. Canteen staff can also scan the code to mark orders as completed, reducing errors and speeding up service.

The entire system is monitored and maintained by administrators, who oversee user accounts, configure system settings, and ensure smooth operation. Regular updates and security audits keep the platform reliable, scalable, and safe for all users.

With its user-friendly interface, secure payment system, and efficient order management features, Campus Bites transforms the way campus food services operate. It reduces waiting times, minimizes food shortages, and creates a smooth, cashless experience for students, employees, and canteen owners. Whether you are ordering your daily meal or managing a busy canteen, Campus Bites ensures that everything runs effortlessly.

IV. WORK FLOW

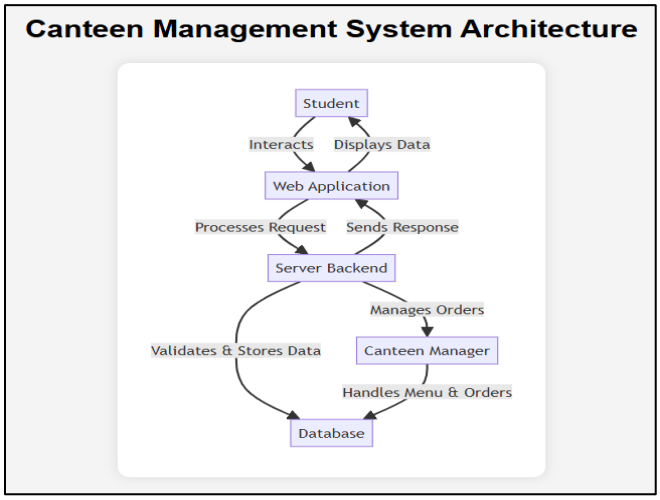

Fig:1 System Architecture

The **Canteen Management System Architecture** is designed to streamline the interaction between students and the canteen, ensuring a smooth and efficient ordering process. This architecture integrates multiple components that work together to manage user requests, process orders, and maintain data accuracy.

1. User Interaction (Student & Web Application):

The process begins with the **student**, who interacts with the **web application** to browse the menu, place orders, and receive real-time updates. The web application serves as the **front-end interface**, displaying available food options, order statuses, and personalized recommendations. It ensures an intuitive user experience by handling user inputs and sending requests to the backend.

2. Request Processing (Web Application & Server Backend):

Once a student submits an order, the **web application** forwards the request to the **server backend**. The server backend plays a crucial role in processing these requests by verifying order details, checking item availability, and determining estimated preparation times. It also handles user authentication, ensuring that only registered students can access the ordering system.

3. Order Management (Server Backend & Canteen Manager);

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ISSN: 0970-2555
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After processing the request, the **server backend** communicates with the **canteen manager**, who is responsible for managing orders. The canteen manager ensures that incoming orders are prepared efficiently, menu items are updated based on availability, and real-time order tracking is available. This step is crucial for maintaining a well-organized kitchen workflow and preventing order delays.

4. Data Validation & Storage (Database):

To maintain system accuracy and efficiency, the **server backend** validates order details before storing them in the **database**. The database acts as a **centralized repository** that maintains records of:

Menu Items – Including item availability, prices, and nutritional details.

Order History – Tracking completed and pending orders for students.

Inventory Management – Updating stock levels based on demand and reducing food waste.

User Profiles – Storing student preferences, past orders, and payment details.

By regularly updating and retrieving data, the database ensures smooth operations, prevents duplicate orders, and optimizes food preparation strategies.

5. System Response & Continuous Interaction

Once the request has been successfully processed and stored, the system sends a **response back to the web application**, updating the student with order confirmation, estimated delivery time, and payment details. The system continuously interacts with students and canteen staff to provide updates on order status, manage feedback, and improve future recommendations.

Key Benefits of the Architecture:

Efficiency: Automates the ordering process, reducing manual work.**Accuracy**: Prevents errors in order processing and payment transactions.**Scalability**: Can be extended to support multiple campuses or corporate cafeterias**User Experience**: Provides a seamless interface for students with real-time updates.**Data-Driven Insights**: Helps in demand forecasting, reducing food wastage, and optimizing menu planning.

V. RESULTS AND DISCUSSION

The implementation of the **Campus Bites – Smart Canteen Management System** has resulted in significant improvements in efficiency, user convenience, and operational effectiveness. This section discusses the key outcomes and benefits observed during the testing and deployment phases.

1. Enhanced User Experience and Accessibility:

The structured **user registration and authentication** process ensures a smooth onboarding experience. By using **JWT (JSON Web Tokens)**, the system provides secure login and prevents unauthorized access. Role-based dashboards allow users to navigate efficiently:**Students & Employees** can easily browse menus, place orders, and track deliveries.**Canteen Owners** manage inventory, monitor orders, and update menus in real time.**Administrators** oversee system security and maintain smooth functionality.This streamlined approach minimizes confusion and enhances usability across all user groups.

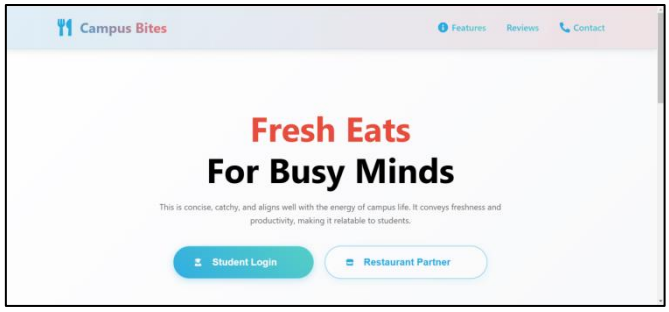

Fig:1 Home Page

2. Efficient Food Ordering and Management

The integration of a **real-time digital menu** provides an interactive browsing experience. Users can:Search for meals based on ingredients and categories.Customize orders based on dietary preferences.Place pre-orders to avoid peak-hour delays.The **cart management system** allows users to modify selections, check live pricing, and save favorite meals, making ordering a hassle-free process.

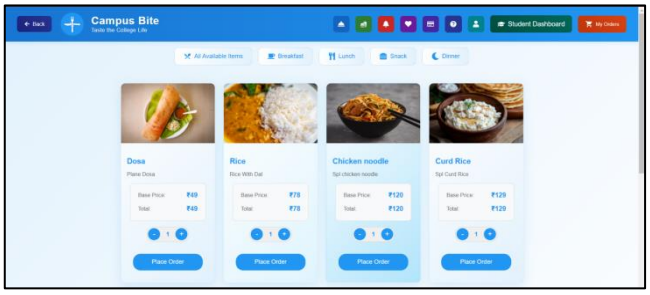

Fig:2 Student DashBoard

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 4, April : 2025

3. Secure and Seamless Payment Processing

The incorporation of multiple **payment methods**, including **UPI, debit/credit cards, net banking, and digital wallets**, enhances flexibility. The system ensures:**Encrypted transactions**, protecting financial information.**Instant order confirmation** via email and app notifications.**Real-time order tracking**, improving transparency.This feature significantly reduces delays caused by manual payment processing and improves transaction reliability.

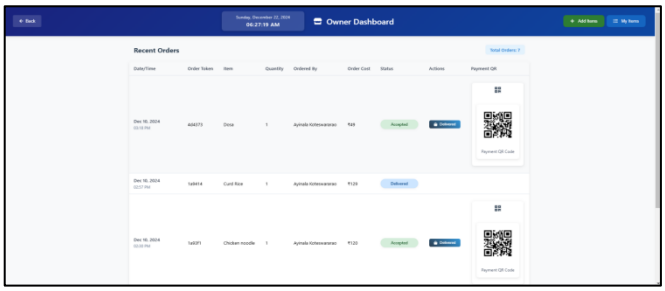

Fig:3 Owner DashBoard

4. Optimized Order Fulfillment Process

Canteen owners benefit from an efficient order management system that enables them to:Receive and process orders in real time.Update inventory status and receive low-stock alerts.Improve preparation efficiency and reduce food wastage.The ability to **track ingredient availability** ensures that customers are only shown dishes that can be prepared, avoiding last-minute cancellations.

5. Faster and Error-Free Order Pickup with QR Codes

The **QR-based order pickup system** has significantly reduced waiting times and improved accuracy. This system allows:**Students and employees** to scan and collect their orders quickly.**Canteen staff** to verify orders before handing them over.**Elimination of manual order verification**, reducing human errors.This **contactless pickup method** enhances operational speed and customer satisfaction.

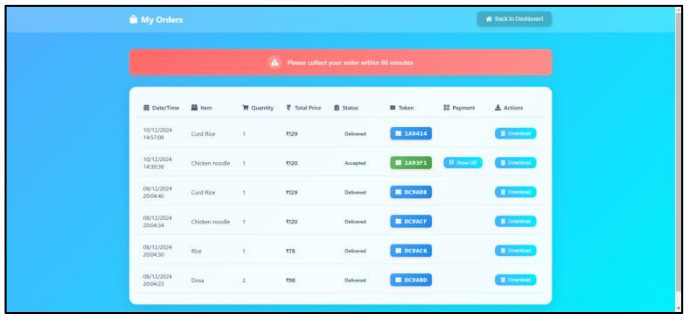

Fig:4 Student MyOrder List

6. Improved System Administration and Security

Administrators play a critical role in maintaining the efficiency of **Campus Bites** by:**Managing user roles and permissions**, preventing security breaches.**Monitoring system performance**, ensuring smooth operation.**Performing regular security audits and updates** to keep data protected.By automating these tasks, the system ensures **long-term scalability and reliability.**

7. Impact on Overall Efficiency

The introduction of **automated processes and real-time updates** has significantly reduced manual efforts, benefiting all stakeholders:**Students & Employees** experience faster and more efficient food ordering.**Canteen Owners** can better manage resources and minimize waste.**Administrators** have improved control over operations and security.

VI. FUTURE SCOPE

Campus Bites, as a modern web-based canteen management system, has immense potential for future growth and optimization. One key enhancement is the integration of AI-powered demand forecasting, which would improve inventory management by using machine learning to predict demand based on historical data, seasonal trends, and external factors like weather. This would enable dynamic menu adjustments, reducing food waste while ensuring availability of popular items. AI could also personalize recommendations based on user preferences, making ordering more efficient and enhancing customer satisfaction.

Expanding the system to support multiple campuses and corporate offices would increase its scalability. Implementing a multi-tenant architecture would allow centralized management of multiple locations while location-based services would enable users to access menus specific to their canteen. Additionally, centralized reporting and analytics would provide valuable insights across all sites, improving resource allocation and data-driven decision-making.

Enhancing mobile accessibility through native iOS and Android apps would further improve user experience. These apps could offer offline capabilities, push notifications for order updates, and leverage mobile-specific features like GPS for location-based services or biometric authentication for security. This would increase engagement, ensure accessibility even with limited internet connectivity, and provide a seamless ordering experience.

Another crucial addition is integrating dietary management and health tracking apps. Features like dietary filters, nutritional information display, and integration with apps like Fitbit or Apple Health would help users make informed food choices based on their health goals or dietary restrictions.

This would promote healthier eating habits and improve user satisfaction, particularly for individuals with specific dietary needs.

Implementing a loyalty program and rewards system could further enhance user engagement. A points-based system with tiered memberships and personalized offers would encourage frequent use of the platform. This would not only foster customer loyalty but also drive higher order frequency and retention.

Expanding payment options, including campus card integration and mobile payments, would streamline transactions and improve convenience. Allowing users to pay via campus ID cards, Apple Pay, Google Pay, or even cryptocurrency would enhance accessibility and reduce cash dependency.

Lastly, introducing a feedback and review system would enable users to rate food items and share suggestions, helping canteens improve their offerings. Analyzing user feedback would ensure continuous enhancement of the dining experience. By adopting these future upgrades, Campus Bites can evolve into a highly efficient, user-friendly, and data-driven canteen management platform, benefiting both users and administrators while promoting sustainability and healthy eating habits

VII. CONCLUSION

Campus Bites revolutionizes canteen management by offering an efficient, user-friendly, and sustainable solution. Built using the MERN stack, it enhances user experience through a seamless interface, secure authentication, and real-time order tracking. Canteen owners benefit from inventory management, automated order processing, and data-driven analytics.Key benefits include improved efficiency, reduced food wastage, and a sustainable, paperless system. Future enhancements like AI-driven demand forecasting and mobile app integration will further optimize operations. Overall, Campus Bites is a smart, scalable solution that modernizes dining experiences while promoting sustainability.

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