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MealMap: Hostel Food Management

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Abstract: Effective food management plays a vital role in maintaining student satisfaction and promoting sustainability in hostel environments. However, many hostels still depend on manual processes such as paper records and spreadsheets, which lead to inefficiencies, food wastage, and poor coordination among stakeholders. MealMap is a digital hostel food management system designed to automate and streamline operations through a unified role-based platform that connects administrators, kitchen staff, and students. The system integrates meal planning, inventory monitoring, and structured feedback mechanisms to enable real-time tracking, automated scheduling, and data-driven decision making. By digitizing hostel food operations, MealMap reduces manual workload, minimizes waste, and enhances transparency and communication among stakeholders. This study presents the design and implementation of MealMap, emphasizing its role in improving efficiency, sustainability, and user satisfaction in hostel food management.

Keywords: Food Management System, Hostel Automation, Meal Planning, Inventory Management, Feedback System.

I. INTRODUCTION

Efficient food management in hostels is not just about serving meals on time - it directly affects student satisfaction, influences operational expenses, and reflects how sustainably a campus is run. Even though digital tools are simplifying administration in many sectors, hostel food services in most institutions still function through manual processes. Meal plans and stock details are usually written down or managed through basic spreadsheets, which may work at first but quickly become difficult to maintain.

When changes in student attendance or ingredient availability occur, these manual methods often struggle to keep up. As a result, kitchens may prepare more food than needed, run out of essentials unexpectedly, or lack proper communication between staff and students. These issues gradually lead to unnecessary waste and leave students with fewer opportunities to share feedback and improve the dining experience.

MealMap was developed as an effort to solve these challenges with a simple digital system. Instead of scattered paperwork and separate communication channels, the platform brings administrators, kitchen staff, and students together in a single space. Everyone has their own access level, making the platform organized and secure.

Within this system, meal schedules can be planned clearly, inventory can be monitored in real time, and student feedback is collected in a structured way. This not only improves communication but also makes every part of the process more transparent and accountable. Previous studies highlight that moving from manual systems to digital ones can drastically reduce waste, streamline work, and make services more responsive to users.

Taking inspiration from these findings, MealMap focuses on turning the traditional hostel mess into a smarter, more adaptive environment. By blending automation with meaningful student involvement, it encourages informed decisions and builds a culture of responsible food management in hostels.

The key objectives of MealMap are:

1. To develop a digital platform for managing hostel food services efficiently.
2. To implement real time inventory tracking and automated meal planning to reduce food wastage.
3. To integrate a structured feedback system that enables students to share meal preferences and quality assessments.
4. To analyse system performance and ensure scalability for various hostel sizes and meal demands.

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II. LITERATURE SURVEY

K. Acharya, "Hostel Management System" Research Proposal, DOI:10.13140/RG.2.2.28935.82081, Jan. 2022.

Overview: This study introduced one of the early attempts to digitize hostel administration by automating daily processes such as student registration and meal record maintenance. The system helped minimize manual paperwork and improved operational accuracy. However, it lacked real time data handling and automation features for food service management, leaving room for further development in areas like meal planning and inventory control. [1]

M. A. Diyaolu, O. B. Abodunrin, A. A. Adedamola, R. S Ogunode, and O. Omoloba, "Development of an E-Based Hostel Management System," International Journal of Innovative Science and Research Technology (IJISRT), vol. 9, no. 6, pp. 1-6, Jun. 2024.

Overview: The authors developed a web-based system that automated several hostel management functions, including room allocation, data entry, and record maintenance. Their research showed that using online platforms can reduce errors and improve data accessibility. However, the system's focus was primarily on administrative management and did not extend to mess operations or mechanisms for monitoring food consumption and wastage.[2]

S. Bhaktavatsala, D. R. Chinthana, H. S., and S. Channad, "Hostel Mess Food Management System," International Re-search Journal of Modernization in Engineering, Technology and Science (IRJMETS), vol. 7, no. 2, Feb. 2025.

Overview: This research introduced an automated hostel mess management platform that integrated meal scheduling, inventory tracking, and staff coordination. The system demonstrated how digital automation could enhance efficiency and transparency in hostel food operations. Despite its promising results, the model was tested on a smaller scale and lacked features like predictive analysis or student feedback integration for continuous improvement.[3]

R. Sharma and A. Wadhwa, "Design and Implementation of a Web-Based Canteen Management System Using PHP and MySQL," International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), vol. 12, no. 3, Mar. 2023.

Overview: This paper presents the design and development of a web-based canteen management system built with PHP and MySQL. The system automates key processes such as menu planning, order placement, billing, and inventory management to enhance efficiency in canteen operations. The study highlights how automation reduces manual workload, minimizes human error, and improves coordination between kitchen staff and customers. Although the system effectively streamlines food service management, it focuses primarily on canteen operations and does not include advanced features such as real-time feedback integration or predictive inventory control. [4]

R. B. Gurav, B. Hingane, V. Poojari, F. Tamboli and A. Bhongane, "A Web Platform for Mess Management System: An Overview," International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), Apr. 2021.

Overview: This overview presents a centralized web portal for mess management where students view menus, apply for leaves, and staff manage inventory and meal records. The authors stress the benefits of centralization but also point out limited analytics and partial automation. MealMap builds on this by adding real-time analytics, more complete inventory automation, and a structured feedback loop.[5]

III. PROPOSED ALGORITHM

The proposed MealMap algorithm introduces a smarter approach to managing hostel food operations. It integrates meal attendance tracking, inventory management, and feedback-driven improvement within a single digital platform. By enabling real time coordination among students, kitchen staff, and administrators, the system helps reduce food wastage, optimize ingredient usage, and enhance meal quality through continuous feedback. Overall, MealMap focuses on improving operational efficiency, supporting sustainability, and increasing student satisfaction through better communication and informed decision making.

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A. Meal Attendance and Demand Prediction

Meal attendance tracking forms the first and most important function of the system. Each registered student uses the MealMap mobile application to mark whether they will be present for a specific meal, such as breakfast, lunch, or dinner. This attendance input is sent to a central server, where the system collects and compiles all responses to determine the exact number of meals required at a given time *t*.

The resulting meal demand can be expressed mathematically as:

$$M_t = \sum_{i=1}^{n} a_i \qquad (1)$$

where M_t denotes the total meal requirement at time t, and a_i represents the attendance status of the 'i'th student (1 for present, 0 for absent).

All the aggregated information is stored in a cloud-based backend, allowing real time updates across all connected modules. The calculated meal count is passed to the inventory management system, helping the kitchen staff prepare meals based on actual demand. This approach minimizes both overproduction and underproduction, ensuring better utilization of available resources.

B. Inventory Optimization

Once the meal demand is established, the inventory optimization module automatically updates the stock levels of all ingredients. The system keeps a detailed record of each ingredient, including its quantity, consumption rate, and minimum threshold levels required for meal preparation. Using this information, the inventory level for the next time step (t+1) is calculated as:

$$I_{t+1} = I_t - (M_t \times C_m) \qquad (2)$$

where I_t represents the current inventory level, and C_m denotes the average consumption per meal for each ingredient.

This approach enables the system to automatically adjust stock levels according to both actual and predicted demand. Whenever the quantity of an ingredient drops below a predefined threshold, a low stock alert is triggered and sent to the management team. This early warning system allows timely procurement, helping to avoid shortages or overstocking. Additionally, the automatic synchronization of consumption data improves accuracy and transparency in tracking resources, ensuring that food supplies remain well balanced throughout multiple meal cycles.

C. Feedback-Based Meal Evaluation

After each meal, students submit structured feedback through the MealMap app. This feedback covers aspects such as taste, quality, hygiene, and portion size, enabling the system to quantitatively evaluate overall meal satisfaction. The collected responses are then analysed to calculate a Meal Satisfaction Score (MSS) as follows:

$$MSS = \frac{\sum_{i=1}^{n} r_i}{n} \qquad (3)$$

where r_i represents the rating given by the 'i'th student, and n is the total number of feedback responses received.

The algorithm continuously monitors MSS values over time to detect trends and changes in meal quality. A noticeable drop in the MSS signals decreased satisfaction, prompting management to review meal preparation methods or adjust the menu. This feedback driven loop supports data informed decision-making, helping to enhance the dining experience while keeping costs under control. Over the long term, analysing MSS trends can also guide predictive menu planning by identifying both popular and underperforming dishes.

D. Automated Decision Flow

The proposed algorithm operates through an integrated, closed loop workflow, maintaining seamless data flow across all system components. The overall process can be summarized as follows:

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1) Student Input: Students record their meal attendance through the mobile interface.

2) Meal Prediction: The algorithm aggregates attendance data to forecast total meal demand.

3) Inventory Update: Ingredient quantities are updated automatically according to predicted meal requirements.

4) Meal Preparation: Kitchen staff prepare meals based on the optimized ingredient list.

5) Feedback Collection: After each meal, students submit feedback and ratings.

6) Data Analysis: The system evaluates satisfaction metrics and recommends menu or process adjustments.

This sequence creates a self-regulating ecosystem in which inputs and feedback continuously refine the entire process. By automating key tasks, the system reduces reliance on manual operations, speeds up communication, and improves decision-making accuracy across all functional units.

E. Algorithm Efficiency

The strength of the proposed algorithm lies in its ability to integrate real time data with feedback collected from users. By combining attendance information with inventory management, MealMap ensures accuracy and scalability in day-to-day mess operations. Reducing manual effort not only lowers operational load but also supports smooth and timely coordination across the system.

In addition, the feedback module helps guide menu planning based on student preferences and seasonal availability of ingredients. With all essential functions operating through a single digital platform, MealMap lowers food wastage while offering complete traceability of resources. Overall, the MealMap algorithm promotes sustainable hostel management by improving communication, enhancing resource utilization, and ensuring better meal quality through continuous user participation.

IV. DATASETS

The MealMap system is designed to bring intelligence and efficiency to hostel food management, and the core of this system lies in its data. Every interaction, whether a student marks attendance or submits feedback, contributes to a growing dataset that supports insights and smooth daily operations. Data is collected from both the student mobile application and the admin web portal, forming a complete record of dining patterns and resource usage.

A. Student Information

Details such as Name, USN, Email, Phone Number, and Password are recorded when a student registers on the platform. This information allows secure login and enables the system to track individual activity, and maintain user-specific history. By identifying each user, MealMap can request feedback, and provide a more personalized experience.

B. Meal Attendance Records

Students select whether they will attend breakfast, lunch, or dinner each day and may also mention reasons if they plan to skip a meal. This data provides the kitchen with essential information on the number of meals that need to be prepared, helping prevent overproduction or underproduction. Over time, attendance records reveal useful patterns such as peak meal timings or days with lower participation, allowing better planning and helping minimize food wastage.

C. Menu and Feedback Data

Students can view the daily menu and rate dishes on a scale of 0 to 5, with an option to add comments. This feedback directly reflects student preferences and satisfaction, helping the kitchen understand which dishes are appreciated and which require improvement. Continuous feedback allows the menu to evolve based on actual tastes instead of assumptions, resulting in a more engaging and satisfying dining experience.

D. Lost and Found Records

The mobile app also allows students to report items they have lost or found within the hostel premises. Recording these items along with descriptions, dates, and status helps hostel staff manage lost property efficiently and return belongings to their owners, creating a safer and more organized living environment.

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E. Inventory Management Data

The management portal maintains detailed records of kitchen stock, including item name, purchase date, quantity, price, and expiry date. By tracking every ingredient, the system helps staff know what is available, what needs restocking, and what may go unused. Low-stock alerts prevent shortages, while better monitoring avoids over-purchasing, saving both money and resources.

F. Event Order Data

College events often require catering, and MealMap records every order placed through the management portal including event name, number of participants, meal type, and special instructions. This ensures large-scale meals are prepared efficiently, resources are allocated properly, and both students and staff experience smooth service during busy occasions.

G. System Metadata

Beyond direct student and staff data, MealMap also tracks interactions such as logins, meal selections, feedback submissions, and portal usage. This metadata helps administrators understand how the system is being used, identify potential bottlenecks, and improve overall performance, ensuring that the platform remains smooth, responsive, and reliable.

H. Scope and Scale of the Dataset

1) The system serves approximately 1500 students, tracking attendance for three meals daily.
2) Feedback data accumulates thousands of ratings and comments for every meal served.
3) Inventory data covers around 200 unique ingredients, updated in real time.
4) Event order data ensures that all special catering needs are accurately captured.
5) System metadata monitors all interactions, providing a complete view of system usage and engagement.

V. METHODOLOGY

The proposed system, called MealMap, is a digital hostel food management platform that connects students, administrators, and kitchen staff through a unified online interface. The system is designed using a structured methodology that integrates a user-friendly frontend, robust server-side logic, and a secure database layer to ensure smooth data flow and efficient handling of daily food management tasks. The architecture follows a client server model, combining a React-based frontend, a Slim Framework API, and a MySQL database to enable effective communication across all modules. The overall development approach emphasizes modular design, scalability, and the use of data driven insights to support better decision making and continuous improvement of the system.

A. Backend

The backend of MealMap functions as the core engine that handles business logic, API routing, authentication, and database interactions. It is built using the Slim Framework, a lightweight PHP microframework known for its simplicity and efficiency in developing RESTful APIs. This framework enables fast request handling and smooth communication between the frontend and the database, ensuring reliable performance even when many users access the system simultaneously.

1. API Implementation**:** Each functional module of the system such as student attendance, menu updates, feedback collection, inventory management, and lost and found tracking is developed as an independent API endpoint. These endpoints are managed by the Slim Framework, which processes incoming requests and interacts with the database through structured queries. This modular design ensures clear separation between components, improving maintainability, scalability, and debugging efficiency.

2. Database Design: The system uses MySQL as its database to store structured information across multiple relational tables including Students, Menu, Attendance, Feedback, Inventory, and Lost and Found. The database is designed with proper indexing and normalization to maintain data consistency and enable fast retrieval even when many users access the system simultaneously.

3. Data Synchronization: All updates made through the student and management interfaces are synchronized in real time to maintain accuracy across the system. The backend processes each request, validates it, and returns responses in JSON format to the respective client interface. This real time communication ensures smooth interaction between users and the system, improving reliability and overall user experience.

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4. Security and Authentication: Authentication tokens are generated for each user session to provide secure and controlled access. Every API endpoint is protected through token-based validation, ensuring that only authorized users can access or modify data. Input sanitization techniques are applied to prevent SQL injection and other security threats, keeping system operations safe and dependable.

5. Performance Optimization: The backend uses caching and optimized query execution to reduce response time and enhance system performance. The modular code structure supports scalability, allowing new features or additional hostels to be integrated with minimum changes to the existing framework.

6. Automation Logic: Student attendance is directly linked to inventory records so the kitchen staff knows how many meals to prepare each day, preventing shortages and reducing unnecessary food preparation. Feedback submitted by students is collected and analyzed to understand preferences and improve meal quality over time. This approach helps minimize wastage while ensuring that the dining experience continues to improve.

B. Frontend

The frontend layer is what users interact with every day, giving students and hostel staff a simple, intuitive, and visually engaging experience. It is built using React, which makes the system fast and responsive, updating information instantly as changes occur in the background. Its modular design keeps the interface consistent and smooth, whether students are marking attendance or staff members are managing daily operations.

Student Mobile Interface:

The student module provides a secure and easy way for students to interact with the platform. They can log in, view the daily menu, mark attendance or specify if they will miss a meal, share feedback on food quality, and even report or check lost and found items. Every action taken by the student is immediately updated in the system through the backend, keeping data accurate and up to date in real time.

Management Web Portal:

The administrative dashboard offers hostel staff a convenient web-based panel to manage all daily tasks from one place. Staff can update menus, track stock levels, review attendance, and view student feedback easily. The dashboard also displays patterns in student food preferences, helping management plan better menus and reduce unnecessary food wastage.

User Experience (UX) and Design:

Both the student and staff interfaces are designed to be clean, simple, and easy to navigate. Developed using React components, the UI adapts seamlessly to both mobile and desktop screens, ensuring accessibility from any device. This responsive design ensures a smooth user experience whether a student is checking the menu on their phone or a staff member is managing operations on a computer.

Real Time Updates:

Whenever changes are made in the backend, such as menu modifications or attendance entries, they reflect instantly on both user interfaces. The system uses real time API calls to sync data, ensuring that everyone always sees the latest information without delays and keeping operations efficient and well-coordinated.

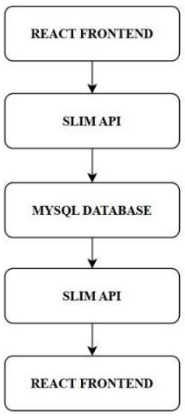

Fig 1. Data Flow

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VI. RESULTS

The MealMap system was developed and implemented for approximately 1,500 to 2,000 students, providing a reliable solution for managing food services in hostels. Its main objective is to digitalize meal planning, inventory tracking, and feedback collection. This improves coordination between students and staff, helps reduce food wastage, and enhances overall satisfaction.

The student mobile application allows users to view the daily menu, report absences with reasons, and submit feedback regarding food quality and taste. Students can also report lost items or check for items found within the hostel, improving communication and making daily hostel activities more convenient.

The web application for staff and management simplifies daily menu updates, inventory management, and attendance tracking. It helps identify students who are not taking meals and enables staff to review feedback to make necessary improvements. This has streamlined operations, improved resource utilization, and helped staff meet student needs more effectively.

ADMIN PORTAL

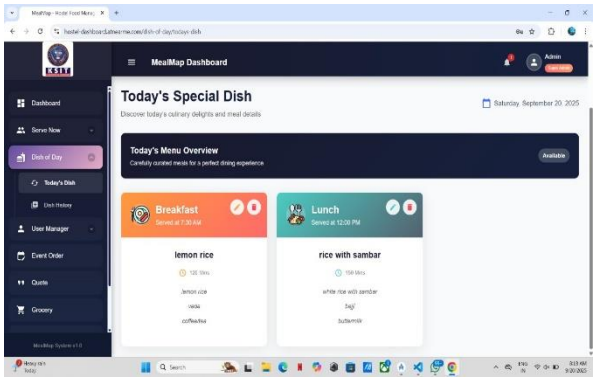

Fig 2. Daily Menu Update

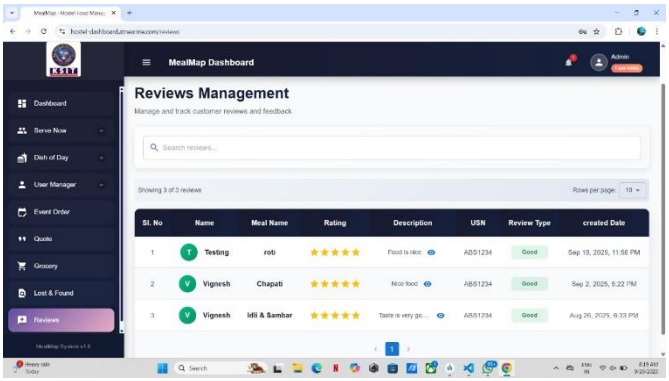

Fig 3. Rewiew Management

STUDENT PORTAL

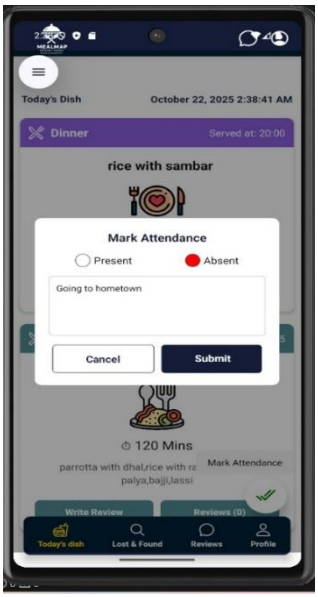

Fig 4. Student's Attendance Mark

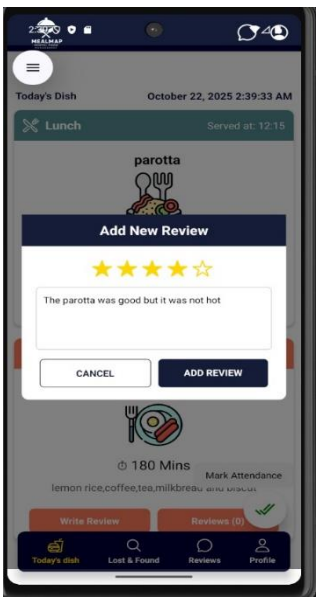

Fig 5. Student's Review

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VII. CONCLUSION AND FUTURE WORK

MealMap was created to solve ongoing challenges in hostel food management by digitizing key processes such as meal planning, inventory tracking, and feedback collection. Many hostels still follow traditional management methods that depend heavily on manual coordination. This often leads to food wastage, irregular stock levels, and the absence of a structured feedback system, making it difficult for kitchen staff to plan meals efficiently or adapt to changing student preferences.

To address these issues, MealMap provides a platform that improves communication between kitchen staff, administrators, and students. One of the core features is the feedback module, which allows students to share meal preferences, give ratings, and suggest improvements directly within the system. This collection of feedback supports continuous monitoring of food quality and helps management make informed decisions regarding menu changes or portion adjustments, ultimately increasing student satisfaction.

The system promotes transparency and accountability through role-based access. Students can view menus and submit feedback, while staff can manage meal schedules, monitor inventory, and plan menus. This organized workflow reduces miscommunication, prevents delays, and ensures smooth daily operations. In summary, MealMap makes hostel food management more efficient by combining meal scheduling, smart inventory control, and structured feedback collection into one platform. Through digital tools, it reduces food waste, improves resource utilization, and creates a more student centered dining experience.

In future enhancements, MealMap could include an AI powered chatbot to strengthen communication between students and management. This chatbot would function as a virtual assistant, responding to common questions about meal schedules, menu updates, and feedback submissions. It could also handle requests such as meal skipping or suggestions for menu changes, making the system more interactive while reducing administrative workload. With the use of Natural Language Processing (NLP), the chatbot would provide quick and personalized responses, improving user experience and engagement.

A real time inventory management component could also be integrated to help kitchen staff monitor ingredient usage and receive alerts when items are running low. This would ensure timely restocking, prevent wastage, and avoid unnecessary purchases. Keeping accurate and updated stock information enhances resource efficiency, reduces operational costs, and supports better planning.

Additionally, incorporating blockchain technology into MealMap could strengthen transparency and accountability throughout the food handling process. Each step of the workflow including procurement, storage, meal preparation, and distribution could be recorded on a decentralized ledger. This tamper proof record ensures traceability of all transactions and inventory movements, reducing the chances of discrepancies or misuse. Blockchain integration would increase trust among stakeholders by ensuring data accuracy and creating a clear, reliable, and transparent hostel food management ecosystem.

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