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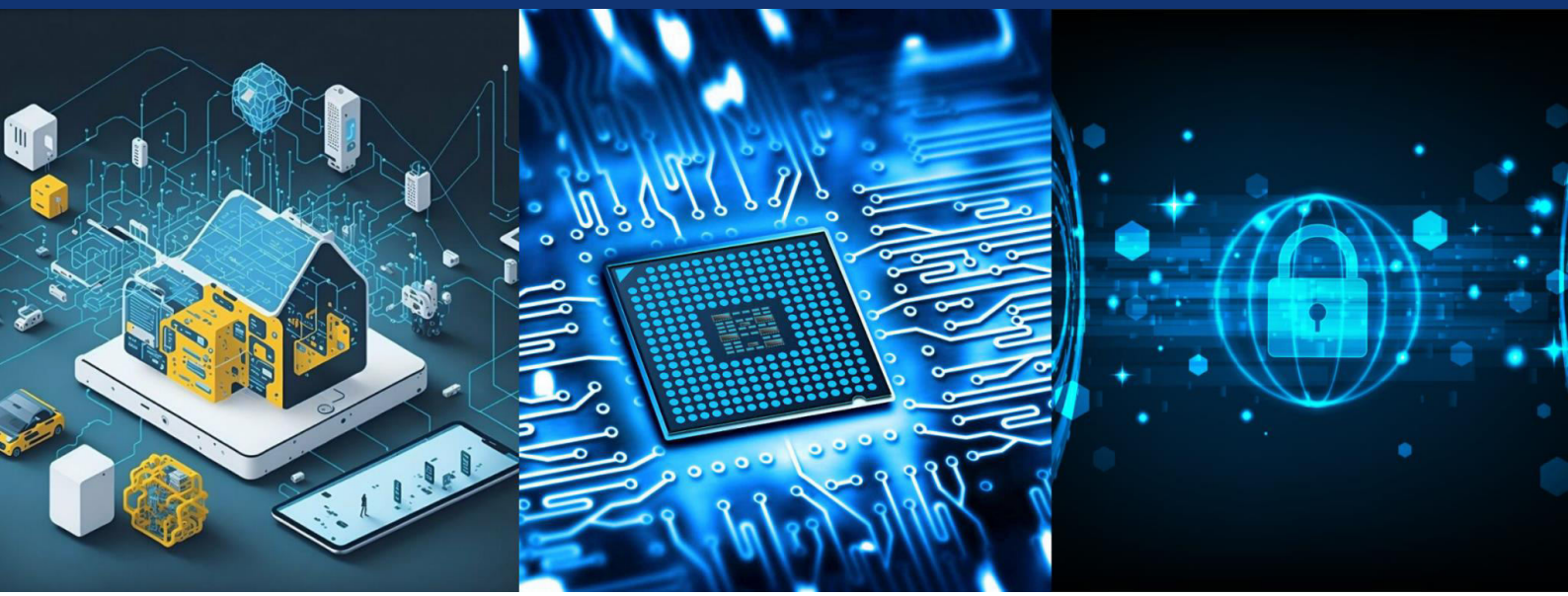

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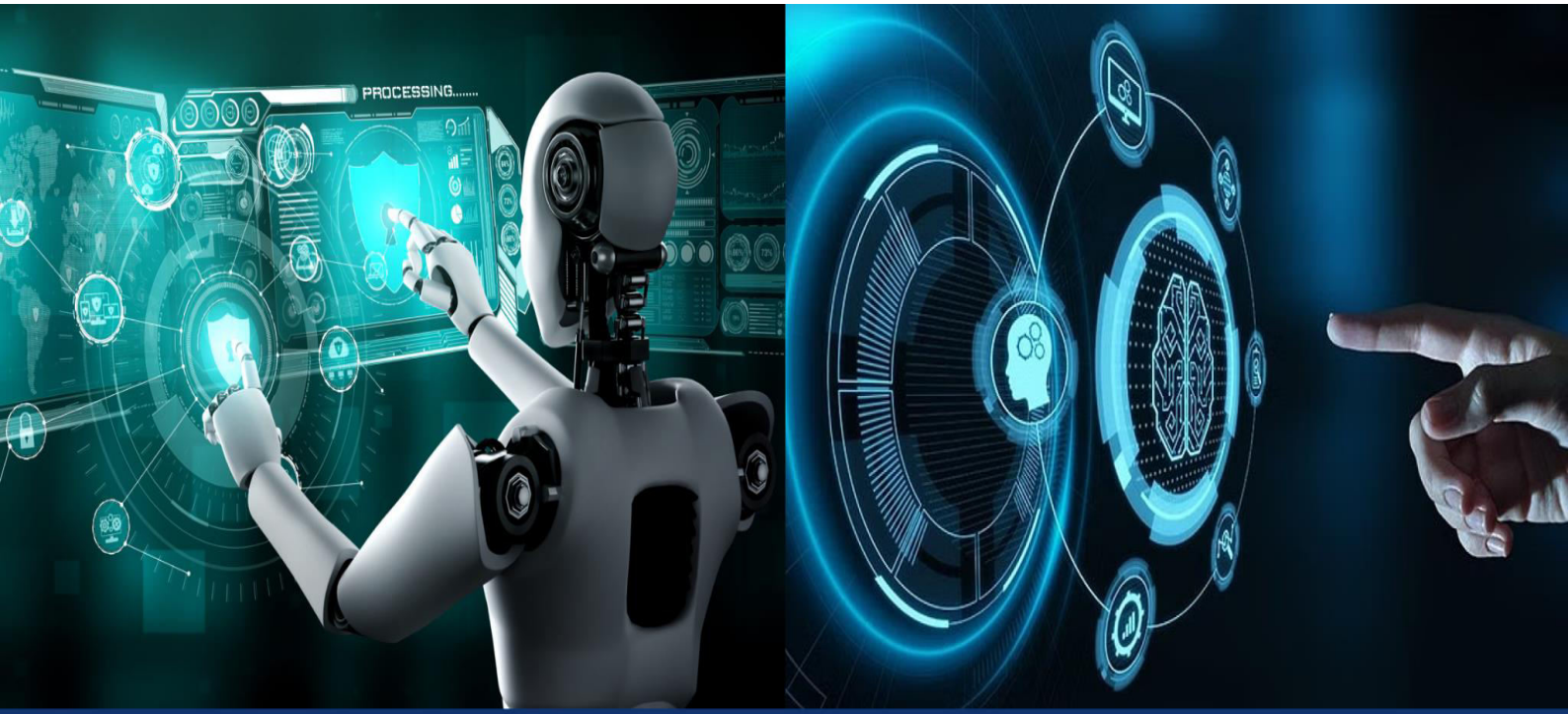

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Meal Spotter: A MERN Stack-Based Dual Interface System for Smart Management with AI Integration

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ABSTRACT: Food service management often suffers from inefficient menu distribution, manual subscription handling, and limited transparency between customers and service providers. Meal Spotter, an AI-powered web platform developed using Next.js, React, MongoDB, and NextAuth.js to modernize mess management through a dual-interface system for students and mess owners. The platform enables real-time menu publishing, digital subscription management, secure role-based authentication, and geolocation-based mess discovery. It incorporates a content-based recommendation engine that suggests suitable messes based on user preferences, budget, ratings, and proximity. Additionally, VADER sentiment analysis is employed to evaluate customer feedback and generate actionable insights for service improvement. The system architecture leverages the Next.js App Router, MongoDB with geospatial indexing, and analytics dashboards for data-driven decision-making. By integrating intelligent recommendations, sentiment analytics, and community-driven reviews, Meal Spotter enhances transparency, operational efficiency, user engagement, and overall service quality, providing a scalable and intelligent solution for modern food service management.

KEYWORDS: Next.js, Mess Management System, MongoDB, Artificial Intelligence, Personalized Recommendation System, Sentiment Analysis, VADER, Subscription Management, NextAuth.js, Food Service Management, Geolocation Services, Web Application, Real-Time Analytics.

I. INTRODUCTION

Food service management plays a crucial role in ensuring the efficient delivery of meals and maintaining customer satisfaction. However, many mess and food service providers still rely on traditional methods for menu distribution, subscription management, and customer communication. These manual processes often lead to inefficiencies, lack of transparency, poor customer engagement, and difficulties in managing operational data effectively[8][9].

With the rapid growth of digital technologies and intelligent web applications, there is an increasing demand for platforms that can streamline food service operations while providing a better user experience. Existing food delivery platforms primarily focus on on-demand ordering and often lack features such as subscription-based meal management, personalized recommendations, customer sentiment analysis, and location-aware service discovery[1][2]. As a result, service providers face challenges in understanding customer preferences, while users struggle to identify suitable meal services based on their requirements. To address these challenges, this paper presents Meal Spotter, an AI-powered web platform designed to modernize mess and food service management through a dual-interface system for customers and service providers. The platform enables real-time menu publishing, digital subscription management, secure role-based authentication, geolocation-based service discovery, and customer feedback analysis. A content-based recommendation engine suggests suitable meal services based on user preferences, budget, ratings, and proximity, while VADER sentiment analysis evaluates customer reviews to generate actionable insights for service improvement[3][4].

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Built using Next.js, React, MongoDB, and NextAuth.js, the system leverages modern web technologies to deliver a scalable, secure, and data-driven solution[10][11]. By integrating intelligent recommendations, sentiment analytics, and community-driven reviews, Meal Spotter enhances operational efficiency, transparency, and user engagement, contributing to the digital transformation of modern food service management.

II. PROBLEM STATEMENT

Traditional food service management is often challenged by inefficient menu distribution, manual subscription processes, and limited communication between customers and service providers. Students, working professionals, and individuals who are new to a city or unfamiliar with a location frequently face difficulties in finding reliable mess services, comparing meal plans, accessing accurate pricing information, and evaluating service quality[8][9]. At the same time, mess owners lack effective digital tools for managing subscriptions, collecting customer feedback, and understanding user preferences. Existing food delivery platforms primarily focus on on-demand food ordering and do not adequately address the unique requirements of mess management, such as subscription-based meal plans, fixed menus, long-term customer engagement, and location-specific service discovery. The absence of a centralized platform results in reduced transparency, inefficient decision-making, and limited opportunities for service improvement. Therefore, there is a need for an intelligent and technology-driven solution that enables real-time menu management, digital subscription handling, personalized recommendations, sentiment-based feedback analysis, and geolocation-based mess discovery. Such a system can improve operational efficiency, enhance user experience, and create a transparent, scalable, and data-driven food service ecosystem.

III. OBJECTIVES OF THE SYSTEM

The primary objective of Meal Spotter is to develop an intelligent and user-friendly platform that simplifies food service management while improving accessibility, transparency, and user engagement. The specific objectives are:

- To provide a centralized digital platform for discovering and managing mess services.
- To enable real-time menu publishing and efficient subscription management for mess owners.
- To help users find suitable messes based on location, budget, ratings, and personal preferences.
- To implement secure role-based authentication and access control for students, mess owners, and administrators.
- To provide AI-powered personalized recommendations for improved user experience.
- To analyze customer feedback using VADER sentiment analysis and generate actionable insights.
- To enhance communication and transparency between users and service providers through reviews and ratings.
- To support data-driven decision-making using analytics dashboards and performance reports.

IV. LITERATURE REVIEW

The development of intelligent recommendation systems and web-based management platforms has been extensively studied across various domains. This section reviews relevant literature on recommendation algorithms, sentiment analysis, web application architectures, and food service management systems.

MERN-Based Canteen Management System: IoT Integration for RFID Payment and Table Reservation: Jay Gosalia, Jash Gosalia, Shila Dhande, and Amrita Naiksatam (2024) proposed a MERN-based canteen management system integrated with IoT and RFID technology[5]. The system provides online food ordering, RFID-based cashless payments, table reservation facilities, calorie-limit monitoring, and administrative management features. The integration of ESP32 microcontrollers and RFID readers enables automated payment processing and reservation check-ins, reducing waiting time and improving operational efficiency. The platform also offers separate interfaces for users and administrators to manage canteen activities effectively. However, the requirement for RFID hardware and IoT infrastructure increases deployment cost and maintenance complexity.

Human-Behaviour-Based Personalized Meal Recommendation and Menu Planning Social System: Tanvir Islam, Anika Rahman Joyita, Md. Golam Rabiul Alam, Mohammad Mehedi Hassan, Md. Rafiul Hassan, and Raffaele Gravina (2023) proposed a human-behaviour-based personalized meal recommendation and menu planning system using Electroencephalography (EEG) signals[6]. The framework employs affective computing techniques to recognize users'

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emotional responses toward different food items. The system utilizes Short-Time Fourier Transform (STFT), Discrete Wavelet Transform (DWT), and Hilbert-Huang Transform (HHT) for feature extraction and applies hierarchical ensemble learning for affectivity prediction. Furthermore, TOPSIS is used for food recommendation, while the Bin Packing algorithm generates personalized menu plans based on emotional state, nutritional values, and calorie requirements. Although the system delivers highly personalized recommendations, its dependency on EEG hardware and complex signal-processing procedures limits scalability and real-world deployment.

A Food Recommender System Considering Nutritional Information and User Preferences: Raciel Yera, Ahmad A. Alzahrani, and Luis Martínez (2019) proposed a food recommender system that combines nutritional information with user preferences to generate personalized daily meal plans[7]. The framework incorporates AHPSort-based multicriteria decision analysis to filter appropriate food items and optimization techniques to create nutritionally balanced meal plans while maximising user satisfaction. The system effectively integrates nutrition-aware and preference-aware recommendation strategies and supports personalized dietary planning. However, the proposed approach primarily focuses on nutritional and preference data and does not include real-time user feedback analysis, sentiment analysis, location-aware discovery, subscription management, or advanced service analytics.

V. PROPOSED SYSTEM

Meal Spotter is an AI-powered web platform designed to modernize food service management by providing a centralized ecosystem for users, service providers, and administrators. The platform addresses challenges associated with traditional food service operations, including inefficient menu distribution, manual subscription handling, limited customer engagement, and the lack of data-driven decision-making[8][9]. Built using Next.js, MongoDB, and NextAuth.js, the system offers a scalable, secure, and intelligent solution that enhances transparency and operational efficiency[10][11][12].

- **System Architecture:**

The platform follows a three-tier architecture consisting of presentation, application, and data layers. The presentation layer provides responsive and user-friendly interfaces developed using modern web technologies[10]. The application layer handles business logic, authentication, recommendation processing, sentiment analysis, and communication between modules through RESTful APIs. The data layer utilizes MongoDB for secure and efficient storage of user profiles, service information, subscriptions, reviews, and analytics data[12]. Geospatial indexing is employed to support location-based service discovery. Key architectural components include a role-based authentication system, menu management module, subscription management engine, sentiment analysis module, recommendation engine, and analytics dashboard. These modules work together to provide a seamless user experience while supporting efficient service management.

- **Service Provider Interface**

The service provider interface enables efficient management of food service operations. Service providers can create and update profiles, publish daily menus, define subscription plans, manage customer subscriptions, and monitor customer feedback. The dashboard provides access to analytics such as subscription trends, customer engagement statistics, review summaries, and service performance indicators. These insights help service providers improve operational efficiency and make informed business decisions.

- **User Interface**

The user interface focuses on service discovery, subscription management, and personalized experiences. Users can browse available food services, view menus, compare subscription plans, manage active subscriptions, and submit ratings and reviews. Geolocation-based search functionality helps users identify nearby meal services, while the recommendation engine suggests suitable options based on user preferences, budget, ratings, and location[1][2]. The platform also promotes transparency through community-driven reviews and feedback.

- **Administrative Interface**

The administrative interface provides centralized control over the platform. Administrators can manage user accounts, monitor service providers, review platform activities, and oversee overall system operations. The dashboard also provides aggregated insights and system-level statistics that assist in maintaining platform reliability, security, and performance. By integrating intelligent recommendations, sentiment analysis[3][4], geolocation services, subscription management, and analytics within a unified platform, Meal Spotter delivers a comprehensive solution for modern food service management while enhancing user satisfaction and service quality.

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VI. IMPLEMENTATION DETAILS

Technology Stack

The proposed system is implemented using a modern full-stack technology stack that ensures scalability, security, and maintainability. The frontend is developed using Next.js and React, providing a responsive and interactive user interface for students, mess owners, and administrators[10][11]. TypeScript is utilized for type safety, while Tailwind CSS and Shadcn/UI components are used to create a consistent and user-friendly design.

The backend functionality is implemented through Next.js API routes, which handle business logic, authentication, data processing, and communication between system modules[10]. MongoDB serves as the primary database, with Mongoose ODM enabling schema definition, validation, and query optimization. Authentication and authorization are managed using NextAuth.js with JWT-based session handling and bcrypt password hashing. Additional services include VADER sentiment analysis for review classification, AWS S3 for image storage, Nodemailer for email notifications, and recharts for data visualization and analytics dashboards[13].

Database Schema Design

The data model consists of six Mongoose schemas optimised for relational queries and geospatial operations:

User Schema: Stores name, email, password (bcrypt-hashed), role (student/mess-owner/admin), and password reset tokens with expiration timestamps. Indexed on email for authentication queries[12].

Mess Schema: Contains ownerId reference to User, mess name, type, cuisine array, geolocation (GeoJSON Point with 2dsphere index), address, contact number, image URL, description, plans array (name, description, price, and duration), menu array (date and items), and itemsIndex array for search optimisation. The location field enables efficient proximity queries for mess discovery.

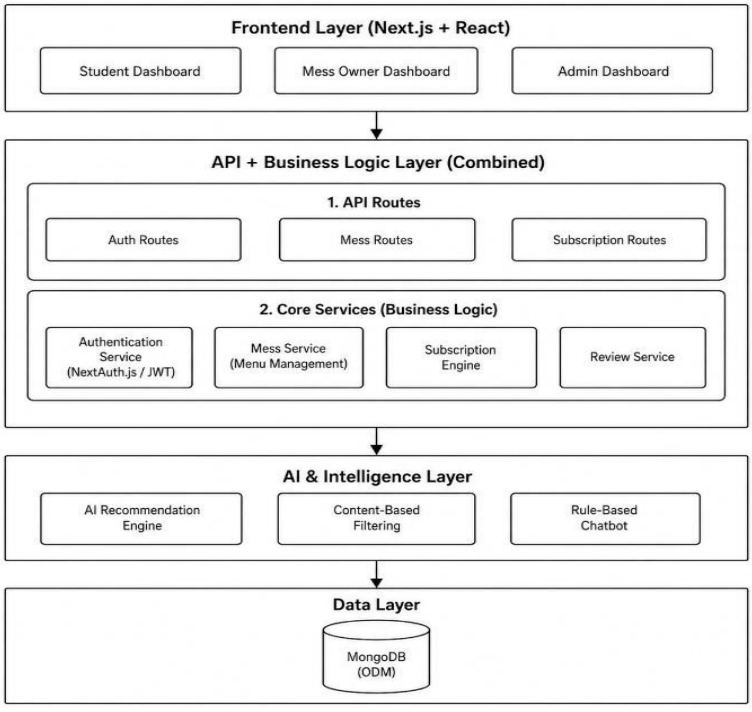

Fig. 1 **Subscription Schema:** References userId and messId; stores plan details (name, description, price, duration); start/end dates; and status (active/expired/cancelled/created). Indexed on userId and status for efficient subscription queries

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Review Schema: References userId and messId with a unique compound index to enforce a one-review-per-user-per-mess constraint. Contains rating (1-5), comment (max 500 chars), sentiment label (positive/neutral/negative), and sentiment score (VADER compound score -1 to 1).

API Architecture

The system implements RESTful API endpoints organised into functional modules: The platform follows a RESTful API architecture that facilitates communication between the frontend and backend components[10]. APIs are organized into functional modules including authentication, service management, subscription management, reviews, artificial intelligence services, administration, and utility services.

Authentication APIs manage registration, login, session validation, OTP verification, and password recovery operations. Service management APIs enable creation and maintenance of service profiles, menus, and related information. Subscription APIs handle plan purchases, renewals, status tracking, and user subscription history.

Review APIs allow users to submit ratings and feedback while automatically generating sentiment classifications. AI-related APIs provide recommendation services and intelligent assistance features. Administrative APIs support platform monitoring, user management, and approval workflows. Input validation, authorization checks, and error handling mechanisms are implemented across all endpoints to ensure system reliability and security.

Authentication and Security

Security is a critical component of the proposed system. Authentication is implemented using NextAuth.js with JWT-based session management, enabling secure access to platform resources. User passwords are encrypted using bcrypt hashing before storage, ensuring protection against unauthorized access. Role-based access control is enforced throughout the platform, allowing users to access only the features and resources associated with their assigned roles. Protected routes prevent unauthorized access to sensitive operations and administrative functions.

Additional security measures include OTP-based verification, password reset mechanisms using time-limited tokens, secure session handling, and validation of all user inputs. These measures collectively enhance data security, user privacy, and system integrity.

AI and Machine Learning Integration

The platform incorporates artificial intelligence features to improve user experience and support intelligent decision-making. A content-based recommendation engine analyzes user preferences, service ratings, location, and subscription history to generate personalized service recommendations[1][2].

The recommendation process evaluates multiple factors and ranks available services according to their relevance to individual users. This helps users discover suitable options efficiently and enhances overall engagement with the platform. The system also employs VADER sentiment analysis to evaluate textual reviews submitted by users. Reviews are classified into positive, neutral, or negative categories, and sentiment scores are stored for future analysis[3][4]. This enables service providers to understand customer satisfaction levels and identify areas requiring improvement.

Analytics and Visualisation

The platform provides analytical dashboards that transform operational data into meaningful insights. Analytics modules present information related to subscriptions, revenue, user engagement, ratings, and sentiment trends through interactive charts and visual reports.

Service providers can monitor customer activity, evaluate subscription performance, and track feedback trends over time. Administrators gain access to aggregated platform statistics that support monitoring and decision-making. Visualizations are generated using chart-based components that present data in an understandable and actionable format. The integration of analytics with recommendation and sentiment systems enables data-driven service improvement, helping both users and service providers make informed decisions while enhancing the overall efficiency of the platform[13].

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VII. RESULTS

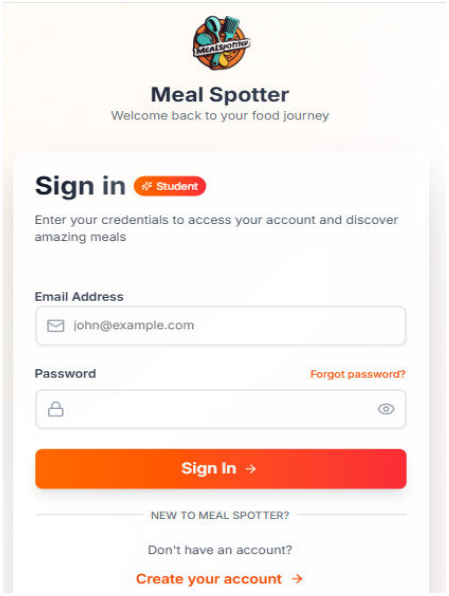

Fig. 2

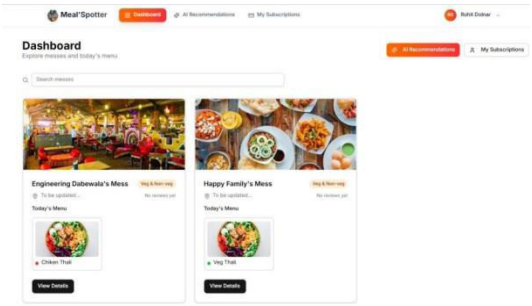

Fig. 3

Figure 2 illustrates the student login interface, which provides secure authentication and role-based access to the platform. The interface allows users to log in using their registered credentials and access personalized services.

Figure 3 presents the student dashboard, where users can browse available messes, search for meal services, and access AI-powered recommendations. The dashboard displays mess information, food categories, and daily menu highlights, enabling users to make informed decisions.

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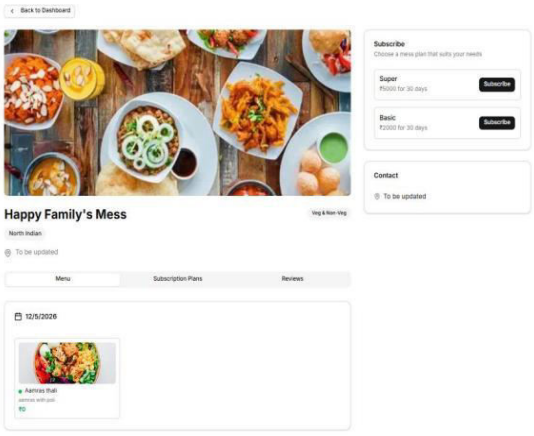

Fig. 4

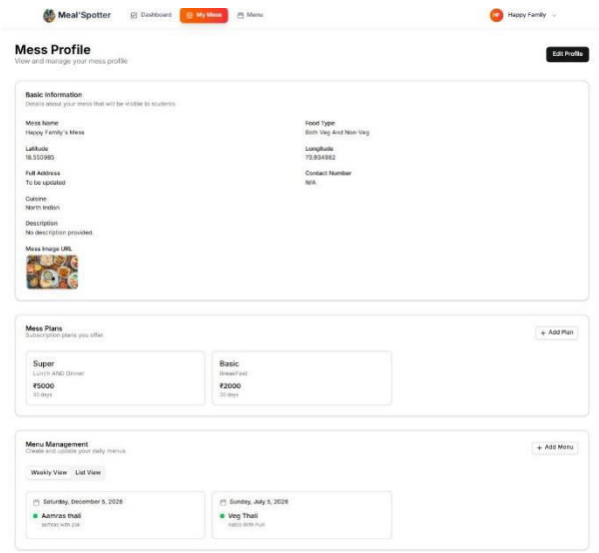

Fig. 5

Figure 4 shows the mess details page, which provides comprehensive information about a selected mess, including menu items, subscription plans, reviews, and contact details. Users can view available plans and subscribe directly through the platform, simplifying the subscription process.

Figure 5 demonstrates the mess owner dashboard, which enables service providers to manage mess profiles, create subscription plans, publish menus, and monitor operational activities. The dashboard centralizes service management and improves communication between providers and users.

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VIII. COMPARISON WITH EXISTING SYSTEMS

Table I presents a comparative analysis of Meal Spotter against existing mess management and food service platforms:

TABLE I: COMPARISON OF MEAL SPOTTER WITH EXISTING SYSTEMS

Feature	Existing Systems	Meal Spotter
Menu Publishing	Limited	Real-time with Images
Subscription Management	Manual/Basic	Automated with Payments
AI Recommendations	No	Yes
Sentiment Analysis	No	Yes (VADER)
Location-Based Discovery	Limited	Yes (Geolocation)
Analytics Dashboard	Basic	Comprehensive (Recharts)
Review System	Limited	Full with Sentiment
AI Chatbot	No	Yes
Payment Integration	No/Limited	Yes
Role-Based Access	Basic	Yes (NextAuth)

IX. FUTURE WORK

While Meal Spotter provides comprehensive functionality for campus mess management, several enhancements can expand its capabilities and improve user experience:

A. Advanced Machine Learning Integration

The current recommendation system uses content-based filtering with predefined parameters. Integrating collaborative filtering algorithms or deep learning models could analyse user behaviour patterns and historical data to generate more accurate personalised recommendations. Implementing K-Nearest Neighbours (KNN) or neural collaborative filtering would enable the system to learn from user interactions and improve recommendation quality over time. Additionally, reinforcement learning could optimise recommendation strategies based on user engagement metrics.

B. Mobile Application Development

Developing native mobile applications for Android and iOS platforms would improve accessibility and user engagement. Mobile apps could leverage device capabilities such as push notifications for subscription renewals, menu updates, and promotional offers. Location services integration would enable more precise message discovery based on real-time user position. Offline functionality could allow users to view saved menus and subscription details without network connectivity.

X. CONCLUSION

Meal Spotter successfully addresses the major challenges associated with traditional campus mess management by providing a centralised, intelligent, and user-friendly digital platform. The system streamlines menu management, subscription handling, mess discovery, and feedback collection while improving transparency and accessibility for students. Through the integration of modern web technologies, role-based access control, and real-time analytics, the platform enhances operational efficiency and simplifies the overall dining experience.

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Furthermore, the incorporation of AI-powered recommendations, sentiment analysis, and location-based services enables data-driven decision-making for both students and mess owners. Meal Spotter not only improves service quality and uses satisfaction but also establishes a scalable foundation for future enhancements such as predictive analytics, nutrition tracking, and mobile applications. The project demonstrates the potential of combining web technologies and artificial intelligence to create smarter and more efficient campus food service ecosystems.

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