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# AI-Integrated Personalized Diet Planning

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***Abstract*—This research presents the development and implementation of an AI-powered diet planning system capable of generating highly personalized and nutritionally optimized meal plans. The core system employs a content-based filtering algorithm to recommend meals based on detailed user profiles, including demographic data, fitness goals, dietary preferences, seasonal food availability, and user feedback. The platform integrates a dynamic back-end built with Node.js and Express.js and uses MongoDB for database operations. Python-based machine learning models process user data to deliver intelligent, context-aware recommendations. Unlike traditional diet planning applications, our system introduces unique features such as season-specific food suggestions and a continuous feedback loop to improve recommendation accuracy. The system architecture, algorithms used, and performance evaluations are discussed in depth.**

***Index Terms*—AI in Healthcare, Content-Based Filtering, Meal Recommendation System, Personalized Diet, Seasonal Nutrition**

## I. INTRODUCTION

Nutritional awareness and personalized healthcare have become essential in today's lifestyle, where users demand solutions that go beyond one-size-fits-all diet plans. Traditional systems offer general guidelines or static meal plans without considering the user's biological, behavioural, and contextual parameters. Our project aims to solve this issue by proposing an AI-Integrated Personalized Diet Planning system, which uses AI algorithms to suggest optimized diet plans.

The system takes a wide array of user inputs like age, gender, height, weight, dietary preferences, activity level, fitness goal (e.g., weight gain, weight loss), and allergies to create a user profile. Based on this profile, the system filters and scores meals from a curated food database using a machine learning model to provide daily meal recommendations. The application stands out by factoring in seasonal availability and nutritional richness of food, which has been proven to enhance digestion and improve immunity.

Our tech stack includes a RESTful API built using Node.js and Express.js, a NoSQL database (MongoDB) accessed via Mongoose, and AI models written in Python using Pandas, NumPy, and Scikit-learn. Feedback from users is collected and used to iteratively improve the recommendations using content-based filtering.

## II. OBJECTIVE

1. Develop a diet planning engine that generates customized meal plans based on user health parameters.
2. Implement content-based filtering to suggest meals aligned with personal preferences and dietary needs.
3. Integrate seasonal food awareness to improve nutritional value and cultural adaptability.
4. Create an interactive feedback loop using user ratings to refine suggestions.
5. Ensure the system is scalable and easy to enhance with new AI modules like collaborative filtering and chatbot support.

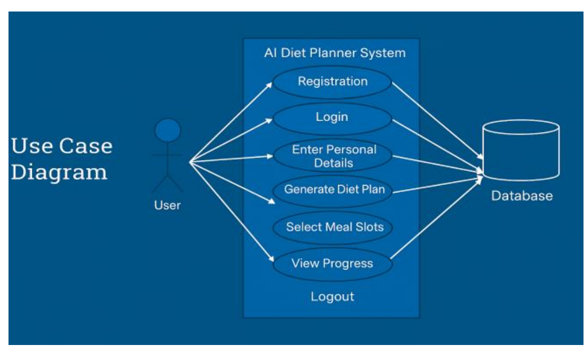


Fig. 1 – Use Case Diagram

## III. REVIEW OF LITERATURE

Our research draws inspiration from the following papers:

1. Optimized Diet Plans for Indian Adults Engaged in Regular Exercise – Explores how to personalize diet plans for Indian adults.
2. Optimizing Nutritional Outcomes: The Role of AI in Personalized Diet Planning – Focuses on the use of AI and ML in nutritional planning.
3. AI Nutrition Recommendation using a Deep Generative Model and ChatGPT – Uses GPT models for text-based diet guidance (our base paper).
4. AI-Based Web Application for Diet Planning and Recipe Generation – Discusses the development of web-based AI diet systems.

Popular apps reviewed include:

- *Eat This Much*: Allows macronutrient-focused meal customization and user-driven substitutions.
- *AskNestle.in*: Indian audience-targeted diet tool, offering static plans without seasonal adjustment.

Despite their utility, these platforms miss dynamic season-based planning and real-time nutritional adjustments during meal swapping.

Identified Gaps:

1. No consideration for seasonal foods.
2. Lack of smart grocery list integration.
3. No real-time macronutrient feedback when replacing food items.

Our system attempts to address these gaps while maintaining accessibility for college-level implementation.

## IV. METHODOLOGY

4.1 System Architecture Overview: The system consists of three core layers:

- Frontend (React.js web interface): Accepts user input and displays meal plans.
- Backend (Node.js + Express.js): Handles user sessions, API endpoints, and routes.
- AI Engine (Python ML): Generates recommendations and learns from feedback.

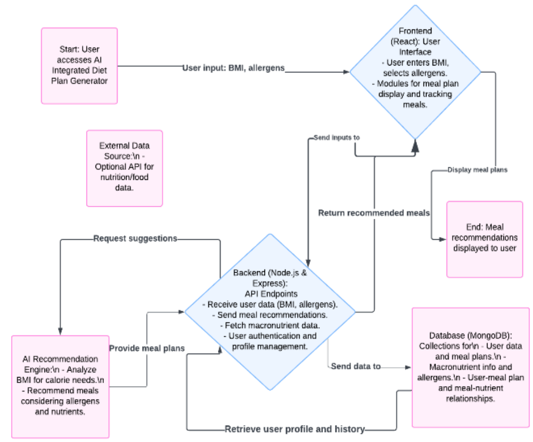


Fig. 2 – System Architecture

4.2 Data Flow and User Input Collection: Users fill out a questionnaire capturing:

- Age, gender, weight, height
- Activity level (sedentary, moderate, active)
- Medical conditions (e.g., diabetes, PCOS)
- Fitness goal (gain, lose, maintain weight)
- Dietary type (vegetarian, vegan, gluten-free)

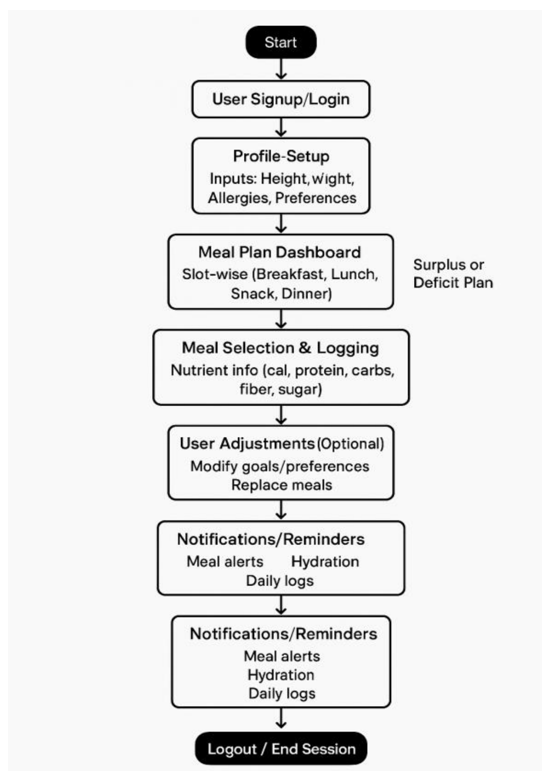


Fig. 3 - Flowchart of User Input Collection and Recommendation Process

4.3 Calorie and Macronutrient Estimation:
The system uses the Mifflin-St Jeor Equation to compute Basal Metabolic Rate (BMR), then applies Total Daily Energy Expenditure (TDEE) by multiplying BMR with an activity factor. A surplus or deficit of 300–500 kcal is applied depending on the user's goal.

4.4 Diet Categories:
1) Weight Gain: TDEE + 300 calories
2) Weight Loss: TDEE - 300 calories
3) Maintenance: TDEE

4.5 Food Dataset and Preprocessing: The food data (~329 items) was sourced from Kaggle. Each item includes:
1) Name, serving size.
2) Calories, protein, carbs, fats, sugar.
3) Tags (e.g., vegan, gluten-free, in-season)

4.6 Recommendation Algorithm:
The core logic is content-based filtering:
1) Represent meals and user preferences as vectors.
2) Calculate cosine similarity to score how closely meals align with user needs.
3) Filter based on dietary tags and seasonal ingredients.
4) Select top meals and return grouped in four slots: breakfast, lunch, snack, and dinner.

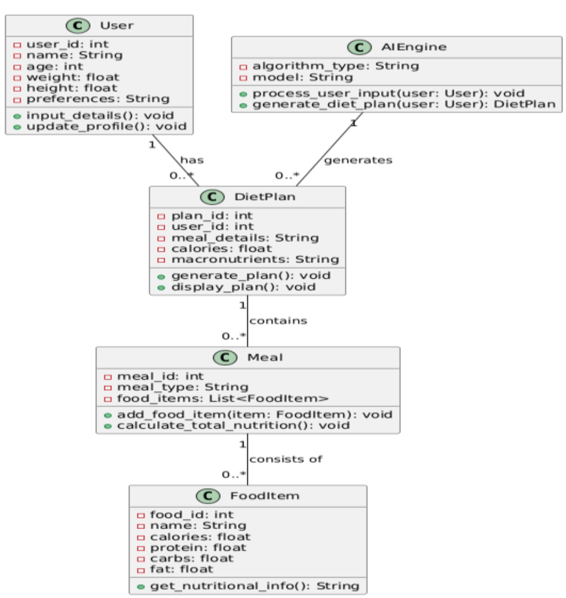


Fig. 4 - Class Diagram Representing Key Components

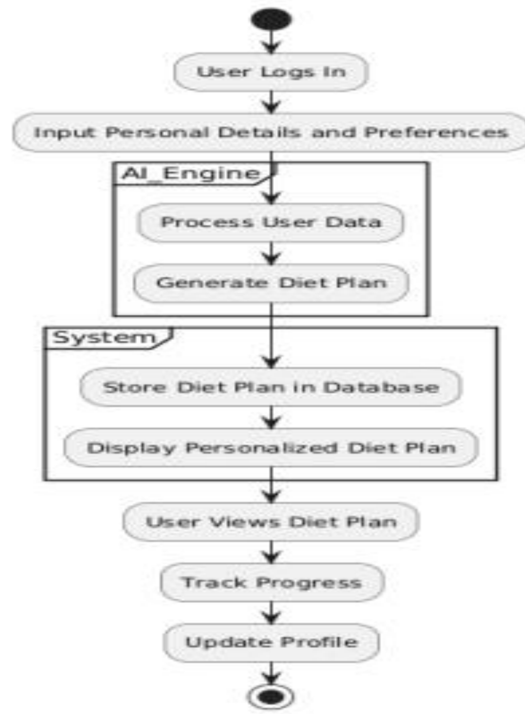


Fig. 5 – Activity Diagram

4.7 Feedback Loop and Rating System:
1) Users can rate meals (1 to 5 stars).
2) The system updates a user preference profile stored in MongoDB.
3) Python script re-runs training jobs periodically to improve relevance.

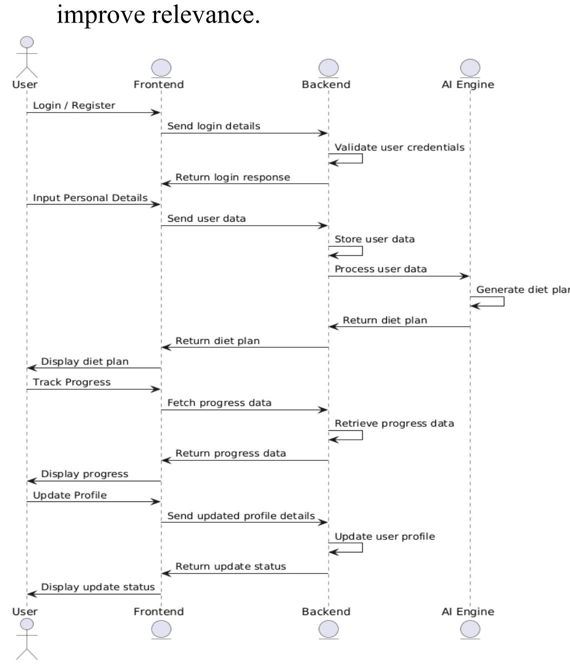


Fig. 6 - Sequence Diagram Showing Feedback Flow and Meal Update Process

4.8 Backend and Database Integration:
1) MongoDB collections store users, meals, ratings, preferences.
2) RESTful APIs return JSON data on meal recommendations.
3) Mongoose handles schema enforcement and queries.

## V. RESULTS

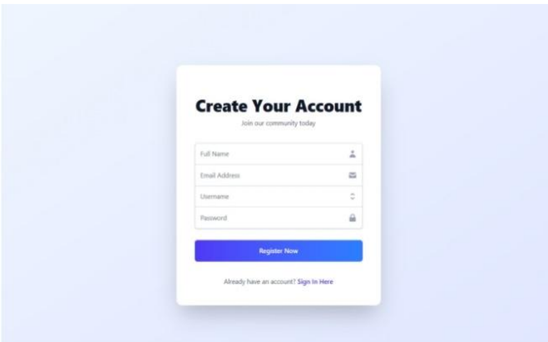


Fig. 5.1 – Create your Account

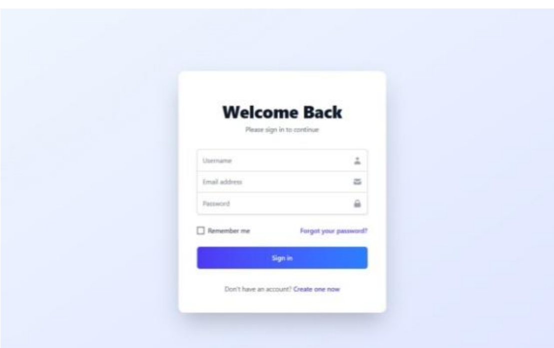


Fig. 5.2 – Signing in Page (only visible after account creation)

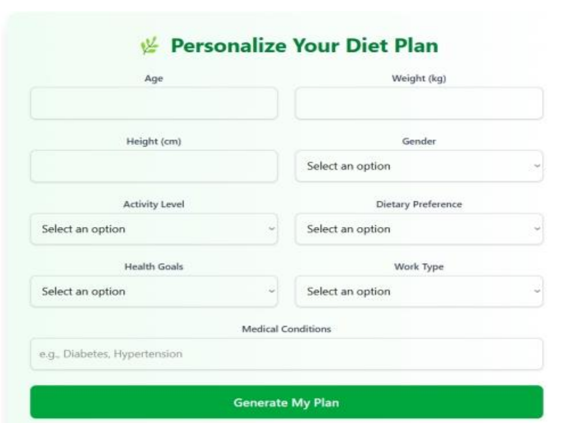


Fig. 5.3 – Enter your Biodata


Fig. 5.4 – Meal Plan Display

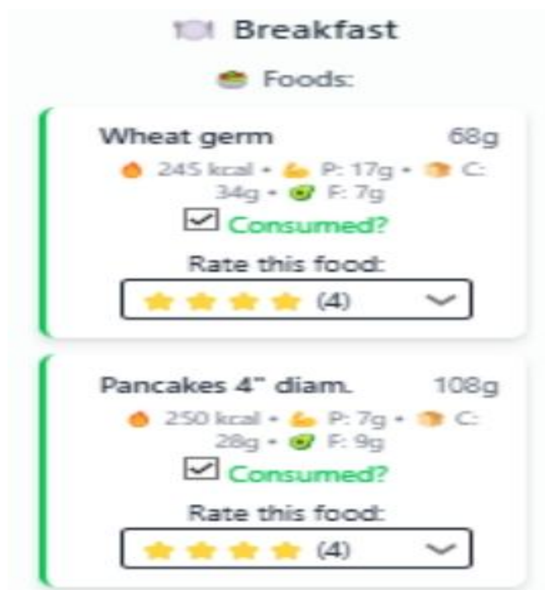


Fig. 5.5 – Feedback System (to improve future recommendations)


Fig. 5.6 - Enter details for Seasonal Recommendation


Fig. 5.7 – Personalized recommendation based on Seasonal Recommendation

Testing was conducted on both backend and frontend.

1) Backend was tested using Postman for API accuracy.
2) Frontend tested by five users from target demographic.

Key Outcomes:

1) Meal plans generated correctly according to input.
2) Seasonal recommendations varied as per date/month.
3) Macronutrient calculations were consistent with dataset values.

User Feedback:

1) Users appreciated clean UI and direct suggestions.
2) Major request: Allow manual meal replacement.
3) Feedback loop worked correctly in reordering meals after second login.

## VI. CONCLUSIONS

This project successfully demonstrates a scalable, AI-driven diet planning system that can offer personalized, nutritionally sound, and season-aware meal recommendations. While the current model focuses on content-based filtering, it lays the groundwork for future enhancements using collaborative filtering, natural language chatbots, and disease-specific diet customization.

## VII. ACKNOWLEDGMENT

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## VIII. FUTURE WORKS

1) Enable drag-and-drop customization and real-time recalculation of macronutrients.
2) Integrate chatbot using ChatGPT for personalized dietary queries.
3) Add pantry tracking and intelligent grocery list generation.
4) Introduce collaborative filtering based on user behaviour patterns.
5) Expand food database to support regional and medical-condition-specific diets.

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