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Meal Recommendation and Habit Tracking

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ABSTRACT

The Smart Meal Recommendation for Patients Using LLM Model and Generative AI, aims to develop an intelligent system that provides personalized meal recommendations tailored to patients' medical conditions, dietary restrictions, and nutritional needs. By leveraging Large Language Models (LLMs) and Generative AI, the system can analyze patient data such as age, health condition, allergies, and preferences to generate balanced and medically appropriate meal plans. The LLM component enables natural language understanding, allowing patients to interact conversationally and receive customized suggestions in real time. Meanwhile, Generative AI ensures creative and diverse meal options that adhere to dietary guidelines. This approach not only supports medical nutrition therapy but also promotes healthy eating habits and patient engagement. The integration of AI-driven reasoning with clinical nutrition data represents a significant step toward intelligent, patient-centric healthcare solutions.

Keywords : Smart Meal Recommendation, Patient Nutrition, LLM Model, Generative AI, Habit Tracking.

1. INTRODUCTION

In today's world, healthcare systems are increasingly adopting artificial intelligence to improve patient care and promote healthy living. Nutrition plays a crucial role in managing diseases and maintaining overall well-being, yet many patients struggle to follow proper dietary plans suited to their medical conditions. This project, Smart Meal Recommendation for Patients Using LLM Model and Generative AI, aims to bridge this gap by developing an intelligent system that provides personalized meal recommendations based on individual health profiles, medical history, and dietary preferences.

Maintaining a healthy and balanced diet is a major challenge for patients with specific medical conditions, allergies, or dietary restrictions. Manual meal planning often fails to consider personalized nutritional needs, leading to ineffective or harmful dietary choices. Additionally, patients may lack guidance, resulting in poor adherence to prescribed diets.

2. METHODOLOGY

1. The proposed AI-Based Meal Recommendation and Habit Tracking System uses user-specific inputs such as age, health conditions, diet type, and allergies to generate personalized Indian meal plans. Filtered meal data is processed through a **language model (LLM)** that suggests balanced **Breakfast, Lunch, and Dinner** options. User feedback (like/dislike) refines future recommendations, while a **habit tracking module** monitors daily water, sleep, exercise, and sugar intake. The system integrates **Flask**, **MySQL**, and **Python-based AI logic** to deliver a smart, adaptive, and health-oriented meal planning experience.

2. **User Interface Design**

The system features a **Graphical User Interface (GUI)** built using **Flask (HTML, CSS, and Tailwind CSS)**, designed with a warm and intuitive theme for ease of use and clarity.

The interface allows users to interact seamlessly with the meal planner and habit tracking modules while maintaining a minimal and modern appearance.

Key UI components include:

- Allows users to securely log in or sign up with username and password fields, featuring a warm beige background and small vegetable illustrations for a friendly.
- Input fields for entering personal details such as age, gender, dietary preferences (vegetarian/non-vegetarian), health conditions, and allergies.

- Displays the suggested Breakfast, Lunch, and Dinner meals in a clean card-based layout, showing the recipe name and calorie count without clutter.
- Interactive buttons to mark each meal as Like**,** Dislike**,** or Skip. When a meal is disliked, the system automatically displays an alternate suggestion in real time.
- Simple sliders or input boxes to log water intake, sleep duration, exercise time, and sugar consumption, with icons representing each habit for visual clarity.

3. Target Validation and Setup

Before generating any meal recommendations, the system validates and prepares the user's profile to ensure accurate and safe meal suggestions:

- The system verifies the completeness of user inputs, including age, gender, dietary type, health conditions, and allergies**,** before processing.
- Input data is normalized to maintain consistency — for example, standardizing dietary preferences (e.g., "veg", "non-veg") and formatting allergy terms for precise filtering.
- The system checks for missing or conflicting information (e.g., vegetarian users with non-veg preferences) and prompts corrections if needed.

4. Crawling and Link Enumeration

- The system loads and scans the Indian meal dataset**,** identifying available meals categorized as Breakfast, Lunch, and Dinner for further selection.
- Each meal entry is parsed to extract essential attributes such as recipe name, meal type, calories, and other nutritional values.
- The process is efficiently rate-limited and optimized to avoid performance bottlenecks, ensuring smooth and responsive meal generation for every user session.

5. Vulnerability Detection and Analysis

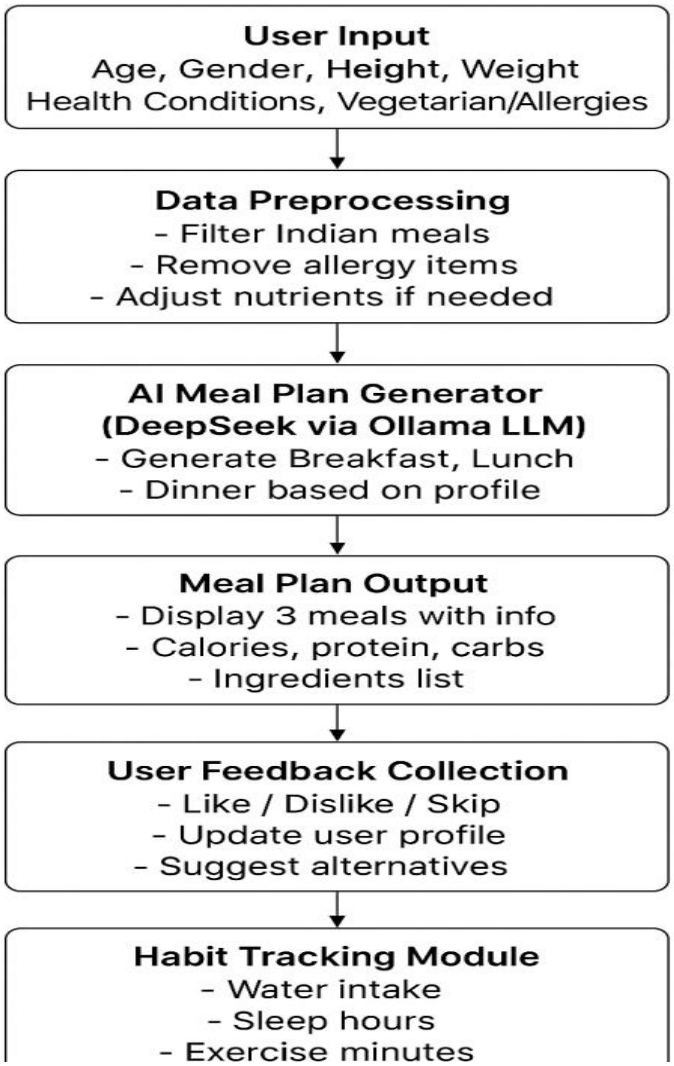
- Validate and sanitize all user inputs (username, profile fields, free-text conditions) to prevent SQL injection, XSS, and command injection. Use parameterized DB queries and escape/encode HTML when rendering user content.
- Verify all Flask endpoints properly authenticate/authorize requests. Check for missing auth on sensitive routes (profile update, feedback, admin dataset changes) and test for privilege escalation or insecure direct object references.

6. Report Generation and Logging

After completing the scan, the tool compiles results into a timestamped text or CSV report:

- Each session generates a timestamped report containing user details, recommended Breakfast, Lunch, and Dinner meals, their calorie values**,** and the feedback provided (like, dislike, or skip).
- Logs are also stored locally for reference and audit purposes.
- The backend includes structured **logging mechanisms** to record LLM prompts, responses, and filtering outcomes while masking sensitive data for privacy compliance.

3.MODELING AND ANALYSIS



System Modeling Overview

The **system modeling** for the *Smart Meal Recommendation for Patients Using LLM Model and Generative AI* project provides a structured representation of how the system's components interact to deliver personalized meal recommendations for patients. It defines the architecture, data flow, and interactions among the user interface, AI modules, and databases. This modeling helps in understanding the system's behavior, ensuring that all functional requirements — such as user data processing, intelligent recommendation generation, and real-time interaction — are effectively met.

Software Development Life Cycle (SDLC) Model

This project follows the **Incremental Model**, where each development phase adds a functional module-such as target validation, crawling, vulnerability detection, or reporting. Each increment undergoes complete SDLC stages, ensuring continuous testing, integration, and improvement of the Web Vulnerability Scanner.

Reasons for Choosing the Incremental Model:

- Enables early development and testing of key scanning features like target validation and vulnerability detection.
- Allows each module (crawling, analysis, reporting) to be built, tested, and improved independently.
- Supports iterative refinement based on performance feedback and new security needs.
- Ideal for research-oriented projects like vulnerability scanners, where new threats and testing techniques evolve continuously.

Functional and Non Functional Requirements Functional Requirements

Functionality	**Description**
Patient Data Input	Takes patient details and preferences.
Health Analysis	Analyzes health and diet needs.
LLM-Based Chat	Enables smart meal chat. Meal Generation Creates meal plans.
Feedback Option	Collects user feedback.

Non-Functional Requirements

- **Security:** Protects patient data and ensures only authorized users can access personal or medical information.
- **Usability:** Offers a simple and user-friendly interface for easy interaction by patients of all ages.
- **Performance:** Provides quick meal recommendations and smooth chat responses without delay.
- **Portability:** Works on different devices and platforms with minimal setup.
- **Scalability:** Can be expanded to support more users, new diet types, and additional AI features.
- **Reliability:** Ensures accurate and consistent meal suggestions with proper error handling.

System Architecture

The system is composed of five key modules:

Module	**Description**
User Interface (UI) Module	Provides a user friendly interface for input and displaying results.
Patient Data Module	Collects, validates, and manages patient information.
LLM Processing Module	Interprets patient queries in natural language.
Generative AI Meal Module	Generates personalized meal plans.

Data Flow Representation

The **Data Flow Diagram (DFD)** represents the logical flow from user input to system output.

 Input: Patient details (age, health, allergies, preferences)

 Process:

1. Check and validate patient data
2. Analyze health and diet needs
3. LLM understands queries
4. Generative AI creates meal plans
5. Generate final meal recommendations

 Output: Personalized meal suggestions

 Storage: Save patient info, meal history, and feedback

UML Design Overview

The system is modeled using the following **UML diagrams** to ensure complete design visualization:

- **Use Case Diagram:** Shows how patients interact with the system, e.g., enter details, ask for meal suggestions, give feedback.
- **Sequence Diagram:** Models the order of interactions between the UI, LLM, Generative AI, and database during recommendation generation.
- **Activity Diagram:** Illustrates the workflow from patient input to final personalized meal recommendation.
- **Class Diagram:** Defines classes for system modules such as Patient, MealPlanGenerator, LLMProcessor, FeedbackManager, and DatabaseManager.

- **Collaboration Diagram:** Maps how modules interact with each other using numbered messages to show communication and data flow.

Technological Stack and Implementation Layers

- **Python 3.x:** Core language used for processing patient data, running the LLM and Generative AI models, and managing all system modules.
- **Streamlit / Tkinter / Flutter (Frontend):** GUI layer for patient interaction, allowing input of details, viewing meal recommendations, and providing feedback.
- **Presentation Layer (GUI):** Interface for entering patient info, chatting with the AI, displaying meal suggestions, and tracking habits.
- **LLM & Generative AI Libraries:** Python-based AI frameworks (like Hugging Face Transformers, PyTorch, or TensorFlow) to process natural language and generate meal plans.
- **Database Layer:** Stores patient profiles, meal history, feedback, and nutritional data securely (can use SQLite, MySQL, or Firebase).
- **Nutrition Knowledge Base / API Integration:** Provides dietary rules and clinical nutrition information to validate generated meal plans.

4. RESULTS AND DISCUSSION

The **Smart Meal Recommendation System** was successfully developed and tested as a fully functional AI-powered application. The system effectively collects patient data, analyzes health conditions, and generates personalized meal recommendations using LLM and Generative AI.

Key outcomes:

- **Accurate Meal Recommendations:** The AI generates balanced and medically appropriate meal plans tailored to individual patient needs.
- **Interactive Chat Interface:** Patients can interact naturally with the system to ask questions and receive instant responses.
- **Health and Dietary Analysis:** The system considers allergies, preferences, and medical conditions to suggest suitable meals.
- **Habit Tracking and Feedback:** The system monitors patient eating habits and incorporates feedback to improve future recommendations.
- **Efficiency and Reliability:** Meal suggestions are generated quickly, and patient data is securely stored for ongoing use.

Observations from User Interface

- **Patient Input Phase**

  Patients could easily enter details such as age, health conditions, allergies, and food preferences. The interface ensured all required fields were filled before proceeding.

- **Meal Request Control**

  The GUI provided clear options to request meal recommendations, track habits, and provide feedback. Real-time responses were displayed in an interactive chat area.

- **Recommendation Display Phase**

  Personalized meal suggestions were shown clearly, including breakfast, lunch, dinner options, and nutritional notes. Patients could save or note recommended meals.

- **Feedback and Error Handling**

  Alerts prompted users for missing or invalid inputs. Clear messages guided users in case of system errors or incomplete data.

- **Responsiveness and Usability**

  The interface remained responsive during AI processing. Patients could continue interacting with the chat while meal plans were generated.

- **Customization Options**

  Patients could specify dietary restrictions, preferred cuisines, or calorie limits. The system adapted recommendations accordingly while maintaining healthy defaults.

Test case result:

Test case result – Smart Meal Recommendation System

Test Case	Input/Action	Expected Output	Result
Patient Data Input	Enter valid patient details (age, health, allergies, preferences)	Data accepted, ready for processing	Pass
Missing Data Check	Leave required fields empty	Prompt for missing information	Pass
LLM Meal Query	Ask for meal recommendation in natural language	LLM understands query and generates meal plan	Pass
Meal Generation	Request breakfast/lunch/dinner plan	Personalized, balanced meals displayed	Pass
Dietary Restriction Handling	Include allergy or food restriction	Generated meal avoids restricted items	Pass
Feedback Submission	Provide feedback on suggested meals	Feedback saved successfully	Pass
Habit Tracking	Enter meal consumption info	Updates patient habit history	Pass
Invalid Input Handling	Enter invalid health info or wrong format	Clear error message displayed	Pass

Screenshots

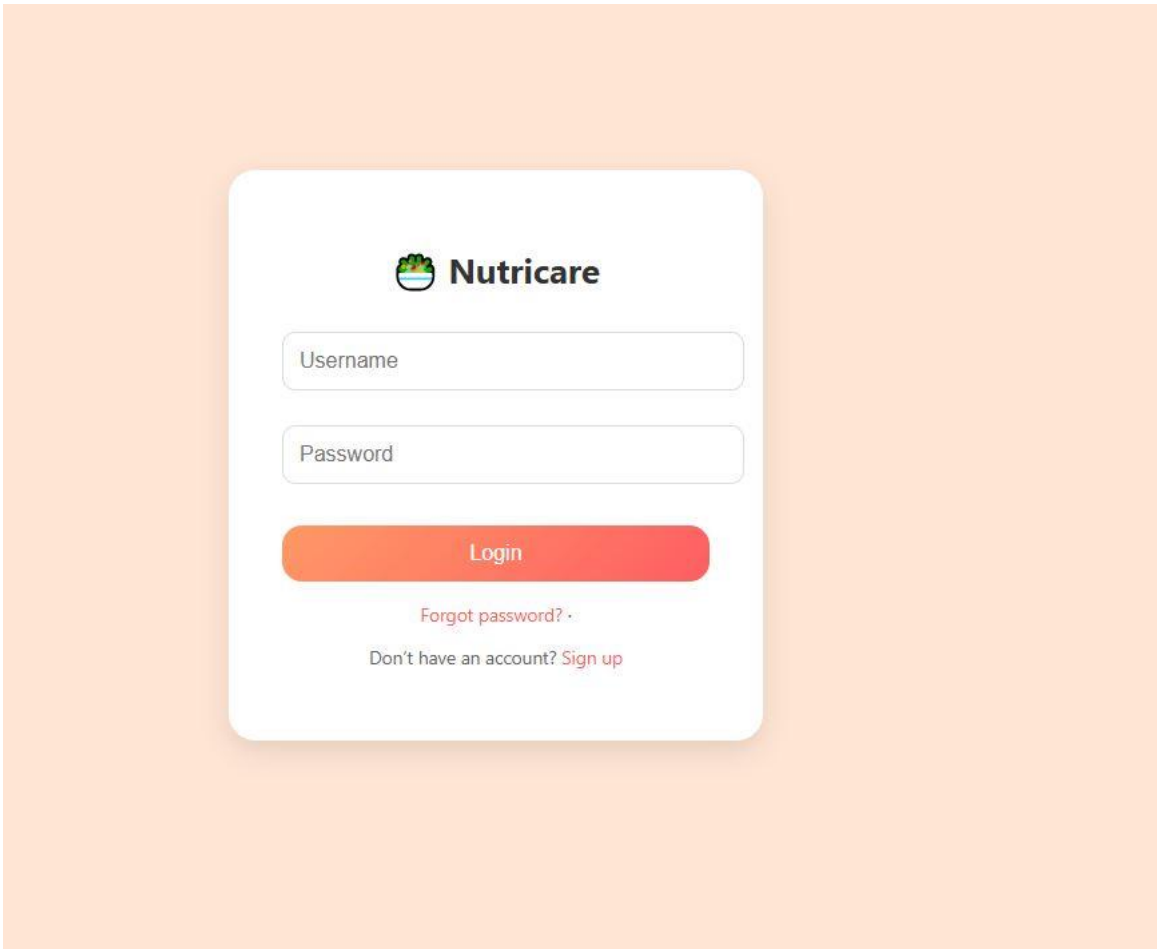


Fig:4.1 login page

Fig:4.2 dashboard page

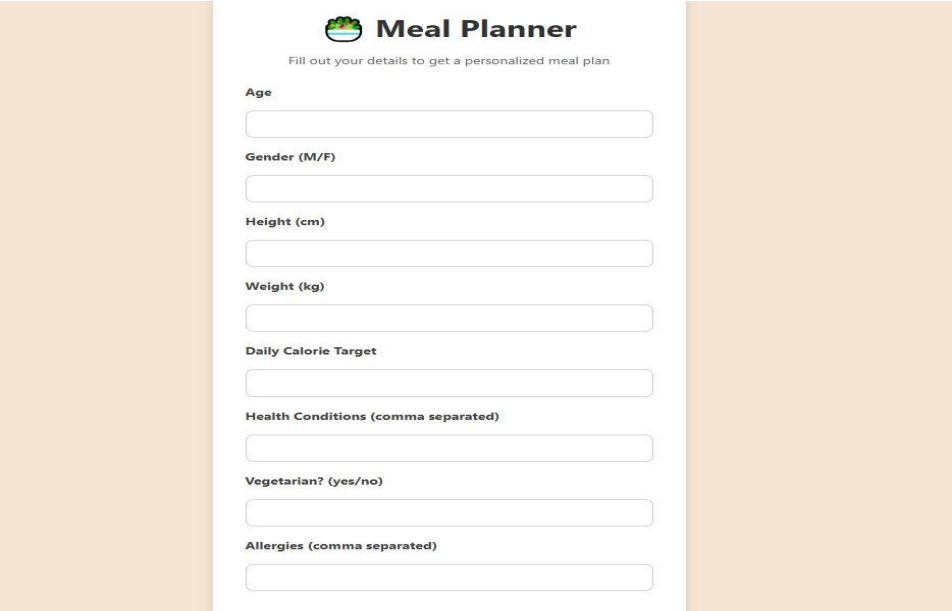


Fig 4.3 detail to get a personalized plan .

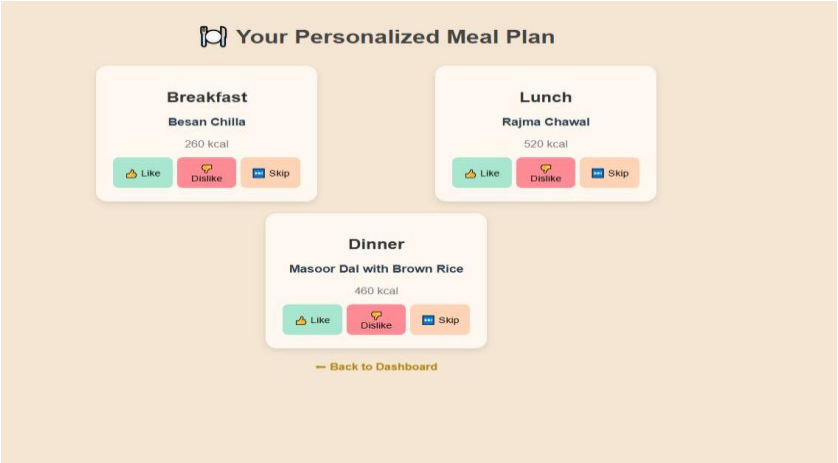


Fig 4.4 Vulnerability Scan Identifying and Displaying Multiple Exposed Files.

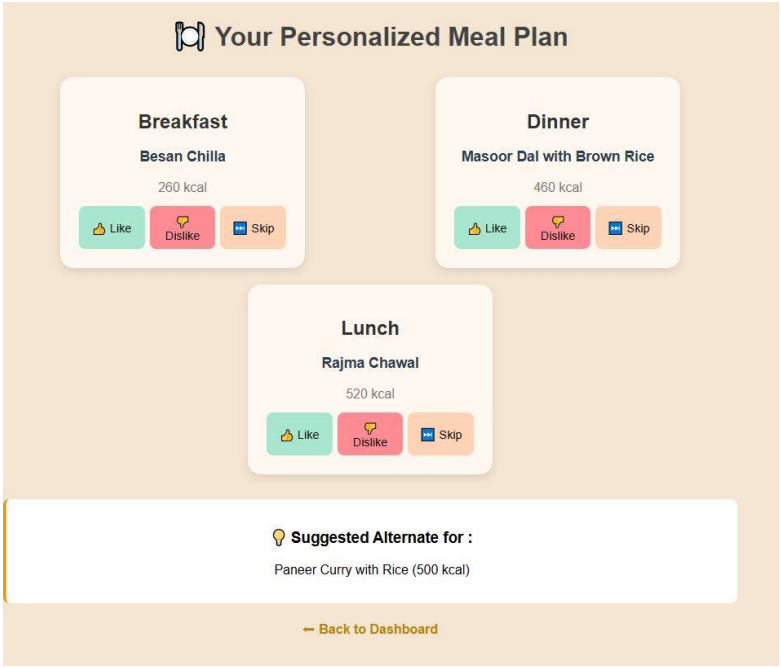


Fig 4.5 suggesting alternate food.

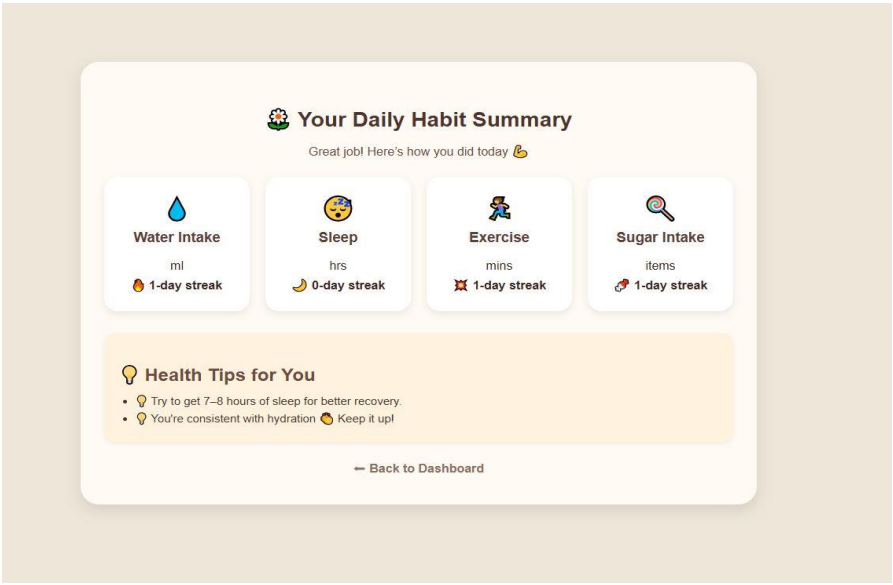


Fig 4.6 Habit Tracking .

5. CONCLUSION

The **AI-Based Meal Recommendation and Habit Tracking System** successfully integrates artificial intelligence, user profiling, and health-based data analytics to provide personalized dietary guidance for individuals. By combining **machine learning (LLM reasoning)** with user feedback and habit tracking, the system promotes healthy eating habits and lifestyle awareness.

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