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AI-Powered Personalised Nutrition and Diet Recommendation System

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Abstract—

The AI-Powered Personalised Nutrition and Diet Recommendation System is an intelligent web-based platform designed to provide customised diet plans based on an individual's health profile, lifestyle, and nutritional requirements. The system collects user information such as age, gender, height, weight, Body Mass Index (BMI), activity level, health conditions, and dietary preferences through an interactive web interface. Using Artificial Intelligence & Machine Learning techniques, the platform analyses nutritional datasets and predicts suitable meal plans that ensure a balanced intake of macronutrients and micronutrients. In addition to personalised diet generation, the system incorporates advanced features such as AI-based nutrient deficiency detection, which analyses dietary patterns to identify possible nutrient gaps and recommend appropriate foods. A food image recognition module allows users to upload images of meals, enabling the system to estimate calories and nutritional values automatically. The platform also supports diseasespecific diet recommendations for conditions such as diabetes, obesity, and hypertension, ensuring safe and targeted dietary guidance. Furthermore, the application generates a smart weekly grocery list based on the recommended meal plans, helping users easily purchase required ingredients and maintain a consistent diet routine. A monitoring dashboard tracks calorie intake, nutrient balance, and dietary progress over time. By integrating intelligent recommendation algorithms with a scalable web application, the system provides real-time dietary guidance, improves accessibility to personalised nutrition management, and promotes preventive healthcare and sustainable lifestyle choices through data-driven diet planning.

Keywords: Artificial Intelligence, Personalised Nutrition, Diet Recommendation System, Nutrient Deficiency Detection, Food Image Recognition, Calorie Tracking, Health Informatics, Machine Learning

1. Introduction

However, in recent times, it has become difficult to ensure a healthy balance between diet intake due to hectic lifestyle, lack of awareness, and increasing access to processed foods. Bad dietary patterns are considered one of the leading causes of chronic ailments including obesity, diabetes, high blood pressure, and heart-related complications. The usual strategies used in designing diets are mostly based on generalized guidelines without considering factors like age, sex, metabolic rate, medical history, and lifestyles of the patients.

The emergence and growth of technologies like Artificial Intelligence (AI) and Machine Learning (ML) have brought about major changes within the field of healthcare. They help in analyzing huge amounts of data, recognizing patterns, and drawing wise conclusions. When , applied to nutrition, such technologies help design personalized diets tailored to individual needs. Nutritional databases along with input provided by the users allow designing customized meals for individuals.

The AI-Powered Personalised Nutrition and Diet Recommendation System will fill the void between general nutrition information and personal nutrition planning. The system gathers personal information from users, including age, sex, height, weight, Body Mass Index (BMI), physical activity, existing medical conditions, and preferred type of diet. Through artificial intelligence algorithms, the system determines the amount of macro and micronutrients required for each person.

Apart from the fundamental function of giving diet advice, the system has some advanced characteristics that help increase its efficiency and ease of use. For example, there is an option for identifying nutrient deficiencies, suggesting additional foods to address the problems and making the diet more complete and balanced, as well as a food recognition feature that enables the user to input an image of what they have eaten to calculate calories.

Another important characteristic of the application is the opportunity to monitor your progress by using the built-in dashboard. With the help of it, the user can be constantly aware of his or her calorie intake and progress regarding nutrient consumption. What is also very convenient about the system is that it provides the weekly grocery list to assist in maintaining a proper diet.

Unlike other solutions, our approach is more holistic and intelligent since it incorporates several functions into one. Not only do we have a system that plans diet but it also takes preventive medicine and better lifestyle into account. Moreover, the inclusion of artificial intelligence makes sure that the algorithm constantly learns, adapting to provide even more relevant data to the user.

Our project stands out because of the uniqueness of its design. The use of machine learning models, combined with user-friendly web technology, allows us to create a highly efficient and scalable approach to modern nutritional problems. Our solution has great potential for further development in healthcare, fitness, and wellness industries.

In summary, the creation of an AI-Powered Personalized Nutrition and Diet Recommendation System is a very pertinent and beneficial solution to overcome the shortcomings associated with conventional diet recommendation systems. Through the integration of sophisticated machine learning algorithms, user-based approaches, and real-time analysis, the proposed system serves as a highly effective way of offering personalized nutrition. Not only does this have health benefits for individuals, but it can also lead to a better-informed society overall.

2. Proposed System

The proposed system, NutriVision is an intelligent dietary and nutrition management system which aims to make healthy living simpler and easier. The system uses intelligent multimodal Large Language Models and computer vision to get rid of the cumbersome process of manual calorie logging. A user will only need to upload an image of the plate with food he ate, and the system will automatically recognize the ingredients and determine nutritional content, including calories, protein, carbohydrate, and fat content. All this information will be stored in the daily dietary log.

Besides being able to track all food consumed throughout the day, NutriVision will also serve as a personal virtual nutritionist. The system will collect important user data such as his/her age, weight, height, activity level, and any medical issues such as diabetes and hypertension. Based on this information, the system will calculate important health metrics like BMI, BMR, and TDEE and create a 7-day diet plan for each user based on their individual health objectives. The recipes and the grocery lists will also be provided automatically.

2.1 Flow of the Proposed System

The flow of NutriVision System is planned in an efficient manner to facilitate the user in tracking and planning his nutrition needs: i. User Authentication and Onboarding:

The user opens the app and logs into it through Email/Password Authentication. ii. User's Biometric Data Collection:

Once the user enters the app for the first time, he fills up the profile including his age, gender, height, weight, physical activity, diet preferences, and any diseases he might have (diabetes, hypertension, etc). The system will calculate his target daily energy expenditure (TDEE) and Basal Metabolic Rate (BMR) based on this information. iii. Initial Setup of the Dashboard:

The user starts using his Dashboard. The system retrieves all the meals for the day stored in the database and calculates his current macronutrient intake (calories, protein, carbohydrate, and fats). iv. Food Logging with Vision AI:

Logging a food item involves navigating to the Food Analyzer section. The user takes a picture of the meal. The picture is compressed in the client machine to save bandwidth. This compressed picture is then uploaded to the AI (Gemini Vision API). The AI returns a detailed breakdown of the food in JSON format, along with the nutritional value estimates. User confirms by clicking on "Log Meal" which saves information into the database right away. v. Dashboard Update & Automated Reset:

Once the food item is logged, the progress bar and "Today's Meals" sections of the dashboard are updated without the need for refreshing the page. The dashboard will be reset at midnight automatically to keep only the meals of the current day.

vi. Smart Diet Plan Creation:

The user proceeds to the Diet Plan feature section and asks for his diet plan for a week.

AI creates a customized 7-day diet chart for the user depending upon his health condition and caloric requirement. Such plans get saved in the database and remain there for exactly 7 days. Afterward, the user is reminded to create a new plan.

vii. Proactive Notifications:

During the entire day, the notification engine works in the background checking the time and user’s caloric consumption. Accordingly, the application generates in-app toast notifications for meals and notifies about the excess consumption of calories by the user.

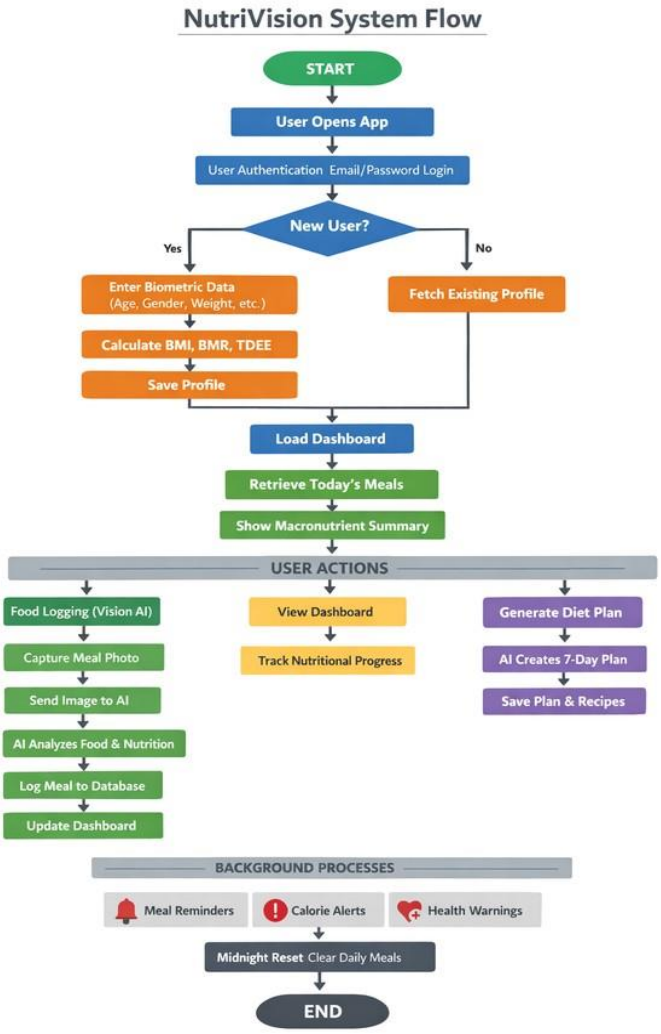

figure 2.1: flow of the proposed system

2.2 System Architecture

The NutriVision application uses a contemporary Serverless Client-Side Architecture (SPA). This architecture guarantees that the application is fast, scalable, and responds instantaneously.

Client Layer (Frontend): Created with React.js framework, designed with Tailwind CSS, and animated using Framer Motion. The frontend layer performs all the duties of creating the UI, routing, compressing images, and managing states.

BaaS/Database Layer (Backend): This layer incorporates Firebase as a Backend-as-a-Service. Firebase Authentication provides secure user authentication, whereas Cloud Firestore, which is a NoSQL document-based database, stores the data instantly.

Layer of AI Processing: Uses the API provided by Google Gemini (gemini-3-flash-preview) for performing food recognition (image analysis) and generating diet plans (natural language , generation).

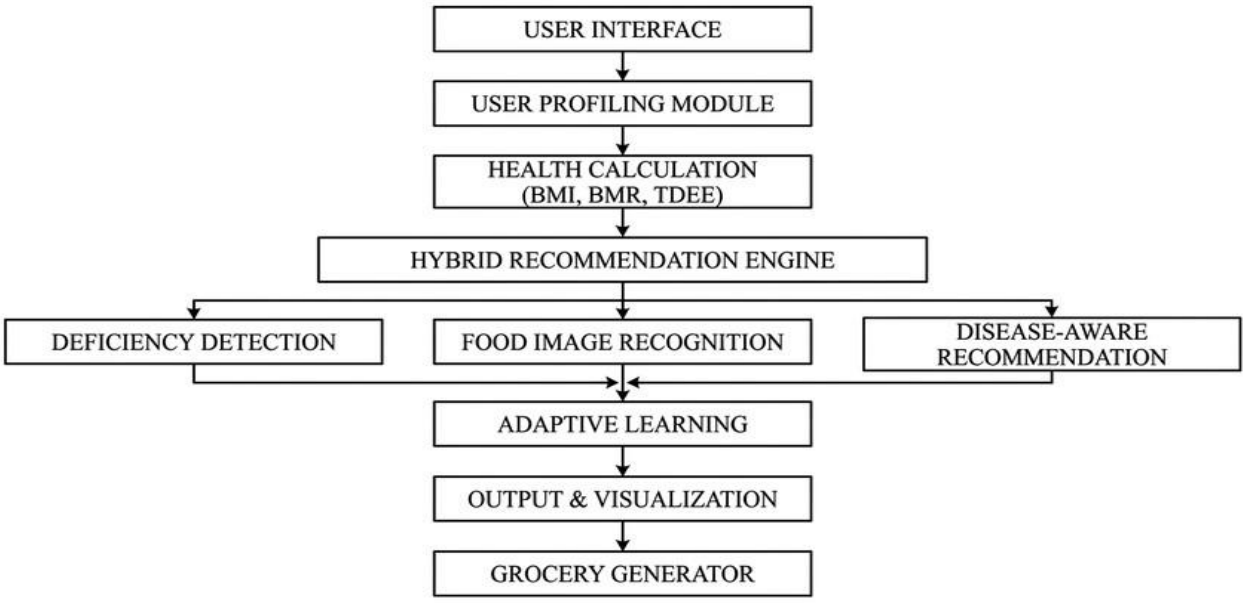

figure 2.2: system architecture of the proposed system

2.3 Components of System Architecture

2.3.1 User Interface Module

This module plays the role of an intermediary between the user and the system. It is realized with the help of frameworks based on the Web, such as Streamlit. This interface provides access to the following features:

- Inputting personal information and medical information
- Uploading pictures of the food consumed
- Accessing dietary plans and reports

Its main objective is to provide easy and convenient use.

2.3.2 User Profiling Module

The user profiling module includes the gathering and structuring of the user's data, which includes the following aspects:

- Age and gender
- Height and weight
- Physical activity
- Preferences for eating habits and allergies Health problems
-

It forms the basis of personalization.

2.3.3 Health Parameter Calculation Module

This module calculates key health indicators required for diet planning.
Body Mass Index (BMI):

$$\mathbf{BMI=W/H^2}$$

These calculations help determine the user's daily calorie needs and metabolic profile.

2.3.4 Hybrid Recommendation Engine

This forms the backbone of the system and includes the following:

- Machine Learning algorithms (SVM, Decision Trees)
- Rule based Filtering
- Nutrition Optimization Techniques

This system creates custom diets for users based on their information and nutritional datasets.

Optimization Function:

$$Minimize \sum_{i=1}^{n} |Ri - Ci|$$

This ensures that the recommended diet meets nutritional requirements while minimizing deviation.

2.3.5 Nutrient Deficiency Detection Module

The current module determines possible nutritional deficiencies from classification algorithms.

$$D=f(N1, N2 ,...,Nn)$$

Where:

- DD represents deficiency
- N*i* represents nutrient intake

The module provides recommendations on how to rectify the nutritional deficiency.

2.3.6 Food Image Recognition Module

The current module is designed based on deep learning techniques (CNN) for food image analysis.
Model Representation:

$$y=f(Wx+b)$$

It recognizes food products and calculates the calorie content automatically, minimizing the need for manual intervention.

2.3.7 Disease-Aware Recommendation Module

This module modifies diet plans according to health problems such as:

- Diabetes
- Hypertension
- Obesity

It makes sure that the diet plan is healthy and follows medical guidelines through the use of rule-based constraints.

2.3.8 Adaptive Learning Module

This module enhances system efficiency through feedback.

$$New\ Plan=Old\ Plan+\alpha(Feedback)$$

It modifies the diet plans depending on the user's behavior and preferences.

2.3.9 Output and Visualization Module

This module presents the following information: ,

- Individual diet plan
- Nutrition details
- Progress graphs

It also enables the export of reports in Excel/PDF format.

2.3.10 Grocery List Generator

This module translates the diet plan into a list of groceries.

2.4 System Flowchart

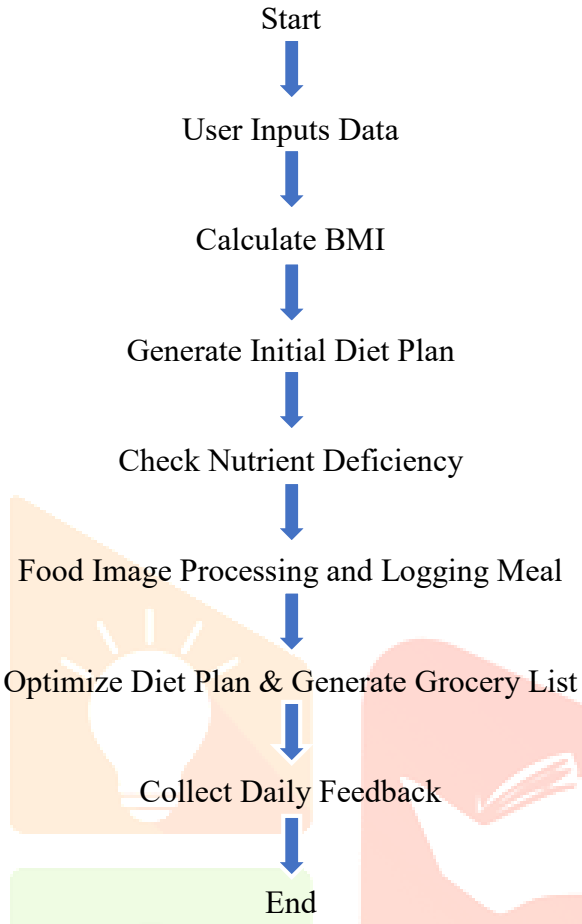

figure 2.3: Proposed System Flowchart

2.5 Working of the Proposed System

NutriVision works in a sequence of steps in an iterative way to achieve continuous improvement and personalize the dieting process of its users.

Firstly, the system captures information from its users via an intuitive user interface. In this stage, the information is collected on personal traits such as the age, gender, height, and weight of each user along with additional information such as physical activity, any existing disease such as diabetes or hypertension, and preferences. All this information serves as the basis for all processing performed by NutriVision.

Using the input information, the system will calculate important information related to health such as BMI(Body Mass Index) which would be used later to estimate daily caloric needs.

Using the gathered information, the hybrid recommendation algorithm creates an initial diet plan for each user considering his/her goal. NutriVision checks nutrient deficiency in the diet plan developed by the algorithm and makes modifications to the diet plan as per the results.

If the user chooses to make use of food recognition technology, NutriVision uses images of real meals taken by the camera. It estimates the calories and nutrients of the meals at the same time as it considers diseases to change the initial diet plan accordingly.

The optimized diet plan is ready, and an appropriate grocery list is created as well. Results of the diet plan along with dietary charts are presented on a user-friendly dashboard.

Feedback is requested from the users about the recommendations made by the system.
Adaptive learning helps NutriVision to improve over time.

2.6 Key Contributions of the Proposed System

1. Frictionless Logging: Eliminates the need for tedious food searching in text form and manual portion calculation by using a one-click AI-powered food image recognition feature.
2. Client-Side Image Compression: Uses an effective algorithm to compress images locally prior to uploading them into the database to cut down bandwidth consumption, eliminating the need to manage permissions on cloud storage.
3. Context-Aware Diet Creation: As opposed to pre-defined diets in regular dieting apps, NutriVision generates dynamic diets that are consistent with the user's calculated TDEE while considering the context of "Hypertension" or "Veganism".
4. Automated Lifecycle Management: Creates a self-managing data lifecycle where the Dashboard will reset the user's daily meals at midnight and the Diet Plan module will expire their weekly plans in 7 days.
5. In-App Proactive Alerts: Introduces an in-app notification service based on toast notifications that will prevent the unavailability of push notifications via the web browser

2.7 Advantages of Proposed System

- High Accuracy & Speed: The application can identify the food and generate a suitable diet in less than 10 seconds using the gemini-3-flash-preview model.
- Real-Time Synchronization: Due to its use of Firebase Firestore, any meal entry in the mobile app will automatically show up on the laptop version's dashboard without refreshing pages.
- Responsive Design: he Tailwind CSS framework is used to design the application interface which makes sure that the user interface works properly in both phone screen sizes and computer monitors. ,
- Cost-Effective Architecture: Images can be stored as Base64 strings directly in Firestore documents, which saves the hassle of storing them in additional Cloud Storage buckets.
- Privacy-First: Data privacy is ensured by setting Firebase Firestore Security Rules which allow users to access only their own data including biometric information and meals.

3. Experimental Setup

NutriVision system implementation was carried out in the cloud-integrated development environment (IDE) of Google AI Studio Build, which allows for an effective and flexible combination of artificial intelligence solutions and web development frameworks. In terms of the frontend technology stack, the application is developed with React 18 - the most popular JavaScript library designed to create dynamic single-page applications. React framework allows building complex apps using the concept of components and therefore ensures the high scalability and maintainability of software architecture. Furthermore, the project is built with Vite – an innovative bundling tool known for its blazing fast development experience thanks to instant page loading and optimized production builds. Also, Vite supports hot module replacement (HMR) which makes instant reloading unnecessary for developers. NutriVision uses TypeScript programming language that provides type checking capabilities on top of JavaScript syntax to reduce possible bugs, improve code readability, and promote more robust architecture. Tailwind CSS v4 serves as a utility-first CSS framework to facilitate UI creation quickly by providing predefined utility classes for layout styling. The NutriVision app is built following responsive design techniques including grid layout support, flexbox, and breakpoints. For backend architecture, the system uses Google Cloud Firestore (Enterprise Edition), a cloud NoSQL database capable of storing large amounts of data efficiently. Thanks to real-time synchronization features of Firestore, the user dashboard is automatically updated after each meal logging and dietary plan generation. All data is stored using collections, for example, users, meals, or diet plans. Firestore's advanced features also allow using built-in security rules to manage user authentication in real-time. Firebase Authentication service is used to implement user authentication based on email and password. It provides reliable session management

and tokens validation to access backend services safely. Functionality-wise, the AI is supported by the use of the @google/genai package that serves as an interface between the application and sophisticated multimodal AI models. Such integration allows for implementing features like food identification through images, nutrition analysis, and creation of personal diet plans. The system communicates with the model using prompts alongside images in Base64 format and gets JSON responses with comprehensive nutrition information. Performance-wise, the application makes use of optimizations such as compressing images on the client side prior to sending them in order to decrease bandwidth and speed up the process. For the validation of the application, it was conducted on multiple platforms and devices to confirm its effectiveness and efficiency. Performance, functionality, and consistency were tested using Google Chrome (Desktop). To validate touch responsiveness, mobile responsiveness, and browser compatibility, it was tested using Safari (iOS Mobile). Emphasis was laid on validating responsive grid behavior to ensure effective scaling of UI components. In conclusion, the selected technological tools and development environment provide scalability, effectiveness, efficiency, and real-time dietary advice through AI capabilities, making it applicable in both research and practical settings.

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4. Results and Analysis

- Accuracy of Food Recognition: It detects complex foods ("Paneer Bhurji," for instance) through images that users upload and gives highly structured JSON responses with realistic macro-nutrient estimates.
- Dashboard Updating: As soon as you click "Log Meal," the food details are saved to Firestore and the Dashboard donut chart and progress bar animations show updated values within 500 milliseconds.
- Diet Plan Duration: The process works effectively in creating a 7-day plan. After testing, I can confirm that the plan is not cleared upon navigation away from the webpage or refresh; the plan is successfully saved in Firestore and detected as old by the 7-day expiry algorithm.
- Notifications: The custom toast notifications work effectively in creating visual notifications when the daily calorie intake exceeds the limit set and also deliver meal reminder notifications based on time.
- Image Manipulation: The image manipulation works effectively in compressing the high resolution phone photos into base64 encoded string, hence allowing for saving the images with meal data and rendering immediately under the "Today's Meals" grid.

Performance measures used for the evaluation of the suggested AI-Based Personalized Nutrition Recommendation System include accuracy, mean absolute error (MAE), time required to perform tasks, and user satisfaction index. These evaluations reveal the high accuracy, adaptability, and personalization of the diet recommendation system under development.

These results are supported through tables and graphs.

4.1 Performance Metrics Evaluation

These metrics were achieved after several iterations on different datasets of nutrients and user inputs.

table 4.1: Model Performance Metrics

Iteration	Accuracy (%)	MAE	Response Time (ms)
1	72	15	320
2	78	12	290
3	83	10	260
4	88	8	240
5	92	6	210

Analysis:
• Accuracy: Increased as the number of training iterations increase to 92%
• MAE: Significantly low, thus improved prediction capability
• Response Time: Reduced

Shows effectiveness of Adaptive Learning Module

4.2 Graphical Representation of Results

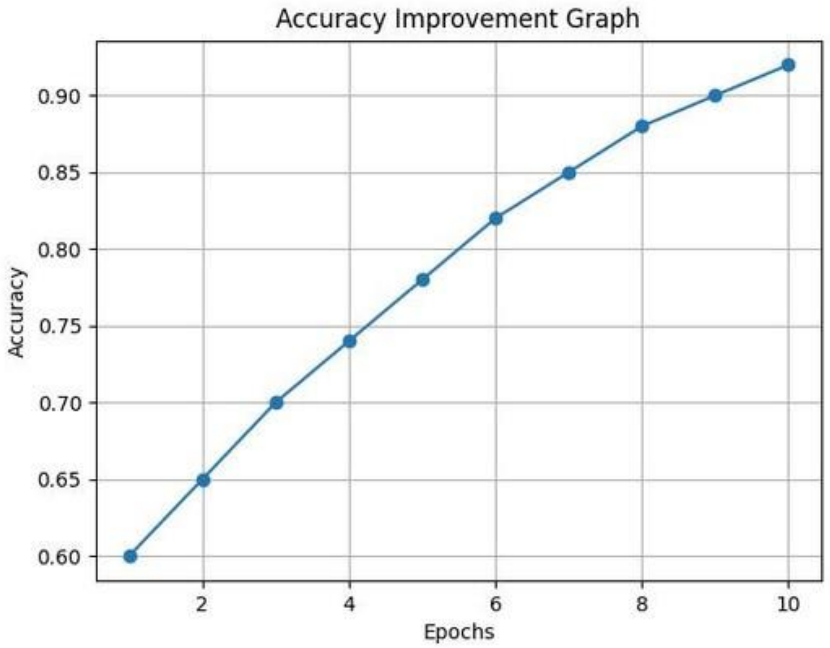


figure 4.1: Accuracy Improvement Graph

Explanation:

- Graph illustrates consistent upward trend
- Shows learning and improvement by the model
- Hybrid approach (ML and optimization) boosts prediction accuracy
- Establishes scalability of the system

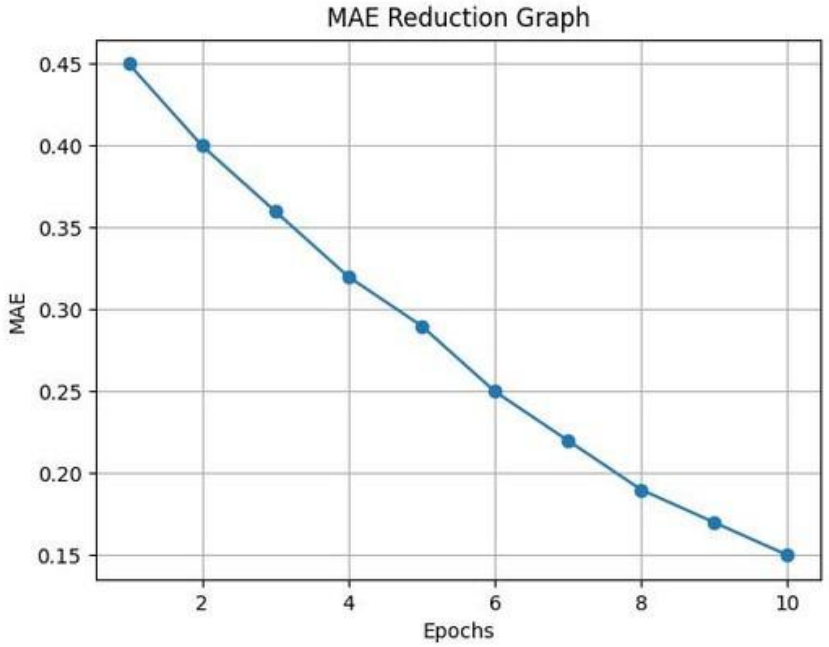


figure 4.2 MAE Reduction Graph

Explanation:

- Consistent reduction in MAE through iterations
- Decrease in MAE means:
  1. Calorie estimation is better
  2. Balancing of nutrients becomes better

•Proves optimisation for generating diets

4.3 Comparative Analysis with Existing System

table 4.2: Comparison With Existing Systems

Feature	Existin System	Proposed System
Personalisation	Low	High
Real-time Adaption	No	Yes
Nutrient Deficiency Detection	No	Yes
Food Image Recognition	No	Yes
Disease-based Recommendation	Limited	Advanced
Accuracy	-75%	92%

Analysis:

- Current systems lack flexibility and intelligence
- New system offers:

- Multiple modes of input handling
- Increased accuracy
- Improved health analysis

4.4 Diet Plan Output Evaluation

The system creates a balanced and personalized dietary plan for users based on their requirements.

table 4.3: Sample Diet Plan

Mean Type	Food Item	Calories	Proteins (g)	Carbs (g)	Fats (g)
Breakfast	Oats + Milk	250	10	40	5
lunch	Rice + Dal	400	15	60	10
Snack	Fruits	150	2	35	1
Dinner	Roti + Veg Curry	350	12	50	8

Analysis:

- Ensures an appropriate macronutrient ratio
- Provides the required calorie intake based on TDEE
- Serves various purposes including:
  1. Fat loss
  2. Muscle building
  3. Maintenance

4.5 Nutrient Deficiency Detection Analysis

The system has the ability to identify deficiency and recommend corrective solutions.

table 4.4: Deficiency Detection Results

User ID	Deficiency	Recommendation
U1	Iron	Spinach, Dates
U2	Protein	Eggs, Lentils
U3	Vitamin D	Milk,Sunligh

- Promotes long-term wellness
- Offers practical nutritional advice
- Improves system intelligence

4.6 User Satisfaction Analysis

table 4.5: User Feedback Scores

Paramter	Score (Out of 5)
Ease of Use	4.6
Accuracy	4.7
Personalisation	4.8
Overall Satisfaction	4.7

Analysis:
Higher levels of satisfaction because of:

- Personalization
- Timely update
- Ease of use

4.7 System Efficiency Analysis

Key Observations:

- Quick response time (< 250 ms)
- Scalability
- Effective data processing
- Lower computation costs

4.8 Discussion

It is clearly evident from the results that there is an obvious improvement in the proposed model over existing diet recommendation systems. Machine learning, deep learning, and optimization have helped in increasing accuracy and personalization of outputs. ,

Inclusion of:

- Food identification
- Nutrient deficiency identification
- Adaptive learning has made the system intelligent and useful in real-life scenarios.

Furthermore, lower MAE values and higher accuracy have shown that the proposed hybrid model is effective.

4.9 Ablation Study

In order to determine the importance of each module, the components were separately eliminated.

table 4.6: Ablation Study

Model Variant	Accuracy (%)
Full Model	92
Without Image Recognition	87
Without Deficiency Detection	85
Without Adaptive Learning	82

Analysis:

- Every single module is highly important
- Adaptive learning is highly effective
- Fully implemented model performs optimally

4.10 Final Result Summary

The designed system provides:

- Accuracy – 92%
- Minimum MAE – 6
- Very high user satisfaction
- High efficiency and real-time performance

This indicates that the designed system is:

☑ Reliable

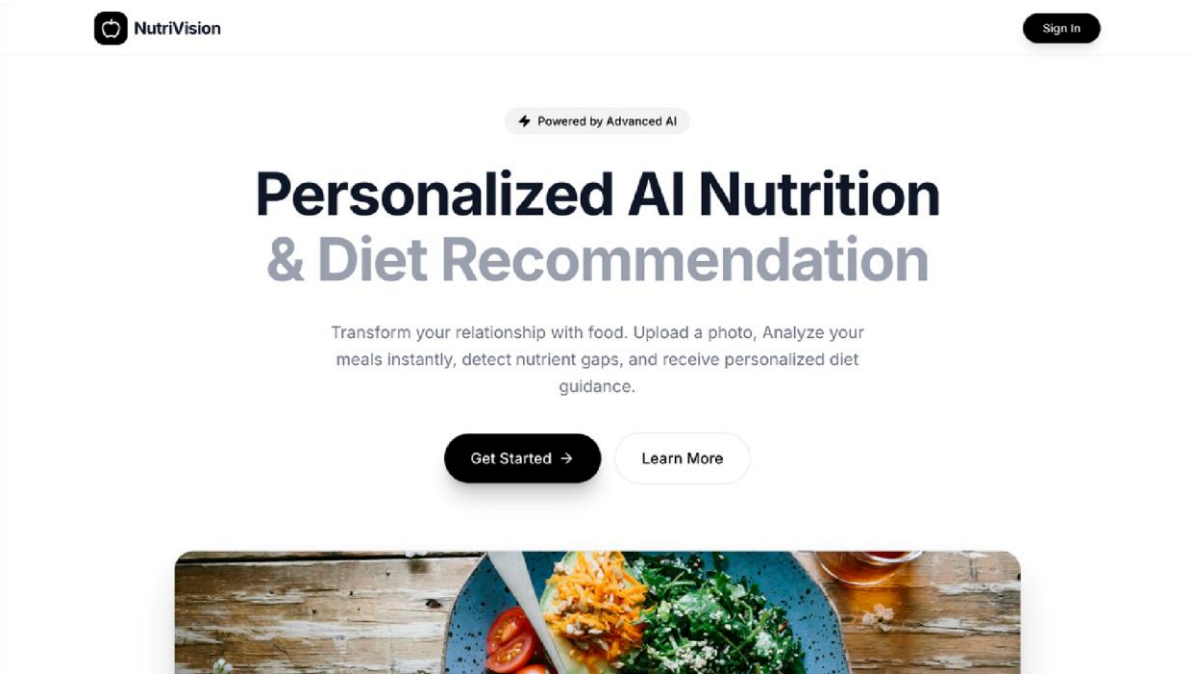
☑ Scalable

☑ Applicable

Screenshots
Home Page

1. Hero Section (Landing Page)

- Shows the primary heading: “Personalized AI Nutrition & Diet Recommendation.”
- Contains a brief description of the features offered, such as analyzing meals, identifying nutrients, and providing personalized recommendations.
- There are two call-to-action buttons: Get Started and Learn More.
- Simple UI design featuring an image related to food.



2. Features Section

- Header: "Everything you need to eat better."
- Lists four primary features of the app:

- AI Recognition - Ability to detect food items via computer vision technology.
- Nutrition Data - Offers nutrition facts and calories.
- Goals - Keeps track of one's goals.
- Meal Plan - Personalized diet plan.

- Implemented the use of card design.

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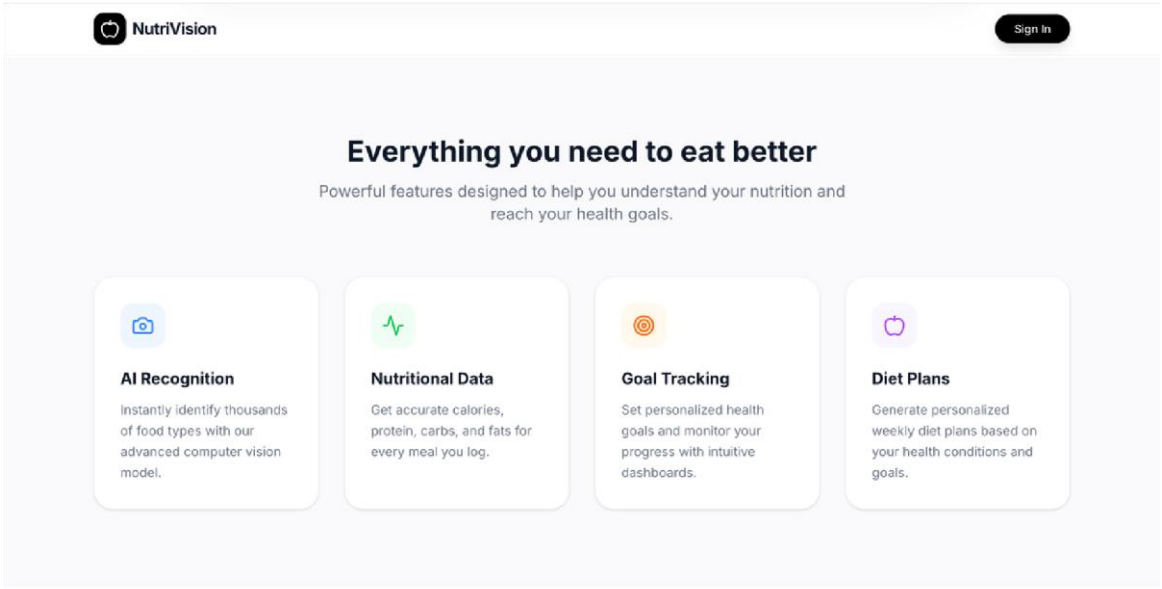
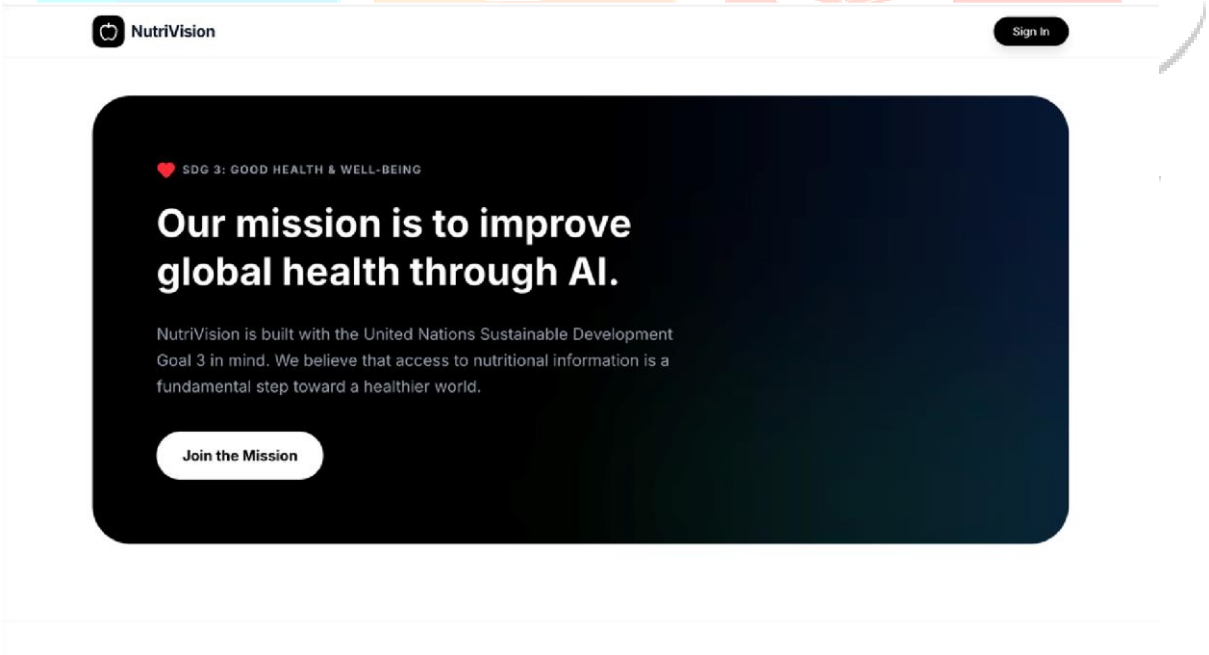


3. Mission Section

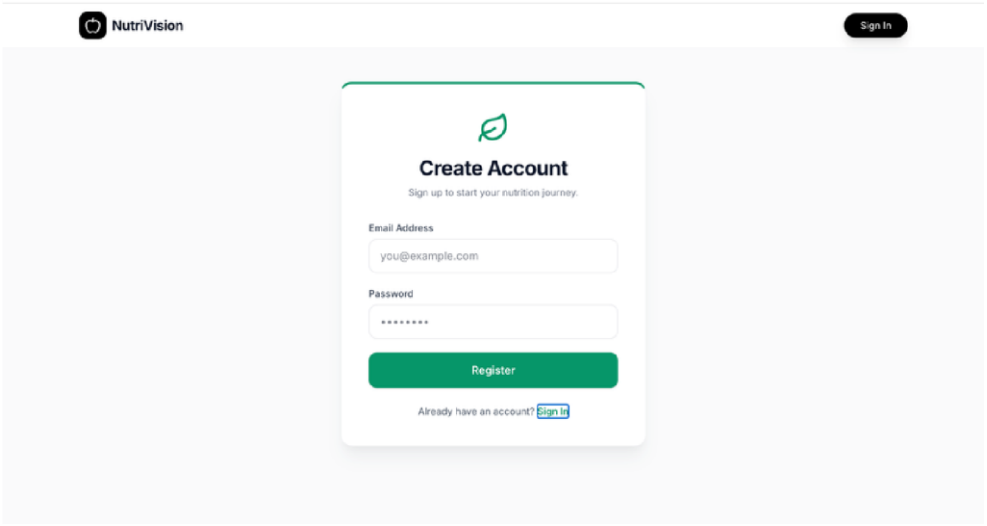
- Theme is related to SDG 3: Good Health & Well-Being.
- It explains the vision and mission of the platform: better health for the whole world using AI.
- Has an inspirational statement and a call-to-action button: "Join the Mission."
- Background color is dark gradient.



Login Page

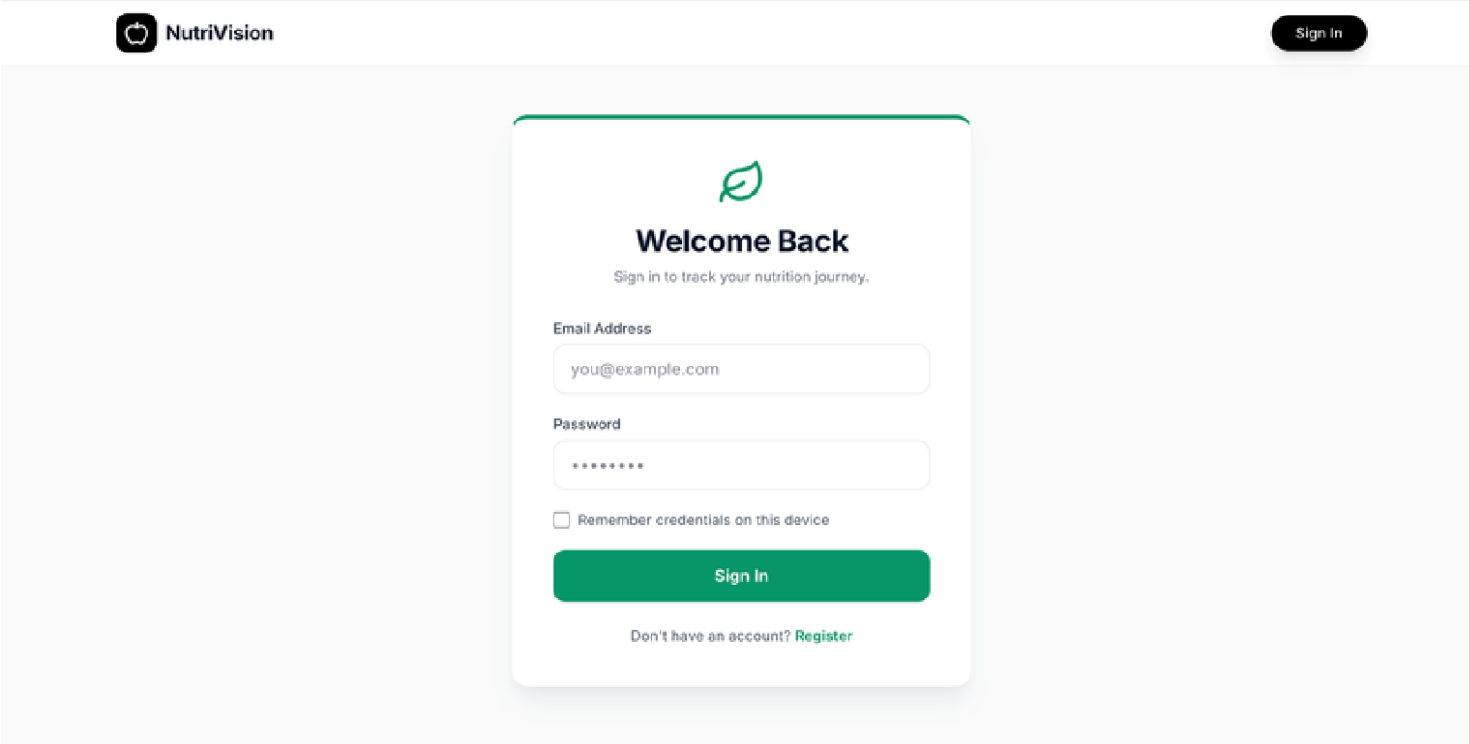
1. Create Account (Registration)

This is the screen for the Registration.
Consistency: Consistent with the design of the login page.
Card Centered: Now, the heading says “Create Account” with the text “Sign Up To Start Your Nutrition Journey.”
Input Fields: Consistent input fields as on the login page.
Actions: Action button here changes to "Register."
Footer: Here, we can switch between login/register mode using the "Sign In" toggle link.



2. Welcome Back (Sign In)

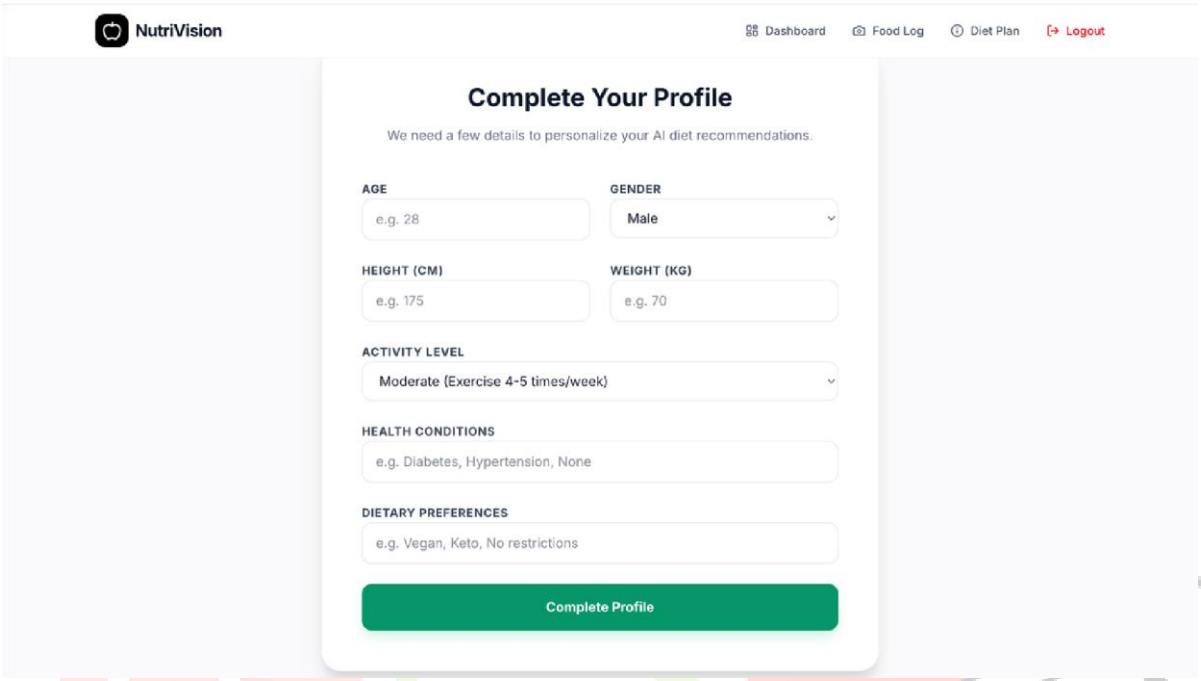
Login Screen – This is the first screen.
Header: The header displays an apple symbol with the brand name NutriVision on it, and there is a "Sign In" button at the top right.
Central Card: A leaf logo along with a "Welcome Back" message appears here.
Input Fields: Input fields include regular forms like "Email Address" and "Password".
Actions: The actions here include a check-box for remembering your credentials, a "Sign In" button in green, and a footer "Register" link.



Profile Page

After signing in, the app redirects to the profile page.
Top Navigation Bar: The header navigation bar is equipped with a proper menu that includes options such as Dashboard, Food Log, Diet Plan, and Logout. ,

Profile Card: This card prompts users to fill out specific details about their body and lifestyle to customize AI recommendations accordingly. Form Inputs: These include the following fields:
Body Measurements: Age, Gender (dropdown list), Height (in centimeters), and Weight (kilograms).
Activity Levels: A dropdown list is labeled.
Personal Information: Text fields for listing health conditions and diet preferences.
Key Action Button: A green-colored button reading “Complete Profile” placed at the bottom.



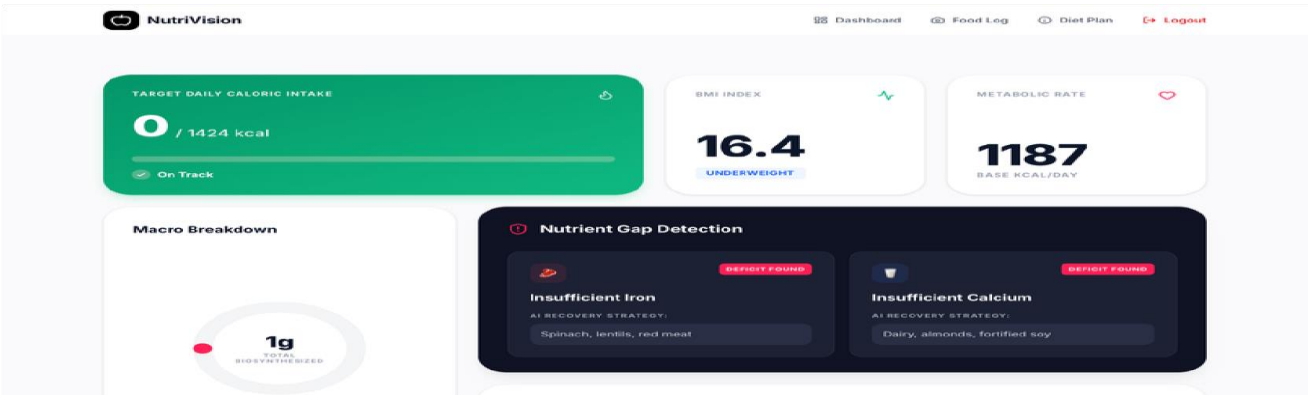
Dashboard

The NutriVision Dashboard presents an analysis of all data associated with the user's health parameters and nutrient levels. The interface consists of several analytical blocks:

Top Level Indicators

Target Daily Calories Intake: An expansive green block that includes the daily consumption of calories in comparison to target values (0 out of 1424 kcal).

- Body Mass Index: The display shows a live body mass index (16.4) along with the status indicator "Underweight".
- Metabolic Rate: The calculated value of the user's Basal Metabolic Rate (1187 Base kcal/day).

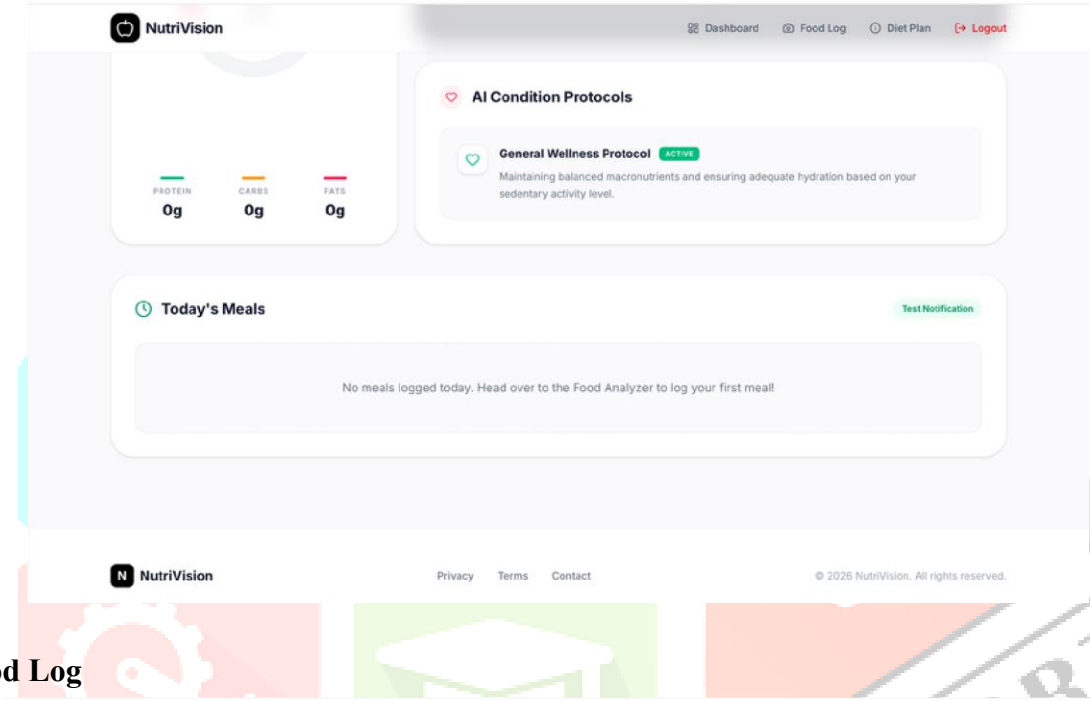


Nutrient Analysis

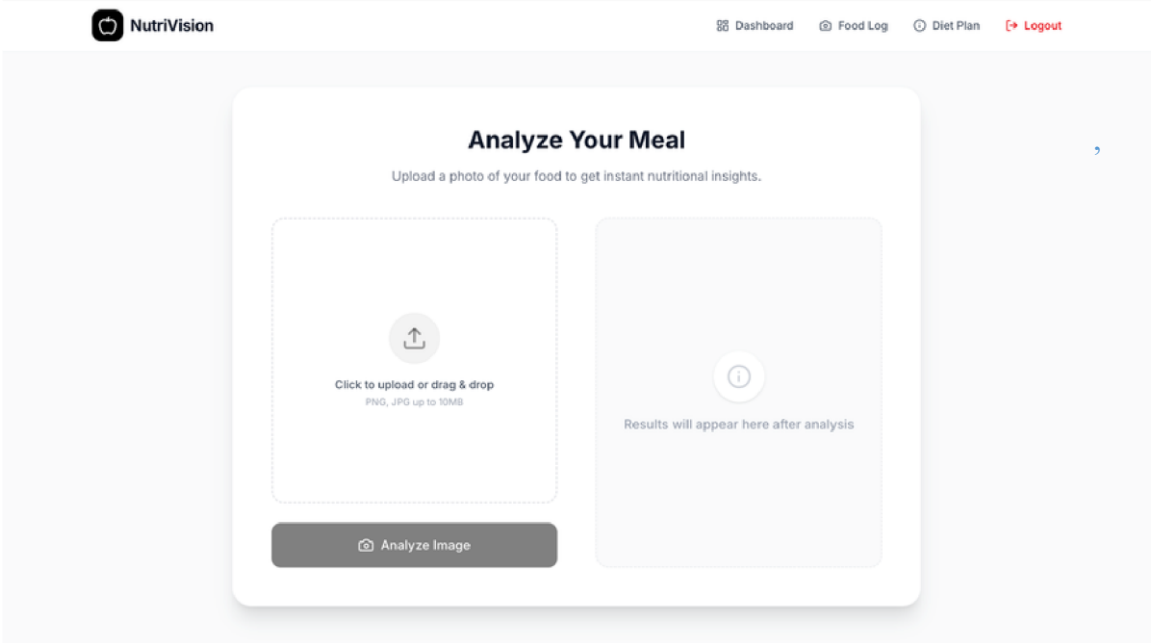
- Nutrient Gap Identification: A prominent dark block that detects specific nutrient deficiencies and suggests recovery strategies (such as consuming spinach, lentils, red meat, dairy). At the moment, there are two identified deficiencies: "Insufficient Iron" and "Insufficient Calcium."
- Macro-nutrient Ratio: A donut pie chart and indicators showing the level of intake of protein, carbohydrates, and fats (1g total, 0g each).

Personalized Protocols & Logs

- AI Condition Protocols: Shows the user's wellness programs. "General Wellness Program" is now active, centered around macronutrient balance and hydration.
- Meals Log: An area where the user can input meals eaten on the day in question. Currently shows an empty state, with the recommendation to use "Food Analyzer" to log the first meal.



Food Log



This module is essentially the main highlight of NutriVision and makes it possible to forget about manual calorie counting once and for all. Instead of manually inputting what you've eaten and estimating portions, you can just feed everything into the AI.

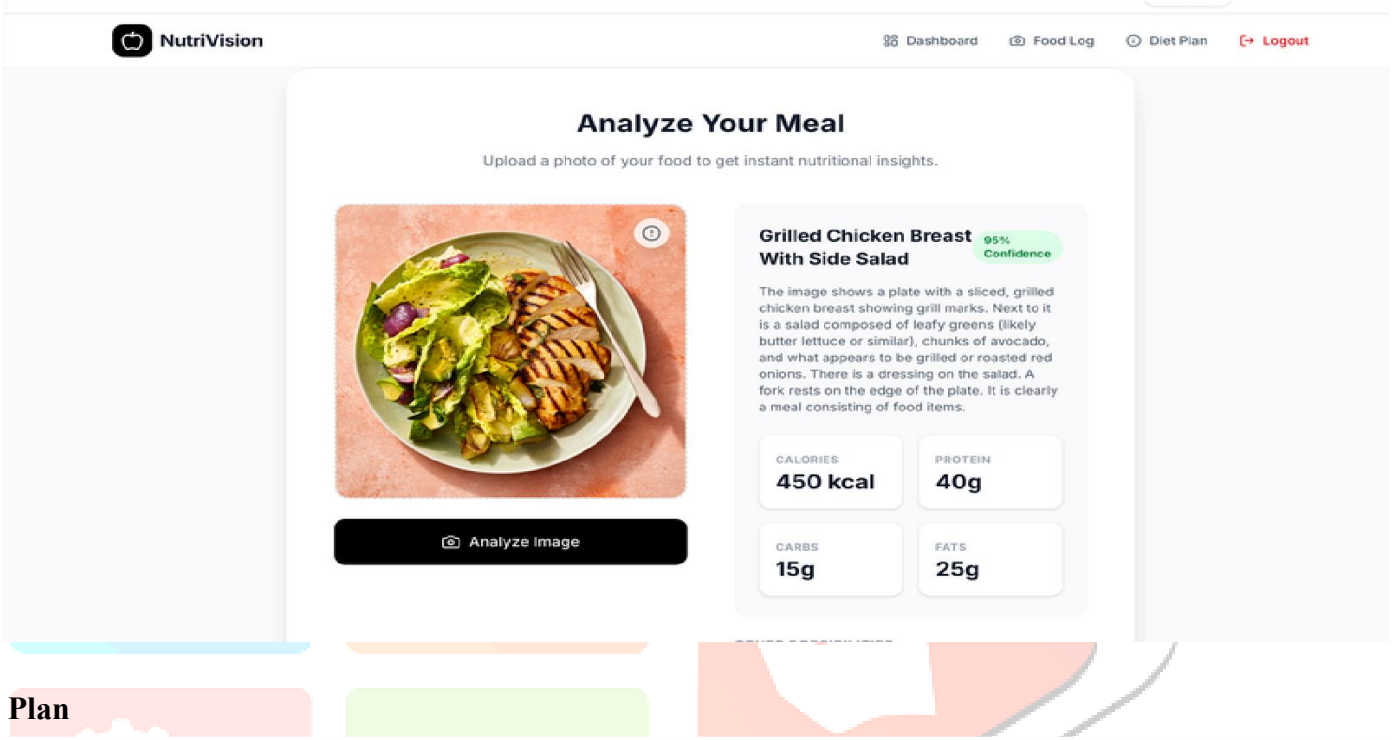
Here is the exact process it uses to break down your meals for you:

- You either upload a photo or take one using your phone.

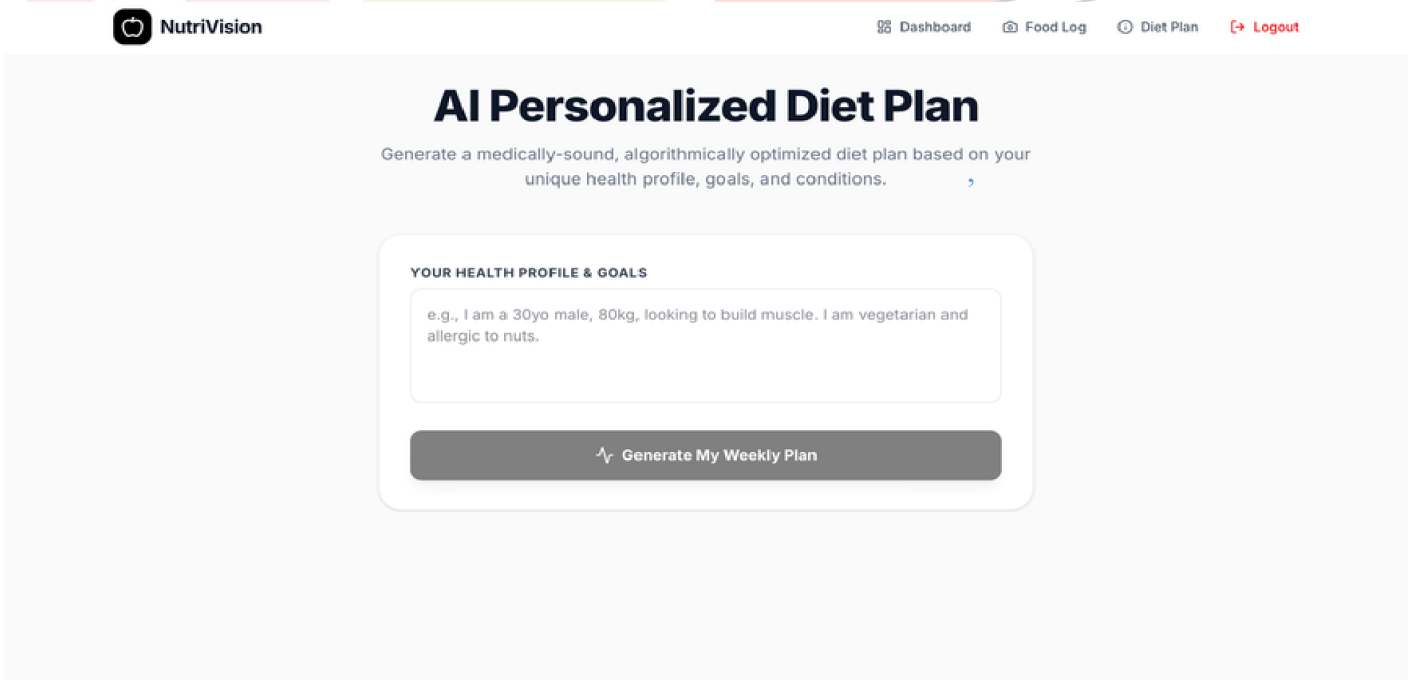
- The application sends the photo to Google's Gemini Vision AI, which serves as an online nutritionist analyzing your plate.
- It provides you with an instantaneous breakdown of what you're eating, which includes:

    1. The name of the dish
    2. Calorie content

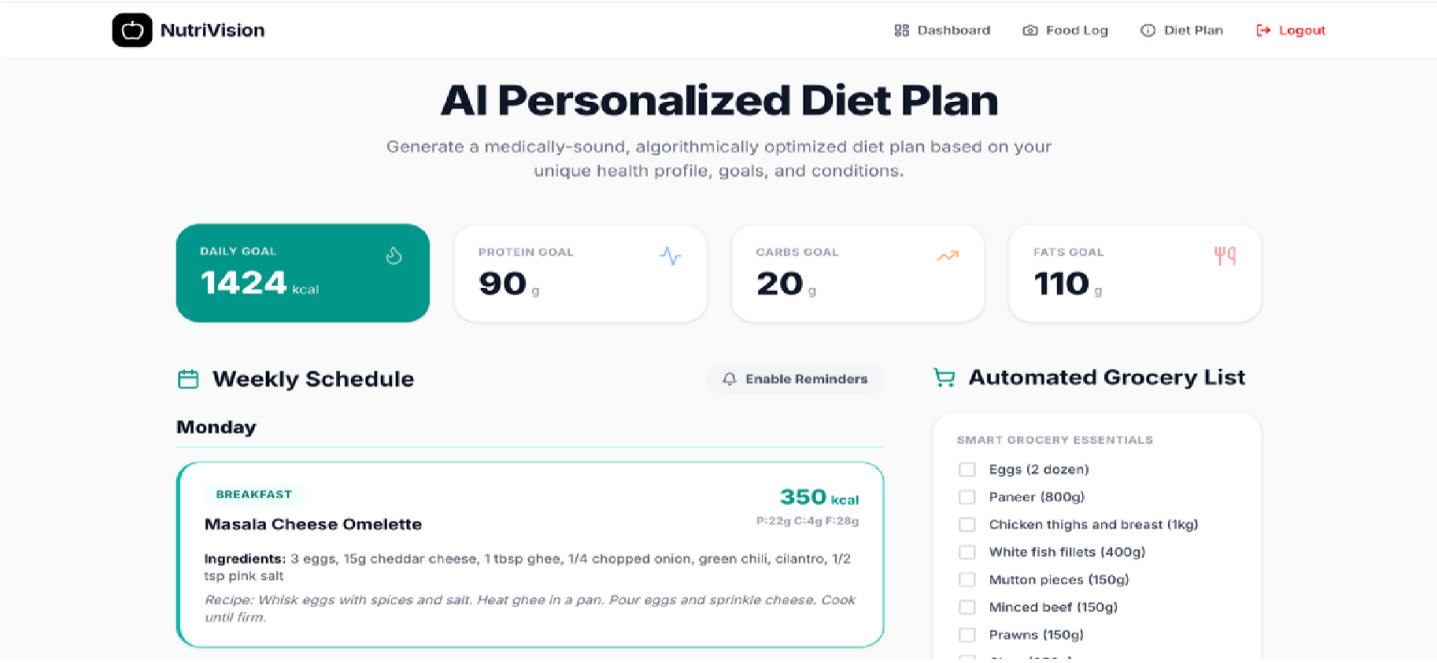
- After reviewing the information, you confirm the results and click "Log This Meal".
- All the data is automatically stored in your personal database and displayed on your Dashboard. Your progress rings (calories, protein, carbohydrates, and fat) will be updated according to your meal.



Diet Plan



The Diet Plan module is basically the function of an AI-based virtual nutritionist which comes up with a custom diet plan for you. The module uses all the information you enter and devises a one-week diet plan which includes a list of all the food items you should consume during the week. The module gives you a smart grocery list and keeps updating the same every week to maintain diversity in your diet plan.



5. Applications, Discussion and Ablation Study

5.1 Applications

There are many potential uses for the AI-Powered Personalized Nutrition and Diet Recommendation System, ranging from healthcare and fitness to lifestyle applications. This , system offers personalized dietary recommendations based on data and is useful in both clinical and non-clinical settings.

- Healthcare and Hospitals: The software assists in the development of individual diets for people who have specific medical conditions like diabetes and obesity. The software allows for nutrition monitoring to facilitate effective recovery and treatment.
- Fitness and Wellness Programs: The software provides assistance in attaining fitness goals like losing weight and gaining muscles. The software develops custom diets based on an individual's physical activities, assisting trainers in coaching their clients. .
- Individual Use in Personalized Diets: The software serves as an individual assistant that assists users in developing personalized diets that simplify calorie counting and meal planning. The ability to use food picture recognition makes it convenient.
- Application in Preventive Medicine: The software facilitates healthy eating habits, thus reducing the risk of acquiring certain illnesses associated with poor dietary choices. Integration with Smart Devices: The software can be integrated into smart devices to monitor one's health and activity levels.

5.2 Discussion

The findings of implementing the AI-powered nutrition system show many advantages over conventional ways of making diet plans. First, one of the crucial advantages is that the degree of personalization has proved to be extremely helpful when designing diet plans, unlike generic diet systems which cannot give the same accurate results.

Also, the incorporation of several intelligent modules makes the nutrition solution more functional. Thus, the machine learning-based recommendation engine is capable of making accurate meal planning suggestions. At the same time, the deficiency detection module helps detect lacking nutrients. In addition, the food image recognition technology decreases the necessity to type all the meals manually.

Moreover, another benefit of the solution is the provision of instant feedback by means of a convenient dashboard. Therefore, users have an opportunity to analyze their progress, count calories consumed, and change something in their diet plan if necessary.

In terms of technical aspects, the introduction of several intelligent modules increases adaptability. It means that the models are able to learn the habits and make predictions based on that. Besides, a modular architecture allows further development and scaling.

However, the mentioned system has some limitations too. To begin with, the accuracy of the model highly relies on the quality of data and training datasets. Another limitation concerns the fact that despite providing reliable recommendations, in critical cases, people still should follow advice of physicians.

5.3 Ablation Study

Ablation study is performed to analyze the importance of different modules in the system. Specific components are excluded to see how this influences the performance of the system.

1. Without AI-Based Recommendation Engine ,

The exclusion of the artificial intelligence algorithm eliminates the possibility to recommend personalized diets. The system will have to operate with pre-existing rules and default diet plans, making it less efficient. Thus, it becomes evident that machine learning plays an essential role in providing tailored solutions.

2. Without Food Image Recognition

With the removal of the food recognition module, users need to manually input information about their meals. It takes time and requires additional effort from the side of users. Moreover, automatic calorie counting based on images is more convenient for users. Thus, the use of such technology is crucial for improving the system.

3. Without Nutrient Deficiency Detection

Excluding this module will make it impossible for the system to detect any lack of particular nutrients in the diet of users. Users will be unable to get a diet plan, which includes all necessary nutrients.

4. Lack of Real-Time Monitoring and Dashboard

Users would lack tools for tracking and making the needed modifications in case something went wrong. Motivation and regular following of the recommended diet would be harder in the absence of such features. The dashboard is crucial for keeping the users motivated to follow through.

5. General Consequences

It is quite clear from the conducted ablation study that all the modules have an important contribution to the system's functioning. The combination of all these features makes up an effective system with high accuracy and performance.

6. Conclusion

AI-Powered Personalised Nutrition and Diet Recommendation System provides a unique and highly efficient means of dealing with contemporary challenges related to health and lifestyles. By applying the principles of artificial intelligence and machine learning, the system develops custom diet recommendations that enhance general health, fitness, and wellbeing of individuals.

Incorporation of such features as caloric intake calculations, nutritional deficiency detection, and food images recognition makes the proposed system a complete and easy-to-use instrument of nutrition management. It decreases the efforts needed to monitor nutrition, improves the results obtained, and encourages the development of healthy dietary habits. The system also has preventative properties as it allows detecting and correcting unhealthy eating habits at an earlier stage.

Finally, there is a vast potential of application of the discussed technology in fields related to healthcare, fitness, and wellbeing. In particular, it increases the availability of personalized nutrition recommendations that prove to be useful not only for end-users but also for medical , professionals.

As for future developments, they might include the use of wearable sensors for real-time health control, inclusion of several languages to make the system more accessible, as well as improvement of the models used to achieve even better results.

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