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Nutri-Guide: An Intelligent System for Personalized Dietary Management and Nutritional Analysis

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Abstract: Food plays an important role in maintaining a healthy lifestyle, but identifying nutritional values and monitoring daily calorie intake can be difficult and time-consuming. To overcome this challenge, NutriGuide is developed as a web-based food recognition and nutritional analysis system that helps users identify food items and maintain healthy eating habits.The system uses machine learning and image processing to recognise food from uploaded images. It combines an Indian food classification model containing 102 categories with the Food-101 model to provide food predictions. Once identified, nutritional information is retrieved from an Indian food database containing 184 dish records, 190 aliases and 197 portion measures. It provides details such as calories, protein, carbohydrates, fats and fibre, with portion-based nutritional calculations NutriGuide also includes barcode scanning using Open Food Facts, user profile management, dietary preferences, meal logging, diet suggestions, water tracking and dashboard summaries. The application is developed using React, TypeScript, FastAPI, Python and SQLite. The Indian food classification model achieved 56.5% top-1 accuracy and 82% top-5 accuracy on 1,698 holdout images, while 135 backend tests passed successfully.Overall, NutriGuide combines food recognition, nutritional analysis and daily food tracking in a single platform to help users make informed dietary choices and develop healthier eating habits.

Keywords: Food Recognition, Nutritional Analysis, Machine Learning, Indian Food Classification, Calorie Estimation, Diet Recommendation, Barcode Scanning.

I. INTRODUCTION

NutriGuide is a web-based food recognition and nutrition analysis system developed to help users maintain healthy eating habits. It uses machine learning to identify food items from images and provides nutritional details such as calories, protein, carbohydrates and fats. The system also includes Indian food recognition, barcode scanning, portion-based calorie calculation, personalised diet suggestions, meal tracking and water tracking.Food plays an important role in maintaining a healthy lifestyle. However, many people find it difficult and time-consuming to identify food ingredients, estimate serving quantities and calculate nutritional values manually. Understanding the nutritional content of daily meals helps individuals make better food choices and maintain balanced eating habits. Image processing and machine learning provide an easier way to recognise food from photographs and retrieve nutritional information from a food database.

Food recognition can be challenging because different dishes may have similar appearances, and the same food may look different depending on its preparation, ingredients and presentation. This is especially important for Indian cuisine, which includes many regional dishes such as dosa, idli, upma, pongal and medu vada. General food classification models may not recognise all these dishes accurately due to limited Indian food categories.

To address these challenges, NutriGuide combines an Indian food classification model containing 102 categories with the existing Food-101 model. It also uses food-name normalisation and alias matching to identify alternate food names. Once a food item is recognised or confirmed, its nutritional information is retrieved from the database. Users can adjust the serving quantity, and the system calculates the corresponding nutritional values based on per-100-gram data.Additionally, NutriGuide provides user profiles, dietary preferences, meal logging, personalised diet suggestions, water tracking and dashboard summaries. Users can record meals under breakfast, lunch and dinner and monitor their food intake. The barcode scanning feature uses the Open Food Facts service to retrieve available packaged food details. Overall, NutriGuide provides a single platform for food recognition, nutritional analysis and daily food tracking, helping users make informed dietary choices.

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A. PROBLEM DEFINITION

To develop a web-based food recognition and nutritional analysis system that identifies Indian food items, calculates nutritional values based on serving quantities and helps users monitor their daily food consumption.

B. PROBLEM OVERVIEW

Identifying food items, calculating nutritional values and monitoring daily calorie intake manually can be difficult and time-consuming. Existing food recognition models may not accurately identify all regional Indian dishes due to their different appearances and preparation methods. Users may also face difficulties in estimating serving quantities, finding correct nutritional information and maintaining regular meal records. Therefore, there is a need for a system that combines food recognition, portion-based nutrition calculation, barcode scanning and daily food tracking in a single platform.

II. PROBLEM STATEMENT

To design and develop NutriGuide, a web-based food recognition and nutritional analysis system that uses machine learning to identify Indian and other food items from uploaded images. The system retrieves nutritional information from a food database and calculates calories and nutrients according to the selected serving quantity. It also provides barcode lookup for packaged food products, user profile management, dietary preferences, meal logging, water tracking and general diet suggestions. The main aim is to simplify food analysis, improve nutritional awareness and help users make better dietary choices.

III. OBJECTIVES

1. To identify Indian and international food items from uploaded images using machine learning.
2. To preprocess food images and improve classification accuracy.
3. To integrate Indian food datasets with Food-101 for better food recognition.
4. To display nutritional information such as calories, protein, carbohydrates, fats and fibre.
5. To calculate nutritional values based on selected food portions.
6. To retrieve packaged food information through barcode scanning using Open Food Facts API.
7. To provide diet suggestions based on user preferences, allergies and calorie requirements.
8. To maintain daily meal records for breakfast, lunch and dinner.
9. To track daily nutrition, water intake and weekly dietary progress.
10. To evaluate the system's accuracy, functionality and overall performance.

IV. LITERATURE SURVEY

1. Enhancing Dietary Management using Deep Learning (2026) – Karthikeyan et al.
This paper uses deep learning techniques for food recognition and nutritional analysis. It helps identify food items and understand their nutritional values. However, it requires high computational power.

2. Food Recognition with CNN + Attention (2024) – Abiyev et al.
This paper uses Convolutional Neural Networks (CNN) with an attention mechanism to improve food recognition accuracy. It helps the model focus on important features of food images. However, it requires a larger dataset for better performance.

3. Food Calorie Estimation using Deep Learning (2024) – Kalivaraprasad et al.
This paper focuses on estimating calories from food images using deep learning techniques. It helps users understand the calorie content of food. However, the estimation accuracy depends on the quality of the input image.

4. CV-Based Nutrient Detection Review (2024) – Chang Liu et al.
This paper reviews different computer vision and AI techniques used for food recognition and nutritional analysis. It explains how these technologies help in dietary management. However, accuracy remains a major challenge.

5. Image Based Food Classification and Volume Estimation (2020) – Frank Po Wen Lo et al al.
This paper reviews image-based food classification and different methods used to estimate food volume. It explains how food images can be used to identify food items and estimate their quantities. However, accuracy issues still remain.

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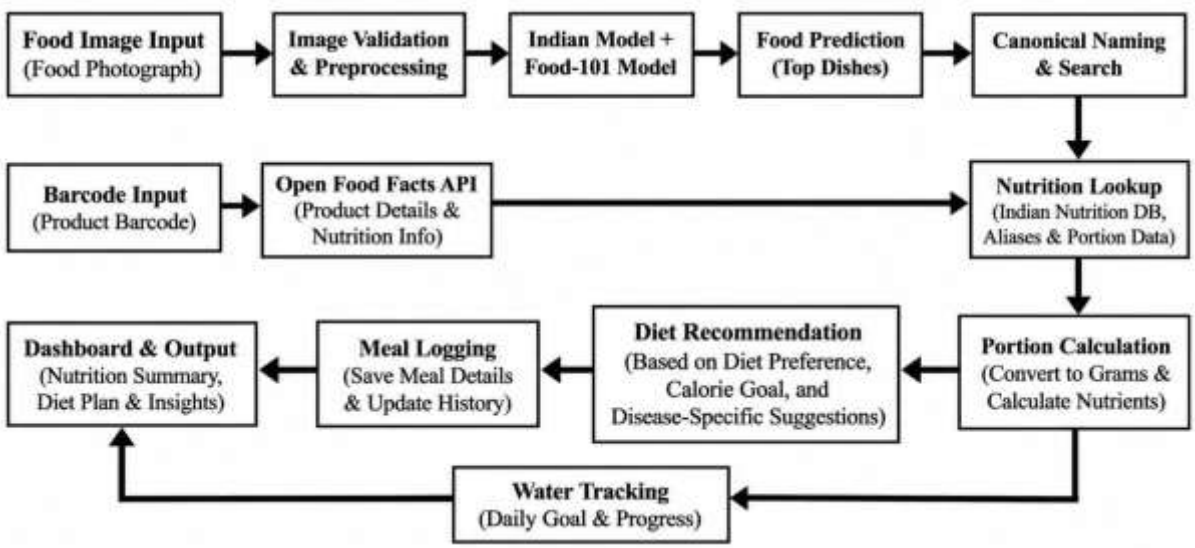
V. METHODOLOGY

The methodology of NutriGuide follows a systematic approach to develop a web-based food recognition and nutritional analysis system. It combines machine learning, image processing, a structured nutrition database and user tracking features to simplify food identification and nutritional monitoring. The application follows a client-server architecture, using React, Vite and TypeScript for the frontend, FastAPI and Python for the backend, and SQLite with SQLAlchemy for database management. TensorFlow/Keras is used for food classification.Initially, users can upload food images or enter/scan barcodes of packaged food products. The uploaded images are validated and preprocessed before being passed to two classification models: an Indian food classifier containing 102 categories and the Food-101 model. Their predictions are combined to identify possible food items. Canonical naming and alias matching are used to connect alternate spellings and regional food names with standard food records.

Once the food item is identified or confirmed, the system retrieves its nutritional information, including calories, protein, carbohydrates, fats, fibre and other nutrients from the food database. Users can select serving quantities such as grams, cups or bowls, and the system calculates the corresponding nutritional values based on the selected portion.For packaged food products, NutriGuide uses the Open Food Facts service to retrieve available product and nutritional details through barcode lookup. Users can also save food records under breakfast, lunch and dinner, manage dietary preferences, receive general diet suggestions and track daily water consumption.

Finally, the dashboard displays nutritional summaries, meal history and weekly insights to help users monitor their food intake. The application is evaluated through food classification testing, automated backend tests, API checks and manual testing. Overall, this methodology connects food recognition, nutritional analysis and meal tracking in a single platform to help users make informed dietary choices.

A. SYSTEM WORKFLOW



The NutriGuide system works through a sequence of steps, starting from food image or barcode input and ending with nutritional analysis, diet suggestions and tracking facilities.

1. FOOD IMAGE INPUT

The user uploads a photograph of a food item through the application. The image is used as the input for food recognition.

2. IMAGE VALIDATION AND PREPROCESSING

The system checks whether the uploaded image is valid and in a supported format. The image is then resized and preprocessed according to the requirements of the classification models before analysis.

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3. INDIAN MODEL + FOOD-101 MODEL
The system uses two food classification models. The Indian food model contains 102 food categories, while Food-101 provides additional food categories. Both models analyse the uploaded image and generate possible food predictions.

4. FOOD PREDICTION (TOP DISHES)
Based on the model results, the system displays the most likely food items as predictions. The user can select or confirm the correct food item from the available suggestions.

5. CANONICAL NAMING AND SEARCH
The system matches different spellings and regional names with standard food names. For example, idly and idli are treated as the same food item. This helps the system find the correct nutritional information from the database.

6. BARCODE INPUT
Apart from uploading food images, users can enter or scan the barcode of packaged food products. This provides another method of identifying food products.

7. OPEN FOOD FACTS API
The barcode is sent to the Open Food Facts service to retrieve available product details, such as product name and nutritional information. If the product is found, its details are displayed to the user.

8. NUTRITION LOOKUP
After identifying the food item, the system searches the Indian nutrition database. It retrieves nutritional details such as calories, protein, carbohydrates, fats, fibre, sugar and other nutrients.

9.PORTION CALCULATION
The user selects the quantity of food they want to consume, such as grams, cups, bowls or katoris. The system converts the selected serving into grams and calculates the nutritional values based on the per-100-gram reference.

10. DIET RECOMMENDATION
Based on the user's dietary preferences, calorie goals and available health information, the system provides general diet suggestions. It helps users understand suitable food choices and maintain balanced eating habits.

11.MEAL LOGGING
Users can save their selected food items under breakfast, lunch or dinner. The saved records are maintained in the application so that users can check their previous meals and monitor their food consumption.

12.WATER TRACKING
The application allows users to enter their daily water consumption. It displays their water intake progress and helps them monitor their daily water goal.

13.DASHBOARD AND OUTPUT
Finally, the dashboard displays the overall nutritional summary, saved meal history, diet plans, water intake and weekly insights. Users can review their food consumption and understand their daily nutritional intake

VI. SYSTEM ARCHITECTURE

A. System Architecture Overview
The system architecture of NutriGuide describes the overall structure and working process of the application. It explains how different components, including the frontend, backend, food recognition models, nutrition database, external API and recommendation engine, work together to provide food recognition and nutritional analysis. NutriGuide follows a **client-server architecture** in which the frontend is developed using React 19, Vite and TypeScript, while the backend uses FastAPI and Python. SQLite with SQLAlchemy is used for database management, and TensorFlow/Keras is used for food classification. The system accepts two types of input: food images and packaged food barcodes. For image-based recognition, uploaded images are validated and preprocessed before being passed to the Indian food classification model (102 categories) and Food-101 model. The models generate possible food predictions, which are processed using prediction ranking and canonical naming to identify suitable food records.

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For barcode-based identification, the application connects to the Open Food Facts API to retrieve available product details and nutritional information. After identifying the food item, the system retrieves nutritional values from the Indian nutrition database and calculates them according to the selected serving quantity. The application also includes a recommendation engine, meal logging and water tracking facilities. Finally, the output is displayed through the dashboard, which provides nutritional summaries, diet suggestions, meal history and tracking information.

B. Overall System Architecture
The NutriGuide system is organised into the following major layers:

1. **User Layer:** Allows users to upload food images, enter barcodes and access application features.

2. **Frontend Layer:** Provides the user interface for food recognition, nutritional results, diet suggestions and tracking.

3. **Backend Layer:** Handles image processing, food classification, nutrition lookup, portion calculation and application logic.

4. **Food Recognition Layer:** Uses the Indian food model and Food-101 model to identify food items.

5. **External API Layer:** Uses Open Food Facts to retrieve packaged food product information through barcode lookup.

6. **Database Layer:** Uses SQLite and SQLAlchemy to manage food records, user information, aliases, portions and meal history.

7. **Recommendation and Tracking Layer:** Provides diet suggestions, meal logging and water tracking.

8. **Output Layer:** Displays nutritional information, meal history, dashboard summaries and other results.

C. Overall Working
The user provides a food image or barcode as input. The system processes the input, identifies the food item, retrieves its nutritional information and calculates nutrients based on the selected portion. It then provides diet suggestions and allows users to save meal records and track water consumption. Finally, all relevant information is displayed through the dashboard.

VII. IMPLEMENTATION

The NutriGuide system is implemented as a web-based application that combines food recognition, nutritional analysis and daily food tracking. The frontend is developed using React 19, Vite and TypeScript, while the backend uses FastAPI and Python. SQLite with SQLAlchemy is used for database management, and TensorFlow/Keras is used for food classification.The application provides a user-friendly interface for uploading food images, entering barcodes, viewing nutritional details, managing user profiles and tracking daily food consumption. The food recognition module validates and preprocesses uploaded images before passing them to the Indian food classification model and Food-101 model to generate possible food predictions. A food name-matching module uses canonical names and aliases to identify regional food names and connect predictions with the nutrition database.The nutritional analysis module retrieves information such as calories, protein, carbohydrates, fats, fibre and sugar for the identified food items. The portion calculation module allows users to select quantities in grams, cups, bowls and katoris and calculates nutritional values based on the selected serving size. The barcode scanning module integrates the Open Food Facts API to retrieve packaged food product details and nutritional information.The system also includes a diet recommendation module that provides general meal suggestions based on user profiles, dietary preferences and calorie requirements. Users can record their meals under breakfast, lunch and dinner and track their daily water intake. The dashboard displays nutritional summaries, meal history, water consumption and weekly dietary insights. Finally, the application is evaluated through model testing, automated backend tests, API checks and manual testing. The Indian food classification model achieved **56.5% top-1 accuracy and 82% top-5 accuracy** on 1,698 holdout images, while the backend test suite successfully completed 135 tests.

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VIII. RESULTS AND DISCUSSION

Results

The NutriGuide application was successfully developed as a web-based food recognition and nutritional analysis system. It combines machine learning, nutritional data and food-tracking features in a single platform.

The application identifies food items using the Indian food classification model (102 categories) and Food-101 model. The Indian food model achieved **56.5% top-1 accuracy and 82% top-5 accuracy** on 1,698 holdout images.

The nutrition database contains 184 dish records, 190 aliases and 197 portion measures. The system provides nutritional details such as calories, protein, carbohydrates, fats and fibre, along with portion-based calculations. It also supports barcode lookup, diet suggestions, meal logging, water tracking and dashboard summaries. The backend test suite successfully completed 135 tests.

Discussion

The results show that NutriGuide provides an integrated platform for food identification and nutritional tracking. Combining two food classification models helps support different food categories, including Indian dishes. The nutrition database and portion calculation features help users understand the nutritional value of their meals.

Barcode lookup provides product information through Open Food Facts, while meal logging and water tracking help users monitor their daily activities.

However, food recognition accuracy can be affected by image quality and similar-looking dishes. Nutritional calculations also depend on correct food identification and serving quantities. Therefore, further improvements are needed to increase recognition accuracy and portion estimation reliability.

A. Overall Outcome

Overall, NutriGuide successfully integrates food recognition, nutritional analysis, barcode scanning and daily tracking features into one application. It simplifies food analysis and helps users make informed dietary choices.

Suggestion: Include screenshots of your application pages, such as food recognition, nutrition results and dashboard, to make the Results and Discussion chapter stronger.

CONCLUSION

NutriGuide was developed as a web-based food recognition and nutritional analysis system to make food tracking easier and support healthy eating habits. It uses machine learning models to identify Indian and other food items from images and provides nutritional information such as calories, protein, carbohydrates, fats, fibre and other nutrients.

The system uses an Indian food classifier and the Food-101 model, along with food-name matching and a nutrition database. It estimates nutritional values based on the selected portion size and also supports barcode-based product lookup using the Open Food Facts API. Additional features such as user profiles, diet suggestions, meal logging, water tracking and dashboard summaries help users monitor their daily food habits.

The Indian food classifier achieved 56.5% top-1 accuracy and 82% top-5 accuracy on 1,698 holdout images, while 135 backend tests passed. Although the system provides useful nutritional estimates, its performance depends on image quality, correct food identification and portion selection.

Overall, NutriGuide combines food recognition, nutritional analysis and daily food tracking in a single platform. It can be further improved by increasing the dataset, improving recognition accuracy and adding more advanced personalized dietary feature.

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