

Data-Driven Smart Food Analytics and Nutrition Advisor

T. Durga¹, Alluri Janani Sahasra², Pericherla Shriya³, Pegetraju Sai Jostna Manaswini⁴,
Peddapatlolla Sahithi⁵

^{1,2,3,4,5}*Department of Information Technology, BVRIT Hyderabad College of Engineering for Women,
Hyderabad, India*

Abstract—People who want to live healthy should track their daily food consumption according to expert recommendations. The existing applications require users to enter data manually which causes them to repeat tasks until they lose interest. The project develops a Data-Driven Smart Food Analytics and Nutrition Advisor which assists users in their dietary analysis work while delivering better quality dietary information. The system uses the Google Gemini API to handle both image and text input which enables automatic food item detection and nutritional value estimation without users needing to enter detailed information. The system needs to track user behavior through food consumption analysis instead of just determining the total calories they consume. The system analyzes collected data to discover patterns and assess dietary completeness while generating customized recommendations based on user preferences and health objectives. The system uses MongoDB Atlas to control all data storage which allows efficient user record management and system expansion. The system uses a visual dashboard to present information which shows patterns that develop over time through user-friendly graphical elements. The system helps users improve their food selection through meal evaluation and intake alert features which present information in an understandable format. The proposed method changes how we track diets, moving from a manual process to an automated system that provides useful information. The system promotes regular usage through its combination of multimodal input processing and cloud storage and visual analytics capabilities which help users make healthier choices throughout their everyday activities.

Index Terms—Nutrition Monitoring, Multimodal Input, Google Gemini API, Calorie Estimation, Data Visualization, MongoDB Atlas, Dietary Insights

I. INTRODUCTION

The rapid growth of digital technologies have brought about significant transformations to contemporary

healthcare systems which handle patient care and lifestyle management [1], [2]. People have developed increased awareness regarding the necessity of maintaining a healthy diet because it helps them prevent obesity and diabetes and heart disease. People still encounter difficulties when they want to track their daily food consumption and understand the nutritional information of their meals. The process of monitoring dietary intake through traditional methods requires extended time periods because it depends on basic calorie calculations.

In real life, Users in real life experience difficulties with food tracking because they have busy schedules and lack knowledge about the nutritional content of their meals. It becomes difficult to determine appropriate serving sizes while assessing both food content and healthiness of items. The majority of apps which exist today fail to provide any valuable insights to users. The existing applications show their users only their consumed calorie amount because the applications fail to display users' complete understanding of their macro nutrient distribution and food intake balance.

Artificial Intelligence has reached a stage where its current technological progress provides workable answers to existing problems. Multimodal AI models are capable of analyzing both food images and textual descriptions to identify food items and estimate their nutritional values [3]. The systems successfully handle intricate meal compositions while they detect changes in food presentation and they minimize the requirement for users to enter information manually. Data analytics methods help convert basic dietary information into valuable dietary patterns which users can use to track their advancement and make healthy food choices. The system benefits from real-time analysis because it enhances both user comfort and operational efficiency [4]. In addition, the system

supports continuous monitoring of dietary habits, allowing users to track their progress over time.

The Data-Driven Smart Food Analytics and Nutrition Advisor which this study presents as a solution to these problems functions as an online dietary monitoring system which helps users track their meals while delivering customized dietary recommendations. The system allows users to input data through food images and text descriptions while it produces structured results which include calorie calculations and macronutrient breakdowns and dietary assessment. The system implements interactive dashboards together with alert systems which alert users about their consumption of harmful foods and their calorie intake problems.

The proposed system uses multimodal AI-based food recognition and automated nutritional analysis and data-driven insights together with interactive dashboards which operate through a user-friendly interface to enable users to understand their dietary intake and develop healthier eating patterns which will help them avoid future health problems. The system creates a major advancement toward digital health solutions which use intelligent systems to provide users with personalized support for better nutritional choices and long-lasting health benefits [5].

II. RELATED WORK

In recent years, Artificial Intelligence has played a major role in improving dietary monitoring systems. Many modern applications now use AI to simplify food tracking, estimate nutritional values, and provide meaningful health insights. Since the proposed system combines food recognition, nutrition analysis, and data visualization, the related work is discussed based on the main components of the system.

A. Food Recognition and Dietary Assessment

Food recognition is one of the most important parts of automated dietary systems. Recent studies show that AI can identify food items from images and estimate their nutritional content with good accuracy. Shobana S et al. [1] proposed system shows how AI-based food analytics can improve dietary tracking by reducing manual effort.

Similarly, smart food detection systems such as [6] are designed to recognize food items even in complex scenarios, including mixed dishes and different

cuisines. While these systems make food logging easier, challenges like accurate portion size estimation and hidden ingredients still remain.

B. Multimodal AI and Smart Dietary Monitoring

Modern dietary monitoring systems increasingly adopt multimodal approaches combining image and text inputs. A smart dietary monitoring system proposed by Shajith S. et al. [2] integrates multiple input methods to improve flexibility and user interaction.

Furthermore, deep learning-based dietary monitoring approaches [4] demonstrate that combining different data sources enhances system performance and reliability. Food recognition using AI models [3] further supports the effectiveness of multimodal processing in improving accuracy for real-world dietary applications.

C. Nutritional Analysis and Calorie Estimation

Jayabhaduri R. et al. proposed Nutrition monitoring system analysis [7] that emphasizes the importance of automated calorie estimation and macro-nutrient computation for effective health tracking.

Recent studies in nutritional analysis using AI systems [8] highlight that automated tools can estimate calories, proteins, carbohydrates, and fats with high consistency. Additionally, advanced nutrition analytics frameworks [9] demonstrate how data-driven approaches can provide deeper insights into dietary patterns and support preventive healthcare.

D. Food Data Analytics and Visualization Systems

Data analytics plays a crucial role in understanding dietary patterns and trends. Food data analytics applications proposed by Ashoka S. [10] focuses on extracting meaningful insights from nutritional data through structured analysis and visualization techniques.

Interactive dashboards and visualization tools enable users to monitor calorie intake and macro-nutrient distribution over time. These systems improve interpretability and enhance user engagement compared to traditional numerical reporting methods.

E. AI-Based Personalized Recommendation System

AI-based nutrition recommendation systems [11] use user-specific data which includes age and weight and activity level information to create personalized dietary recommendations.

In AI in personalized nutrition systems, Pawan Whig et al.

[5] demonstrated the importance of individualized recommendations in improving dietary habits and achieving health goals. These systems provide actionable insights, including health scores and improvement suggestions, enhancing decision-making capabilities for users.

F. Smart Integrated Dietary Monitoring Platforms

Recent research is moving towards building complete systems that combine all features into a single platform. Studies such as [1], [2], and [12] show that integrating food recognition, nutrition analysis, and visualization improves overall system performance and user experience.

However, many existing systems still focus on only one part of the problem, such as food detection or analytics. This creates a gap where users do not get a complete solution in one place. Therefore, there is a need for systems that bring together all components into a unified and easy-to-use platform.

III. PROBLEM STATEMENT

People need to track their daily food intake because this practice helps them sustain proper nutritional balance. Most people struggle to maintain this practice because they find it challenging to keep up with their daily food consumption. Most calorie tracking applications force users to repeat the same process because they need to enter every food item by hand which creates greater work demands. Users of these applications stop using them because their motivation declines when they fail to see their actual eating patterns.

The first hurdle requires people to determine their actual food consumption while estimating its nutritional content. Users face difficulties in identifying the complete ingredient list and food quantity when they order mixed dishes or restaurant meals. Manual tracking becomes both burdensome and untrustworthy because it decreases the performance of dietary tracking systems.

Current solutions only provide calorie information when they should deliver complete dietary behavior analysis and individualized dietary recommendations. Users need proper

guidance to determine their dietary balance and identify methods to enhance it. The effectiveness of these systems to help people build healthy eating patterns for extended periods becomes restricted. The existing problems require a better system which can automatically identify food items and determine their nutritional values while delivering useful insights through an easily understandable format. The system should minimize user work requirements yet drive ongoing user interaction while supporting improved decision making.

The proposed approach focuses on processing dietary data to generate useful information, including calorie intake, macronutrient distribution, and overall eating patterns. The interactive dashboards present these insights to users, who can use them to track their habits over different time periods. The system combines three elements, which include AI-based food recognition and automated nutrition analysis and intuitive data visualization, to help users make better decisions about their dietary and health choices.

IV. PROPOSED SYSTEM

The proposed Data-Driven Smart Food Analytics and Nutrition Advisor is developed as a user-friendly system that makes dietary tracking simpler and more efficient. The system operates through automated processes that provide valuable insights because it reduces the need for users to enter data manually. The system uses Streamlit for its frontend development and Python for backend processing together with Google Gemini API for food recognition and MongoDB Atlas for data storage and Plotly for visualization. The components create a seamless workflow that enables users to monitor their nutritional intake through intelligent nutrition tracking. The overall design establishes system performance through efficient operation while maintaining scalable capabilities and user-friendly access.

The proposed system is described as follows:

- 1) User Authentication and Profile Management: The system starts with a secure login process which protects user data. The system uses hashed password storage and session management to stop unauthorized users from accessing protected areas. Users who log into the system gain access to tools which allow them to create and control their

personal profiles. This system uses user-provided information about their age weight height activity level and dietary goals to determine their daily nutritional needs and create customized dietary recommendations. The system implements basic input validation to verify that users input data which meets accuracy and consistency standards.

2) Multi-Modal Input System: The system allows users to record their meals through multiple methods to simplify their food logging process. Users have two options to record their meals they can either upload food images or use the Streamlit interface to write meal descriptions. The system enables users to track their meals with less work because of its flexible tracking system which makes the system suitable for daily use. Furthermore, the system supports quick input processing to enhance user experience. It also ensures flexibility in handling diverse food inputs across different real-life scenarios.

3) AI-Based Food Recognition and Nutrition Estimation : The primary system operation depends on Google Gemini API to handle both image and text data for food item recognition. The system calculates nutritional values through its food identification process which determines the presence of various items. The system calculates total nutritional intake for each meal through its automated dietary tracking system which uses aggregated values. The method decreases manual mistakes while it boosts operational productivity.

4) Data Storage and Management : The System uses MongoDB Atlas as its NoSQL database system to store all user data together with their meal records and nutritional information that the system has calculated. The system provides automatic scaling capabilities and quick data access while ensuring that the data remain accessible for future use. The stored data enables permanent monitoring of user behavior patterns while it permits researchers to study

changes in dietary habits from the past. The system uses data backup solutions to guarantee operational dependability while it protects against data loss incidents.

5) Nutrition Analysis and Personalized Insights : The system uses the calculated nutritional information to study eating habits which results in the generation of valuable health information. The system evaluates both how many calories are consumed and how nutrients are distributed, which allows it to create personalized dietary recommendations. The system presents its findings through an interactive dashboard which uses Plotly to display user-friendly visualizations of daily and weekly and monthly data patterns. MongoDB Atlas stores all processed information together with meal records which allows users to monitor their eating patterns over time while making smart food choices.

6) Interactive Dashboard and Visualization : The system uses an interactive dashboard which Plotly software development tools to present its complete insights to users. The dashboard tracks calorie intake patterns and nutrient distribution patterns throughout daily and weekly and monthly time frames. The visualizations help users track their progress because they enable users to monitor their progress and make needed changes to their routines. The use of graphical representations creates better understanding and higher user satisfaction.

7) Secure Storage, Report Management, and Monitoring: The system saves all processed reports and results in a secure database which links them to specific user accounts.

The user has the ability to access past reports while also downloading their summary report as a PDF document. The system carries out monitoring together with secure report logging processes. The system uses access control mechanisms to prevent unauthorized access to user data which maintains user confidentiality.

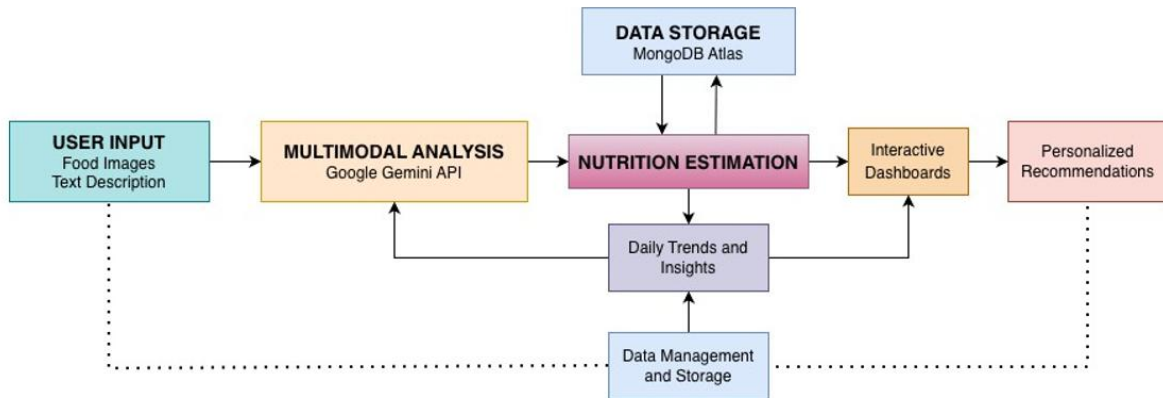


Fig. 1. Data Flow

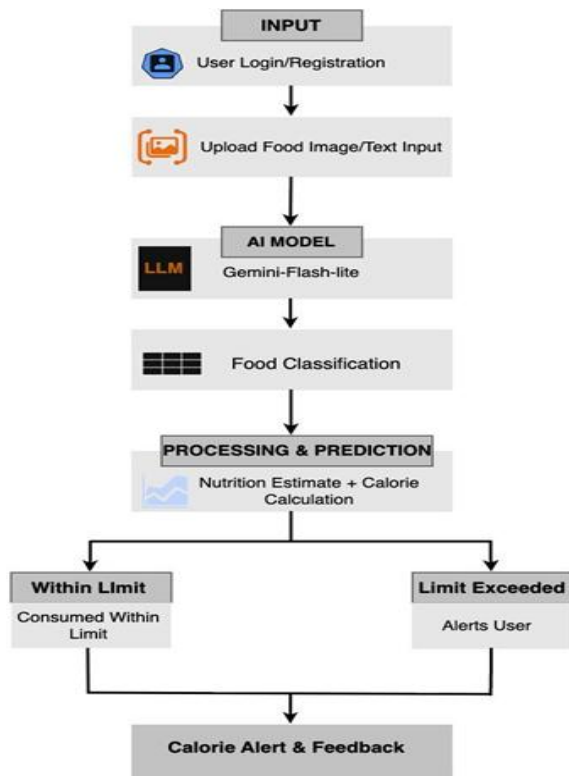


Fig. 2. System Architecture

V. METHODOLOGY

The proposed Data-Driven Smart Food Analytics and Nutrition Advisor is developed as an intelligent dietary monitoring system that integrates artificial intelligence with data analytics. The system combines Streamlit for user interface creation with Python-based processing and MongoDB Atlas data storage and Google Gemini API food recognition and Plotly interactive data

visualization.

The methodology follows a structured workflow, as described below:

- 1) **User Authentication and Secure Access** : The system begins with a login process so that only valid users can access it. The system keeps passwords in a hashed format because direct password storage would create security risks. The system uses session handling to protect user information during their time in the system. After logging in, users can enter their personal details like age, height, weight, activity level, and diet goals. The system uses these details to create a better understanding of the user, which helps it determine their calorie requirements. The system performs basic checks to validate user input and prevent incorrect data entry. The system stores all user information together with food logs in MongoDB Atlas, which enables tracking of data throughout different time periods.
- 2) **Multi-Modal Input** : The system provides multiple input methods to assist users with their food logging tasks. Users can choose between two options for their meal description because they do not need to enter everything through typing. The process becomes faster and requires less effort when compared to traditional applications because users must enter every detail manually.
- 3) **AI-Based Food Detection and Nutrition Estimation** : The system processes user input data through Google Gemini API which handles

all incoming data after users submit their information. The system determines nutritional content which includes calories and protein and carbohydrates and fats and fiber compounds. The meal's total nutritional content gets calculated through basic Python programming methods which use fundamental nutritional components. The system operates without human input while it protects against mistakes that occur during math calculations.

4) Nutrition Analysis and Data Visualization : The system evaluates user eating patterns after it completes value computations. The system evaluates calorie consumption together with nutrient distribution to determine whether they meet healthy standards before providing basic health recommendations. Users can access their daily and weekly and monthly patterns through an interactive dashboard built with Plotly which displays the results. Users can track their advancement because all information gets stored in MongoDB Atlas.

VI. RESULTS AND DISCUSSION

The Data-Driven Smart Food Analytics and Nutrition Advisor system was tested with different meals that were presented as both text descriptions and food pictures. The system evaluation testing included three components which assessed food detection performance and nutritional assessment success and the ability to create insights and the functional effectiveness of the food analytics dashboard.

The system assessment used two testing conditions which included basic meals and intricate meals with multiple components. The system assessment process started with individual module tests which were done before the overall system test. The system assessment testing evaluated how well the system maintained its performance standards when different input types were used. The results demonstrate that multimodal input processing combined with structured nutritional analysis implementation enhances the system's usability. The system provides stable performance across different input types. The system allows users to visualize their dietary habits through its design.

- The system can properly identify food items from various meal types by processing both their visual and textual information.

- The system calculates dietary components through precise nutritional assessments which include calorie and protein and carbohydrate and fat measurements.
- The system creates precise health information together with appropriate dietary advice for users.
- The use of interactive dashboards together with visual analytics tools leads to better user involvement with the system.
- The system maintains equal accuracy and performance throughout all food types which include both basic and advanced mixed food combinations.
- The system uses AI-based food processing methods together with automated food logging to decrease the need for manual work.
- The system achieves faster food identification and nutritional data assessment through its ability to quickly recognize food items.
- The system monitors calorie intake throughout the day while sending alerts at appropriate times to support users in maintaining their dietary requirements.

A. User Profile Interface

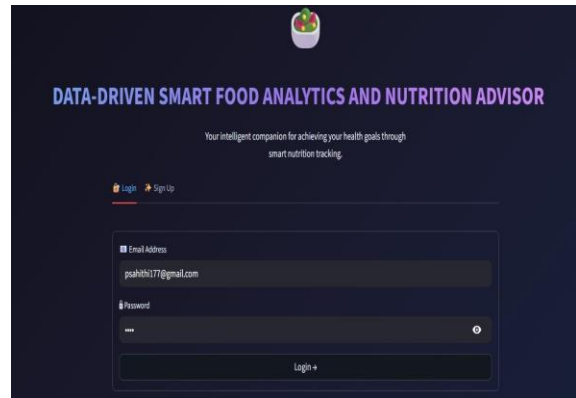


Fig. 3. Log in

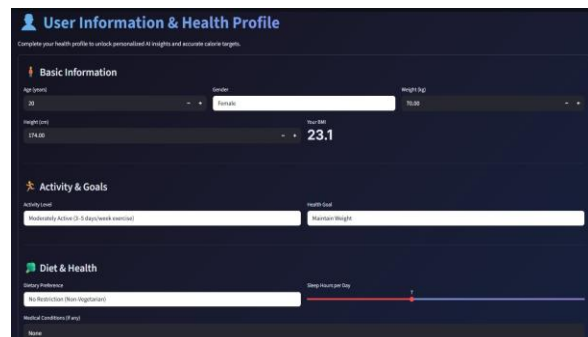


Fig. 4. User details and health parameters.

B. Food Detection Module

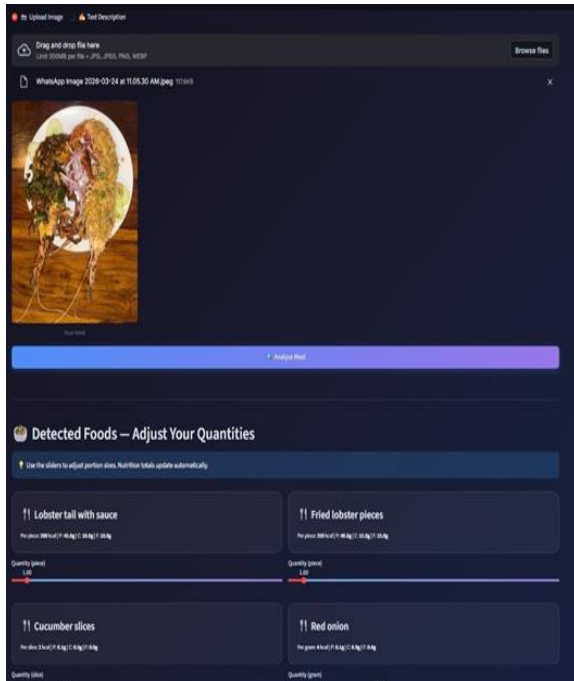


Fig. 5. Detects food items from images and estimates quantities.

C. Nutrition Analysis Dashboard

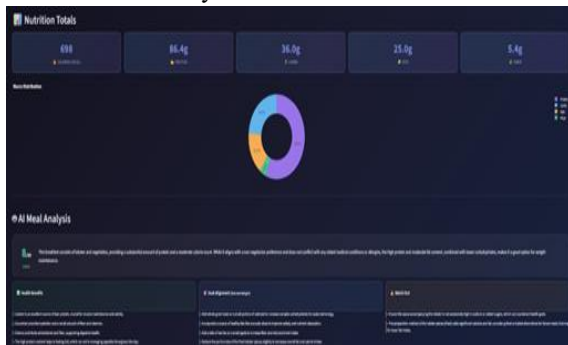


Fig. 6. Nutritional values and summary insights.

D. System Dashboard

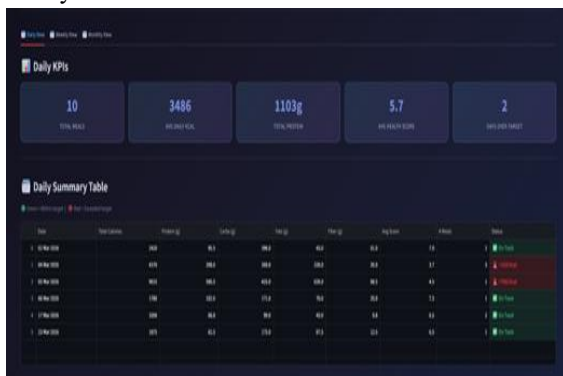


Fig. 7. Daily summaries.

E. Dietary Trends Visualization



Fig. 8. Trends in calorie and nutrient intake.

F. Calorie Alert System



Fig. 9. Alerts users when daily calorie limits are exceeded.

The experimental results show that the proposed system performs automated diet monitoring with both dependable and efficient results. The combination of AI-based food detection with nutritional analysis and interactive dashboards gives users the ability to monitor their dietary patterns and track their dietary patterns. The system improves user understanding which helps them make better choices for sustaining a healthy and balanced way of life.

VII. CONCLUSION AND FUTURE SCOPE

The proposed Data-Driven Smart Food Analytics and Nutrition Advisor functions as a smart diet monitoring

system which aims to improve diet tracking while using Artificial Intelligence and data analysis to help users understand nutritional information. The system offers multiple functions which include processing food input through various methods and using Artificial Intelligence to identify food and automatically estimating nutrition and delivering interactive data visualization through a secure web-based platform. The multi-step process enables users to capture their dietary system which leads to better health results through proper nutrition comprehension. The system uses a multimodal Artificial Intelligence model to process both images and textual descriptions of the user's food consumption which enables users to interact with the system in various ways. The system evaluates the obtained data to identify food items and determine nutrition details which include the total calorie count and protein content and carbohydrate amount and fat percentage and fiber quantity of the food. The extracted information is organized into specific structures which allow the meal total nutritional content to be calculated while improving the clarity of information and decreasing uncertainty to assist users in understanding their food consumption patterns.

The system offers personalized analysis through its system which evaluates user food intake against recommended dietary allowances that match their health profile. The system delivers valuable insights about dietary patterns which cover dietary balance and calorie intake and distribution of macronutrients while creating a health score and recommending better options to replace less healthy choices.

The proposed system delivers better user convenience through its automatic food and nutrient analysis system compared to existing calorie tracking applications which require users to enter data manually. The interactive dashboard allows users to track the trends of the diet by displaying graphs and charts, which show the daily, weekly, and monthly patterns of the diet. The authentication process ensures user data privacy.

From the experimental evaluation of the system, it has demonstrated reliable performance and consistent results with different types of food inputs, ranging from simple meals to complex meals. The process is also efficient, with the analysis and visualization done in near-real-time. The system has the capability to assist users in understanding their dietary habits and

enhance nutritional awareness.

Further enhancements to the proposed system can improve its accuracy, usability, and scalability.

Firstly, advanced computer vision techniques can be incorporated to increase the accuracy of food recognition based on images of meals that contain multiple food items. Portion sizes can be estimated using techniques to increase the accuracy of calculations.

Secondly, the system can be improved by enhancing the AI-based recommendation system to make the dietary recommendations provided to users more personal and specific according to their goals and conditions, as well as their long term eating habits. The inclusion of Explainable Artificial Intelligence (XAI) will also make the system more transparent.

Thirdly, the system can be extended to provide more health-related information by considering the history of the diet over a period of time. The system can be integrated with wearable devices or fitness trackers, which can help the system to analyze the diet along with the physical activities, thus more accurately measuring the balance of calories.

Moreover, the system can be implemented in a scalable manner using cloud computing infrastructure to cater to more users and increase system performance. The development of a mobile application can also increase the system's accessibility for users to track their food intake anywhere and anytime.

Thus, with these developments, the proposed Data-Driven Smart Food Analytics and Nutrition Advisor can develop into a comprehensive, intelligent, and scalable digital health assistant to promote better nutrition awareness and preventive healthcare.

REFERENCES

- [1] "AI-Based Food Analytics System," IEEE Xplore, 2025. [Online]. Available: <https://ieeexplore.ieee.org/abstract/document/11336451>
- [2] "Smart Dietary Monitoring System," IEEE Xplore, 2025. [Online]. Available: <https://ieeexplore.ieee.org/abstract/document/11004768>
- [3] "Food Recognition Using AI Models," IEEE Xplore, 2025. [Online]. Available: <https://ieeexplore.ieee.org/abstract/document/112>

- 34250
- [4] “Advanced Nutrition Analytics for Health Monitoring,” Springer, 2025. [Online]. Available:
<https://link.springer.com/article/10.1186/s41110-025-00360-4>
 - [5] “AI-Based Nutrition Recommendation System,” IEEE Xplore, 2025. [Online]. Available:
<https://ieeexplore.ieee.org/abstract/document/10985124>
 - [6] “Food Data Analytics and AI Applications,” ScienceDirect, 2024. [Online]. Available:
<https://www.sciencedirect.com/science/chapter/edited-volume/abs/pii/B9780443264689000370>
 - [7] “Nutrition Monitoring System Analysis,” IEEE Xplore, 2025. [Online]. Available:
<https://ieeexplore.ieee.org/abstract/document/11004678>
 - [8] “Machine Learning for Food Recognition,” Springer, 2025. [Online]. Available:
https://link.springer.com/chapter/10.1007/978-981-96-7473-2_45
 - [9] “AI in Personalized Nutrition Systems,” Springer, 2025. [Online]. Available:
https://link.springer.com/chapter/10.1007/978-981-96-2120-0_6
 - [10] “Smart Food Detection System,” IEEE Xplore, 2025. [Online]. Available:
<https://ieeexplore.ieee.org/abstract/document/10932496>
 - [11] “Deep Learning Approaches for Dietary Monitoring,” IEEE Xplore, 2025. [Online]. Available:
<https://ieeexplore.ieee.org/abstract/document/11308634>
 - [12] “Nutritional Analysis Using AI Systems,” Nutrients, 2024. [Online]. Available:
<https://www.mdpi.com/2072-6643/17/1/190>