Gastro-Health Project: Revolutionizing Personalized Nutrition and Health Forecasting Through Integrated AI Technologies

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1. Introduction

Modern healthcare confronts dual challenges: managing diet-related diseases and optimizing pharmacotherapy amid complex food–drug interactions. Traditional one-size-fits-all nutritional advice overlooks individual differences in health profiles, medications, and lifestyles, which is a critical issue in clinical settings. We propose the Gastro Health Project, which aims to build an advanced machine learning and natural language processing platform for synthesizing diverse data. This platform offers a robust tool for healthcare professionals and clinical nutrition researchers while also delivering practical insights for everyday users. By continuously integrating emerging research, our platform updates its nutrient and interaction models in real time, ensuring recommendations are both scientifically rigorous and user-friendly, thus bridging advanced medical research and daily guidance.

This novel platform introduces a dynamic, user-centric model in which personalized health scores are generated based on a comprehensive health profile that includes age, biometric data, health conditions, allergies, and dietary goals. Healthcare professionals benefit from detailed, actionable insights that enhance patient care, while everyday users receive clear guidance on food compatibility and adjustments to align choices with their health needs. Moreover, the platform's predictive analytics module forecasts potential adverse drug–food interactions and long-term health risks, empowering both clinicians and individuals to proactively adjust dietary habits and mitigate chronic conditions before they escalate. With an intuitive interface that supports interactive consultation, users can experiment with meal plans, receive immediate nutritional analyses from food images and recipes, and engage with an AI nutritionist for customized advice.

2. Gastro-Health system

The Gastro-Health platform integrates multiple AI-driven modules designed to deliver comprehensive nutritional support, making advanced clinical insights accessible to healthcare professionals and practical for everyday users. Each module works synergistically to enhance personal and clinical nutrition management.

User-Food Personalized Health Score: This module processes individual health data, including biometric information, existing medical conditions, allergies, and dietary goals, to generate a personalized health compatibility score for any food. It uses evidence-based nutritional guidelines and continuous literature mining to suggest actionable advice and modifications, such as ingredient swaps to improve dietary compatibility.

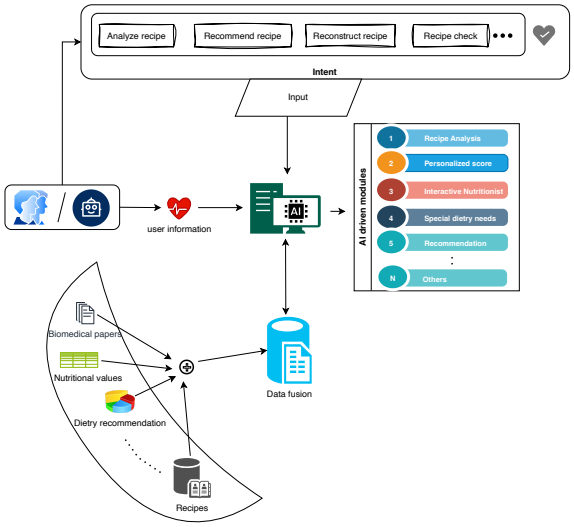

Fig. 1: Architecture of the Gastro Health platform, showcasing the integration of user-specific data inputs and AI-driven analysis modules.

Interactive AI Nutritionist: This platform features a virtual nutritionist that engages users in interactive dialogue to deliver evidence-based nutritional guidance. It tailors advice to individual goals, health profiles, and preferences, ensuring personalized recommendations for nutrition-based health management. Additionally, users can ask a variety of food and health-related questions to receive reliable, scientifically supported answers.

Food/Ingredient and Drug Pairing: This module focuses on optimizing medication efficacy and safety by analyzing the interactions between dietary components and pharmaceuticals. It alerts users to potential adverse reactions, such as the well–documented grapefruit-statins effect, and recommends food pairings that support medication performance. The system leverages clinical guidelines and pharmacokinetic data to personalize dietary advice for patients on medication.

Table 1: Comparison of Food-as-Medicine Systems

Feature	Gastro Health	Brightseed[1]	HealthifyMe[2]	WW AI[3]
Customized Nutritional Health Scoring	✓	✗ (focus on bioactives)	Limited (calorie tracking)	Limited (points-based)
AI-Based Custom Meal Suggestions	✓	✗	✓	✓
Medication-Food Interaction Study	✓	✗	✗	✗
Live Dietary Monitoring	✓	✗	✓	✓
Preventive Health Prediction	✓	✗	✗	✗

AI-Driven Image-to-Recipe Analysis: This platform employs computer vision technology to analyze meal images, estimating macronutrient and micronutrient content and identifying potential dietary risks. Users can obtain detailed nutritional insights simply by capturing an image of their meal.
Mood-Optimized Nutrition Advisor: This module integrates nutritional psychological insights to curate meals that enhance mood and overall mental well-being. By tailoring dietary guidance to consider mental states, alleviate stress, and promote a balanced emotional state, the system provides personalized recommendations that address both nutritional and mental health needs.
Gastro-Health AI for Special Dietary Needs This component caters to individuals with severe food allergies, intolerances, or specific recovery needs. It generates gourmet, nutritionally balanced alternatives that adhere to strict dietary restrictions, ensuring patients receive safe, appetizing, and effective meal plans.
Proactive Health Forecasting This module leverages predictive modeling and real-time dietary tracking to anticipate long-term health risks associated with food choices and medication use. Offering proactive dietary strategies helps mitigate potential health issues, enabling users to make informed decisions before complications arise.

3. Related work

Recent literature has highlighted the growing impact of AI in personalized nutrition and precision medicine [4, 5, 6]. For instance, several systematic reviews and studies have detailed AI's role in dietary assessment and food recognition systems [7, 8]. In contrast to these systems, which typically focus on single aspects such as image-based nutrient estimation or recipe recommendations, our approach offers an integrated solution that combines personalized nutritional scoring, food–drug interaction analysis, and predictive health forecasting into one cohesive platform. Table 1 compares some existing solutions.

Our previous works, [9, 10] studied the food NER task and introduced Entity Relationship Sentiment Analysis (ERSA) to capture sentiments between biomedical entities, providing a foundation for understanding food-health relationships. Building upon these and other works, we propose a comprehensive system that not only offers personalized nutrition recommendations but also proactively identifies potential health-based food interactions. Our system continuously ingests new scientific literature through advanced NLP techniques. This ensures that our recommendations remain current with evolving dietary guidelines and biomedical discoveries.

4. Implementation

The platform features a modular and scalable architecture (see Fig. 1) that seamlessly integrates diverse data sources. It comprises three main components:
Data Aggregation Layer: This layer gathers user data from various sources—including manual inputs and images—and ensures that it is stored securely.
AI Engine: Made up of specialized sub-modules, the engine performs nutrient analysis, evaluates pharmacological interactions, and conducts predictive health modeling.
User Interface: An intuitive dashboard presents personalized health scores, forecasted risks, and actionable recommendations in a clear, accessible format.

5. Conclusion and Future Work

The Gastro-Health Project revolutionizes personalized nutrition and health management by integrating multi-source data, continuous research updates, and predictive modeling to deliver actionable, science-backed insights. It serves as a robust tool for healthcare professionals, clinicians, and researchers while also offering practical dietary guidance for everyday users. Future enhancements will include behavior tracking, improved real-time feedback, and deeper integration with electronic health records to further strengthen its decision support capabilities and broaden its impact across both professional and consumer settings.

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