Int. J. Sci. R. Tech., 2025 2(5)
A Multidisciplinary peer-reviewed Journal
www.ijsrtjournal.com [ISSN: 2394-7063]

Original Article

Research on Nutrition Deficiency Analysis and Diet Plan Recommendation System

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ABSTRACT

Nutrition is the source of energy that is required to carry out all the processes of the human body. "Nutritional deficiency" consists of severely reduced levels of one or more nutrients, making the body unable to normally perform its functions and thus leading to an increased risk of several diseases like cancer, diabetes, and heart disease. This paper presents a Nutrition Deficiency Analysis and Diet Plan Recommendation System developed using Python with a backend SQLite3 database and deployed through Flask. The system is designed to identify nutritional deficiencies and generate personalized diet plans based on user-provided data, including medical history, dietary habits, symptoms, genetic predispositions, and lifestyle factors. By leveraging machine learning techniques, the system analyzes this data to detect imbalances in essential nutrients and visualizes the results through a nutrient deficiency graph. It then recommends tailored meal plans using a rich knowledge base of nutritional information, ensuring science-backed dietary guidance. This paper aids in the construction of a diet plan based on the needs of the user.

Keywords: Diet Recommendation System, Nutritional Deficiency, Medical Data Analysis

INTRODUCTION

The World Health Organization (WHO) has shown that a lack of or uneven intake of food contributes to roughly 9% of heart attack fatalities, 11% of ischemic heart disease deaths, and 14% of gastrointestinal cancer deaths globally. More than a billion individuals are anemic due to iron deficiency (anaemia), 0.25 billion children have vitamin deficiencies ranging from vitamin A to vitamin K inadequacy, and 0.7 billion are iodine deficient, making a total of roughly 0.25 billion people anaemic. The main objective of this paper is to provide dietary recommendations. This paper introduces a technology-driven solution that brings together artificial intelligence, data analytics, and nutritional science to offer personalized dietary insights in an efficient and user-friendly manner. By utilizing modern machine learning techniques, the system is capable of interpreting a wide range of user inputs and health indicators to provide targeted diet recommendations that are not only relevant but also adaptable to individual lifestyles. This approach enhances the accessibility of preventive nutrition strategies and supports early detection of deficiencies, ultimately empowering users to take control of their health in a more informed and proactive way.

LITERATURE REVIEW

2.1 Overview of Nutrition deficiency analysis and diet plan recommendation System

The system focuses on identifying nutrient imbalances in individuals and offering tailored dietary solutions to address these deficiencies. Nutrient deficiencies, those in iron, vitamin D, calcium, can lead to a range of health issues, including fatigue, weakened immunity, bone disorders. Traditional methods for diagnosing deficiencies, like blood tests and dietary surveys, are often costly and labor-intensive, making them inaccessible for many individuals. Recent advancements in technology have introduced automated systems, such as mobile applications and websites, to detect nutrient imbalances in real time and provide personalized diet recommendations. These tools offer a more efficient

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

and accessible approach to managing nutritional health by tracking food intake and health biomarkers, ultimately promoting better long-term health outcomes. The development of systems holds the potential to significantly improve global health making personalized nutrition guidance available to a wider population.

2.2Techniques used in system

AIML techniques that are used in nutrition deficiency analysis and diet plan recommendation:

- **Nutrition Deficiency Tracking and Visualization:** It creates dynamic health graphs that track key nutrient levels (e.g., iron, calcium, vitamins). These graphs visualize deficiencies and improvements based on real-time data with the help of graphs helping users and healthcare providers monitor progress and adjust dietary plans.
- **Predictive Analytics for Health Risks:** Systems analyze trends in the health graph to forecast future nutrient deficiencies and associated health risks. By predicting potential issues (e.g., vitamin D deficiency leading to weakened immunity), these models enable early intervention and proactive dietary recommendations.
- **Personalized Diet Recommendations**: Based on the health graph and deficiency analysis, AI models suggest personalized diet plans tailored to address specific nutritional imbalances. These recommendations are updated dynamically, taking into account user feedback and health changes over time to ensure ongoing optimization.
- **Integration of Multi-Source Health Data:** The systems combine data from various sources, such as dietary logs, wearable health trackers, and medical records, into a unified health graph. This multi-modal approach provides a comprehensive view of an individual's health and nutrient status, ensuring more accurate and holistic recommendations.
- **Real-Time Monitoring and Dynamic Adjustments**: Health graphs are updated in real time as users make dietary changes or receive new health data (e.g., blood test results). AI continuously monitors these updates, offering adaptive, data-driven recommendations to address deficiencies and improve health outcomes effectively.

2.1Data Sources

A diverse set of data sources is essential for Nutrition deficiency assessment and diet plan recommendation to function effectively:

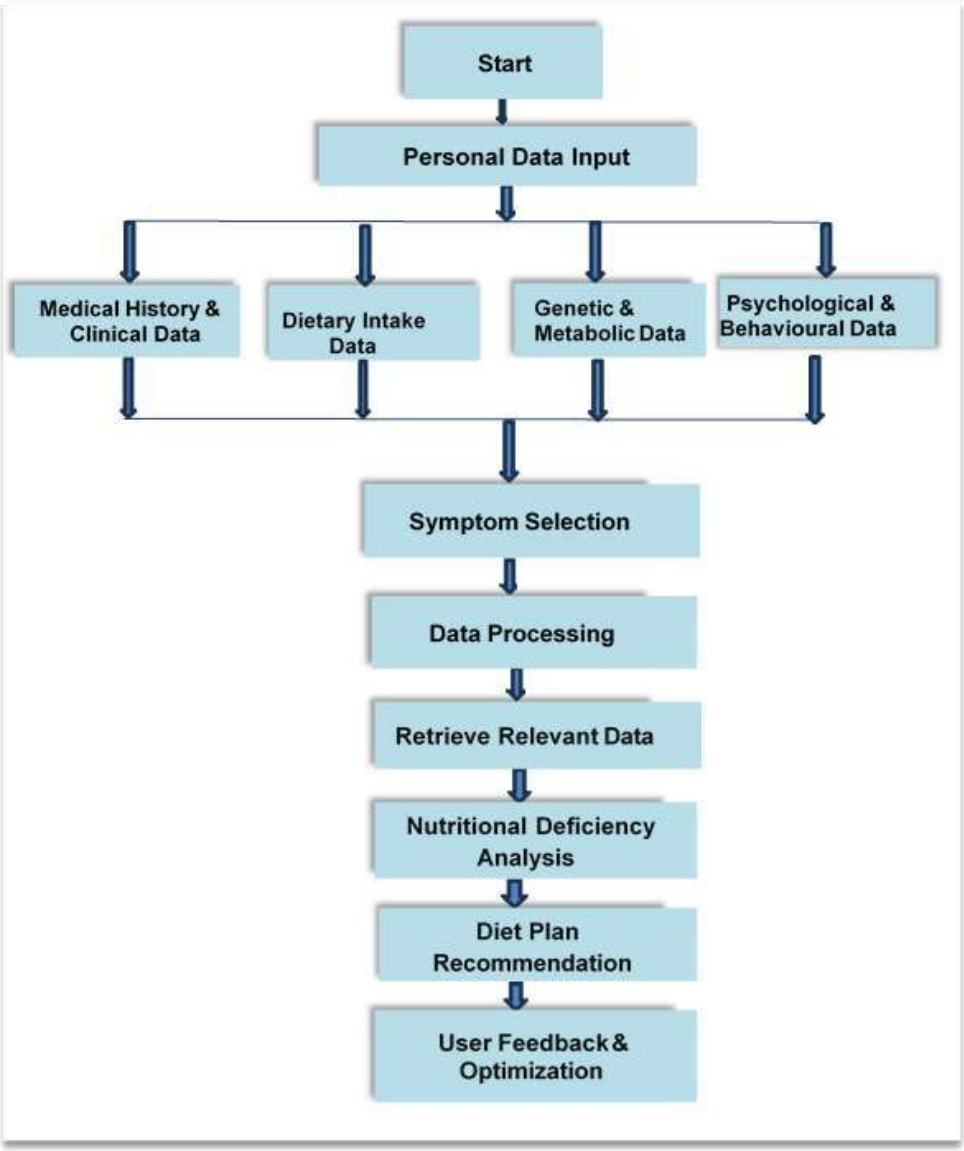
- **Dietary Intake Data:** Capturing detailed information about what the user eats is essential for understanding nutrient intake. This data helps assess the user's overall nutrition and identify deficiencies in specific nutrients. A reliable food composition database is crucial for accurately assessing the nutritional content of the foods logged by the user.
- **Medical History and Clinical Data:** Data on chronic conditions (e.g., diabetes, hypertension) and medications is vital to tailor diet plans, as certain conditions and drugs affect nutrient absorption and metabolism.
- **Genetic and Metabolic Data:** Genetic data revealing how an individual metabolizes certain nutrients (e.g., vitamin D absorption, lactose intolerance) can be crucial for creating personalized diet plans that optimize nutrient utilization.
- **Psychological and Behavioral Data:** Understanding eating behaviors, meal timing, portion sizes, and emotional eating patterns is important for personalizing dietary changes in a way that suits the user's lifestyle.

Fig 1. Nutrition based on multiple data aspects

METHODOLOGY

The proposed Nutrition Deficiency Analysis and Diet Plan Recommendation System begins by interacting with users—either individuals or healthcare professionals—seeking personalized dietary guidance. Users input vital information such as medical history, dietary habits, genetic and metabolic data, as well as psychological and behavioral patterns. Additionally, users can select symptoms like fatigue or brittle nails, which help indicate possible nutritional deficiencies. This data is then preprocessed through cleaning and feature extraction to ensure accuracy. Using a trained machine learning model, the system analyzes the input to detect deficiencies in vitamins, minerals, or macronutrients and generates a nutrient deficiency graph for visual representation. Based on this analysis, it retrieves relevant data from a backend SQLite3 database—including food nutrition values and medical guidelines—and provides a tailored diet plan that includes nutrient-rich food suggestions and meal planning strategies. Finally, the system gathers user feedback to optimize its recommendations through continuous learning, ensuring the model improves over time and delivers increasingly accurate and effective dietary guidance. The entire pipeline is developed in Python, trained using Jupyter Notebook or VS Code, and deployed using Flask for real-time user interaction.

FLOW CHART



Working

The system operates by first collecting comprehensive user data through an intuitive interface, capturing details such as medical background, dietary intake, symptoms, and lifestyle habits. This information is then preprocessed to handle missing values and extract meaningful features that influence nutritional health. Using a machine learning model trained on relevant datasets, the system analyzes the user's profile to identify potential nutrient deficiencies and generate a visual nutrient deficiency graph. It then consults a backend SQLite3 database containing food nutrition data and clinical guidelines to recommend a personalized, balanced diet plan. These recommendations are tailored to the user's deficiencies and preferences, promoting better health outcomes. As users follow the plan and provide feedback, the system refines its suggestions using continuous learning, ensuring increasingly accurate and effective dietary guidance over time.

System Requirement

Software Requirement

1) Python Version IDE
2) VS Code

Modules Used

1) Flask
2) PyTorch

IMPLEMENTATION & RESULT

Implementation

Implementation Step by Step

Step 1: Run the Python File for Output

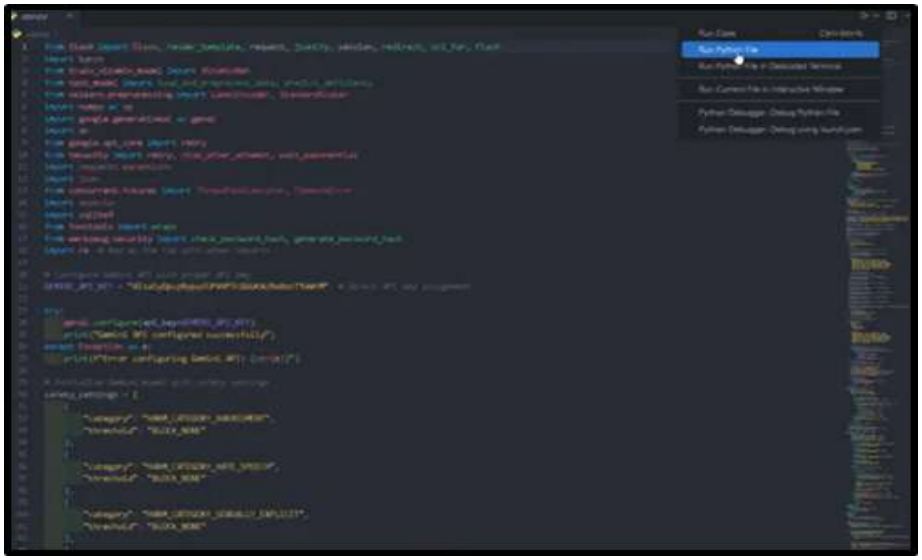


Fig. Shows Running the Code for Output

Step 2: User Authentication and Data Input Interface

Fig. Shows Login Interface for User Data Input

In this paper, we focus on analyzing and predicting deficiencies in key vitamins and minerals that are essential for maintaining good health. These include Iron, Vitamin A, Vitamin B1, B2, B3, B6, B12, Vitamin C, D, E, K, Folate, and Zinc. Each nutrient plays a critical role in the body, such as improving vision (Vitamin A), supporting nerve function (B12), enhancing immunity (Vitamin C), maintaining bone strength (Vitamin D), and aiding in blood formation (Iron, Folate). Based on the user's symptoms and lifestyle factors, the system identifies potential deficiencies and provides personalized diet recommendations to restore nutrient balance and improve overall well-being.

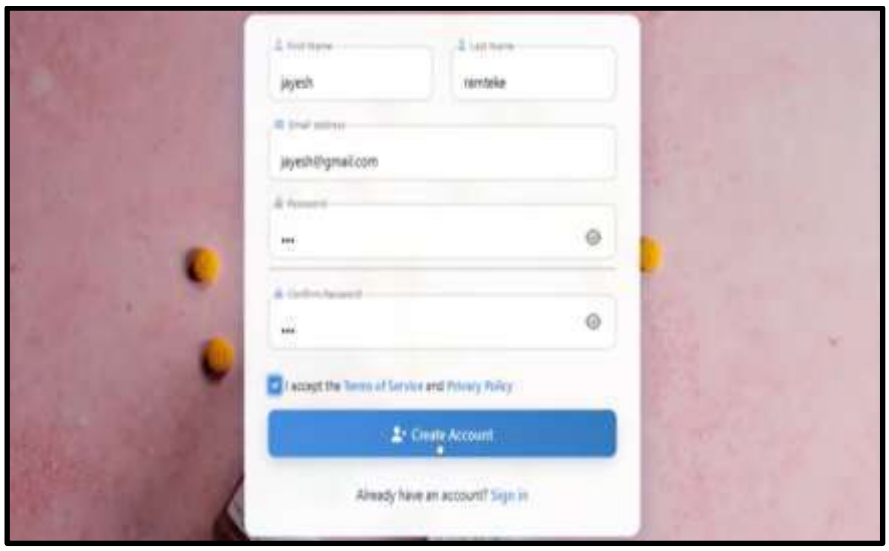


Fig. Shows User Registration Form for New Account Creation

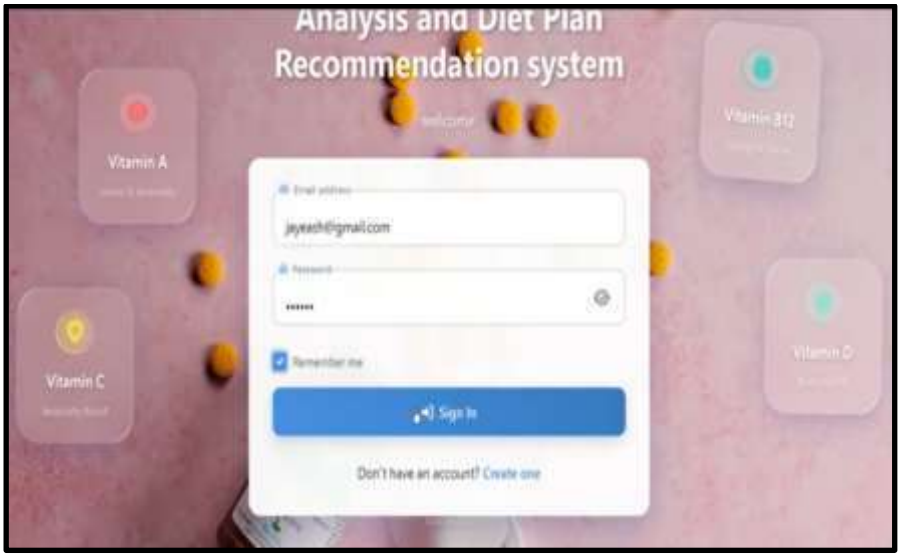


Fig. Shows User Login Interface

Step 3: User-Guided Symptom Assessment Dashboard

Fig. Shows the User Dashboard

Fig. shows User interface displaying symptom selection and personal data input fields

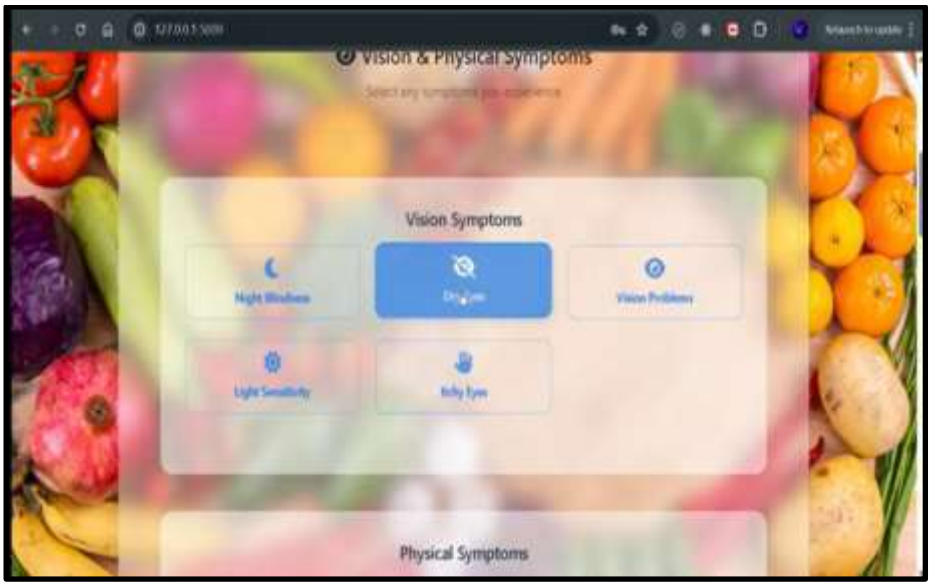


Fig. i)

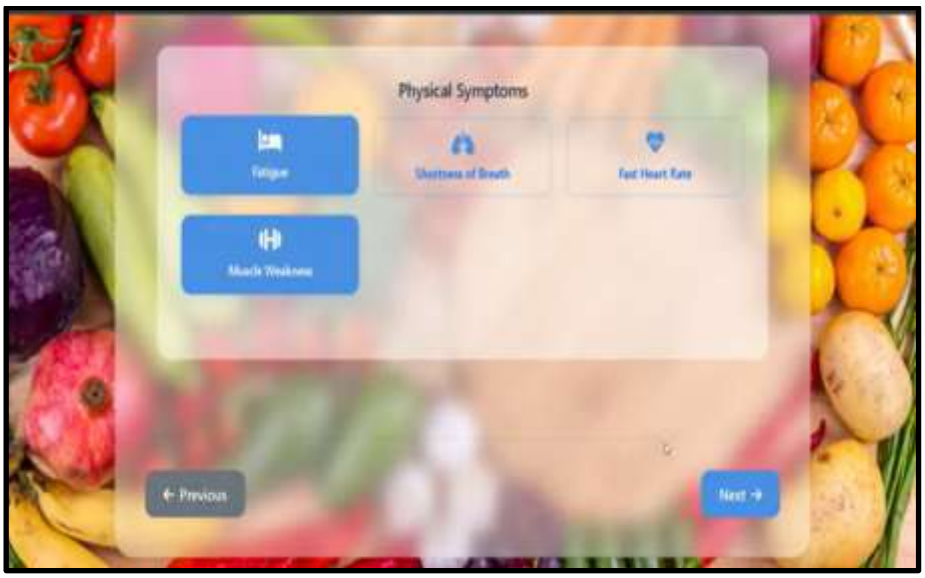


Fig. ii)

Fig. i) & ii) shows a web interface for selecting symptoms

Step 4: Prediction Analysis and Performance Metrics

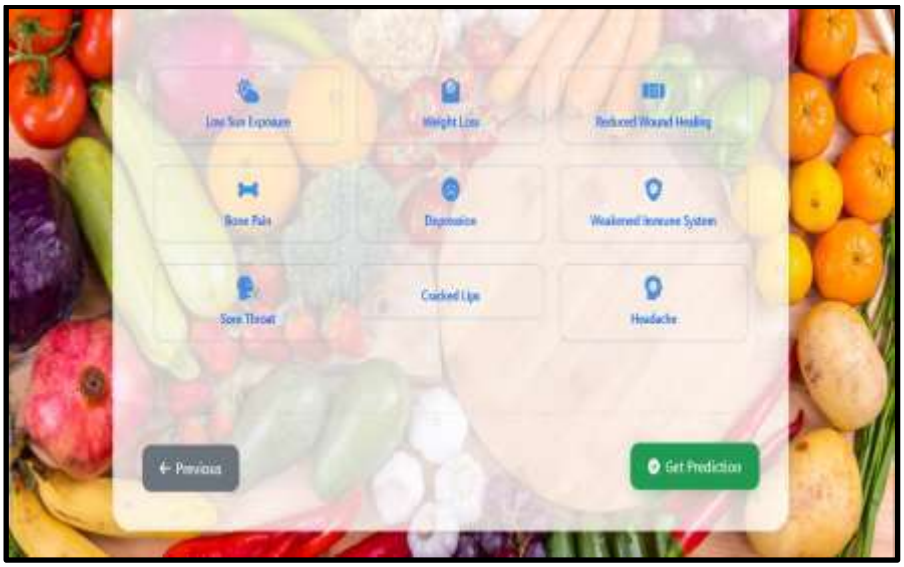


Fig. Shows User Interface for Selecting Symptoms Related to Nutritional Deficiencies

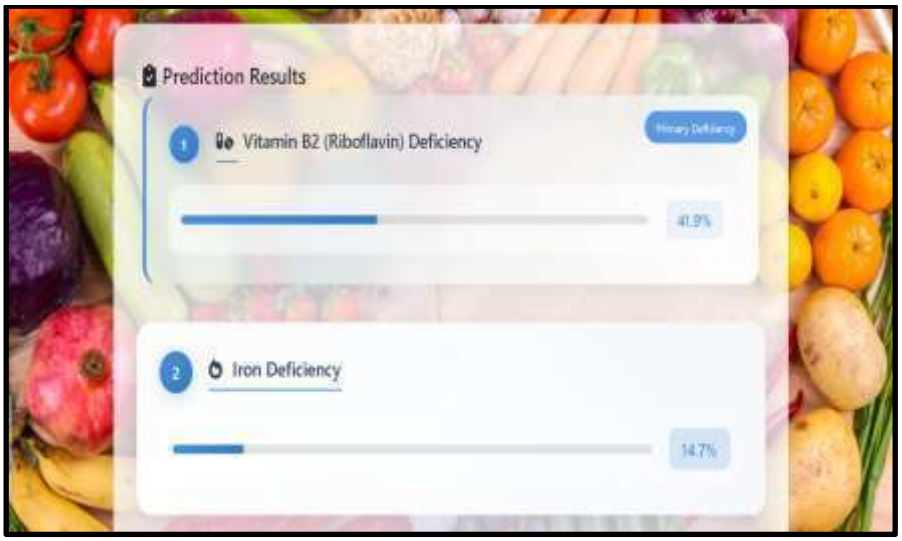


Fig. shows a web interface displaying identified nutritional deficiencies with percentage likelihood

Fig. iii)

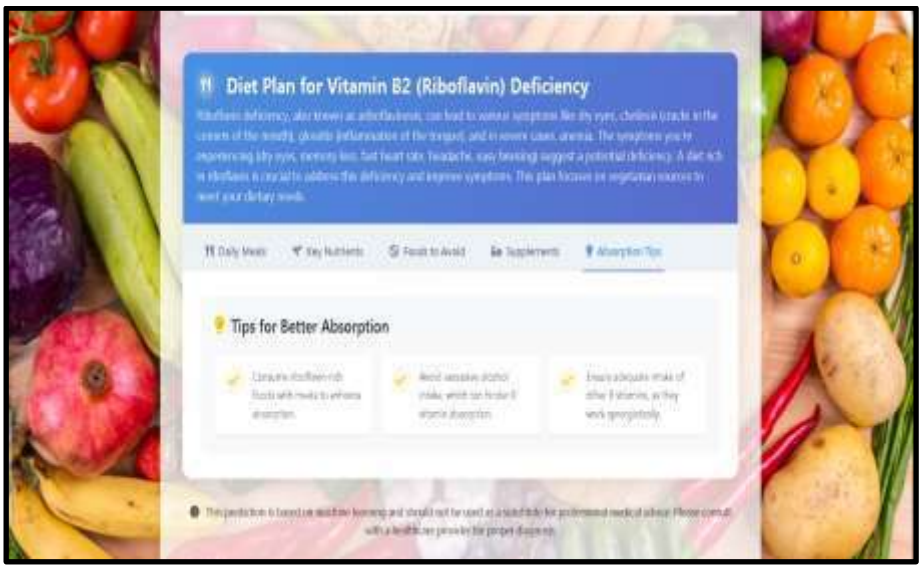


Fig. iv)

Fig. iii) & iv) shows a web interface displaying a personalized daily meal schedule and recommended foods based on identified nutritional needs and better nutrient absorption tips

Following the generation of the diet plan, the system provides supplementary information to maximize the benefits of the dietary recommendations. This image illustrates the "Absorption Tips" section, offering advice such as consuming Riboflavin-rich foods with meals and ensuring adequate intake of other B vitamins. This step highlights the system's comprehensive approach to dietary guidance, going beyond just suggesting foods to also educating users on how to optimize nutrient uptake for better health outcomes.

Fig. shows a web interface displaying reported symptoms and a disclaimer about machine learning-based predictions

RESULT

The Nutrition Deficiency Analysis and Diet Plan Recommendation System leverages comprehensive user data, including medical history, dietary intake, genetic factors, and lifestyle behaviors, to assess and address potential nutrient deficiencies. By analyzing symptoms such as fatigue, hair loss, and poor wound healing, the system identifies specific deficiencies like iron or vitamin D. It then generates personalized diet plans tailored to individual health profiles, recommending nutrient-rich foods and structured meal plans to optimize nutritional balance and overall well-being. Through user feedback and continuous

learning, the system refines its recommendations, ensuring effective and tailored dietary guidance for improved health outcomes.

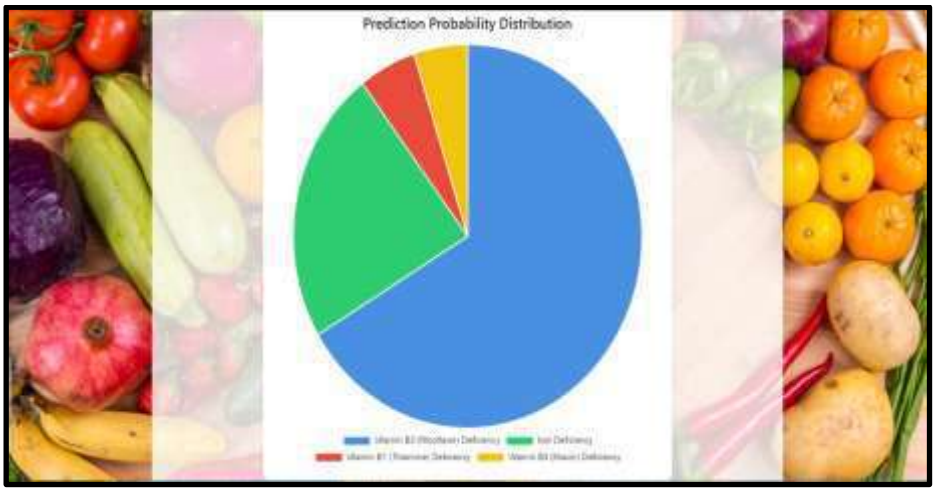


Fig. shows the graph of common vitamin deficiencies and deficiency distribution across age groups

Fig. shows a visual representation of symptom correlation with vitamin deficiencies and monthly trends of new cases

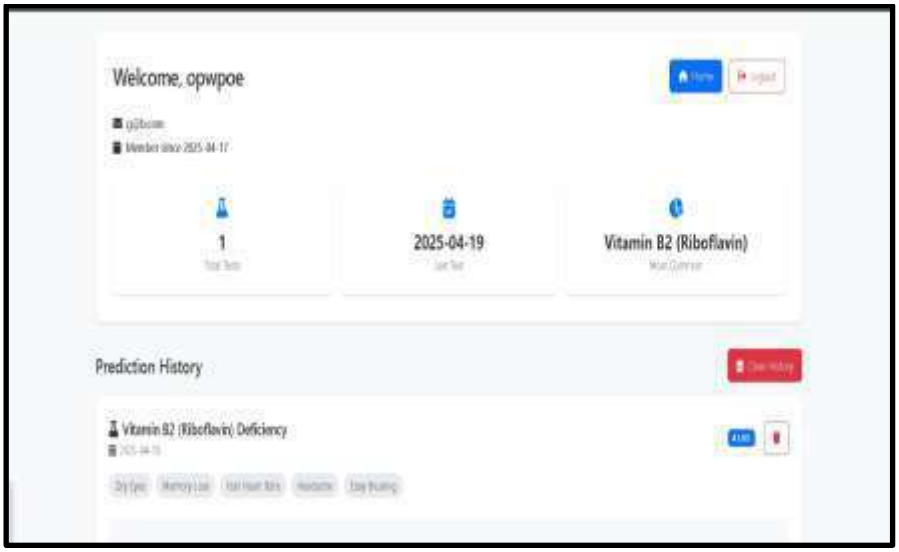


Fig. shows a web dashboard showing user history, predicted vitamin deficiency (Vitamin B2)

The user profile section indicates that "opwpoe" has been a member since April 17, 2025, and has taken a total of one test, with the last test conducted on April 19, 2025. The "Prediction History" clearly shows that on April 19, 2025, the system identified a Vitamin B2 (Riboflavin) deficiency for this user, based on the reported symptoms: Dry Eyes, Memory Loss, Fast Heart Rate, Headache, and Easy Bruising. This feature allows users to easily access their past diagnostic outcomes within the system.

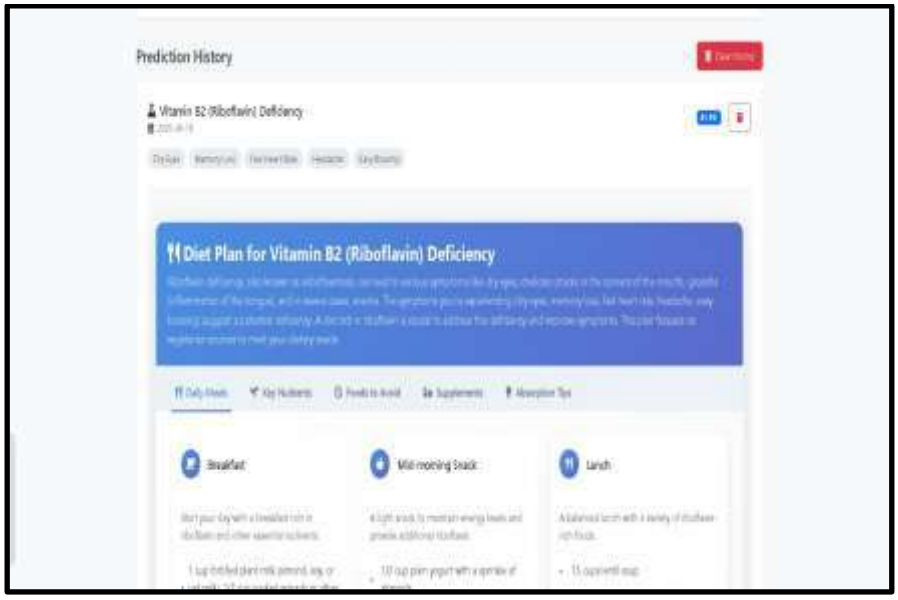


Fig. Shows Prediction history interface displaying a previous diagnosis of Vitamin B2 (Riboflavin) deficiency along with associated symptoms and a personalized dietary plan generated based on the prediction

This image presents a user dashboard, displaying details such as the username ("opwpoe"), membership since date (2025-04-17), total tests taken (1), and the date of the last test (2025-04-19). Below this, the "Prediction History" section shows past analyses, in this case, indicating a "Vitamin B2 (Riboflavin) Deficiency" was identified on 2025-04-19, along with the associated symptoms reported (Dry Eyes, Memory Loss, Fast Heart Rate, Headache, Easy Bruising). This step illustrates the system's ability to store and present a user's interaction history, allowing them to track past predictions and potentially monitor changes over time. Further implementation could include options to view detailed reports of past predictions or compare different analyses.

CONCLUSION

The Nutrition Deficiency Analysis and Diet Plan Recommendation System represents a significant step forward in the integration of technology with healthcare and wellness. By combining machine learning with personalized health profiling, the system offers a dynamic and intelligent approach to understanding and addressing individual nutritional needs. It bridges the gap between complex clinical data and practical, actionable dietary solutions, enabling users to receive tailored recommendations that support long-term health and well-being. Beyond its immediate utility in identifying and correcting deficiencies, the system is designed to grow smarter over time through continuous learning from user feedback, making it increasingly precise and responsive to diverse user profiles. Its user-friendly interface and backend efficiency also make it accessible for both individual users and healthcare professionals, promoting widespread adoption. As lifestyle-related health issues and malnutrition continue to be global challenges, this system has the potential to contribute meaningfully to preventive healthcare by encouraging balanced nutrition and informed decision-making, ultimately fostering healthier communities and reducing the burden on traditional healthcare systems

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HOW TO CITE: Minal Pardey, Yogita Puttewar*, Janhavi Keche, Vaishnavi Paghrut, Vaishnavi Jayale, Research on Nutrition Deficiency Analysis and Diet Plan Recommendation System, Int. J. Sci. R. Tech., 2025, 2 (5), 370-381. https://doi.org/10.5281/zenodo.15385892