# A Nutritional Recommendation Expert System for Ailing Human

**Ekwealor, Oluchukwu Uzoamaka[1*], Ezuruka, Evelyn Ogochukwu[2], Uchefuna Charles Ikenna[3], Chukwudum, Chiemeka Prince[4]**

**[1,2]Department of Computer Science, Nnamdi Azikiwe University, Awka, Nigeria**

**[3]Department of Computer Science, Federal Polytechnic, Oko, Nigeria**

**[4]Department of Forensic Science, Nnamdi Azikiwe University, Awka, Nigeria**

**[*]Corresponding Author**

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## ABSTRACT

A nutritional recommendation expert system for ailing human is an expert system that diagnoses, controls and monitors human nutrition. Its aim is to assess human nutritional health in order to provide medical advice and recommend healthy nutritional habits for the users. The system has a user-friendly interface through which the users can provide their personal health information. Based on this information, the system assesses their health status and gives them medical guidelines as well as recommends appropriate dietary habit to promote their healthy living. The methodology adopted for this work was the structured systems analysis and design methodology and the system was developed using MySQL, CSS and HTML. This system is very helpful to health clinics, fitness centers, educational institutions and dieticians.

**Keyword:** Artificial Intelligence, Expert system, Nutrition, Healthy living, Dietary habit

## INTRODUCTION

Proper dieting is a rudiment to healthy living and human well-being. It contributes greatly in preventing and controlling various health conditions, and promotes the overall quality of individual's life. As lifestyles and nutritional choices differs significantly, there is serious need to have systems that can assist humanin checking and optimizing their nutritional status.

Recently, overall nutritional pattern has changed substantially as a result of shift in nutritional habits, urbanisation and growing sedentary lifestyle. The World Health

Organization (WHO) pointed out poor nutrition as a great promoting factor of global ill health such as cardiovascular diseases, diabetes, and different kinds of malnutrition resulting to serious global morbidity and mortality.

Improper dieting poses a lot of challenges on health, leading to deficiency diseases such as poor sight, anemia, preterm birth, scurvy, stillbirth and cretinism (Whitney, et al. 2013) and health threatening conditions as metabolic syndrome, obesity as well as other chronic diseases like cardiovascular disease, diabetes, and osteoporosis.

Conversely, a properly balanced nutrition promotes the functioning of immunes, mental health, and long life. Healthy diet is essential in tackling overall public health challenges, promotion of maternal and child health and curbing diet-related ailments (Black et al., 2013).

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In the past few decades, the integration of technology in healthcare sectors has witnessed significant improvement especially in the area of individual well-being and disease prevention. Automated nutrition assessment systems are now used to provide a more refined and customized approach to health. Through consideration of factors such as nutritional patterns, symptoms and signs, these systems are able to provide personalized recommendations.

Artificial Intelligence, with its ability of analyzing large datasets and identifying patterns, has introduced a new approach to tailored nutrition. Incorporating Artificial Intelligence algorithms into nutritional assessment systems provides a more sophisticated analysis, thereby allowing identification of direct connection between nutritional choices and health outcomes.

## REVIEW OF RELATED WORKS

Artificial Intelligence involves developing computer systems that are capable of performing tasks that normally require human intelligence. Expert systems on the other hand, is a field of AI, that leverages knowledge representation and reasoning in emulating human expertise in specified domains (Stuart,2020). The following concepts provide the theoretical framework necessary for creating a system capable of emulating human expertise in the complex domain of nutrition and health.

The concept of tailoring dietary recommendations to individual characteristics, aligns with the principles of precision medicine (Leroy, 2012). The work draws inspiration from precision medicine's focus on individual variability, considering factors such as genetics, lifestyle, and health history to provide precise and personalized nutritional guidance for ailing individuals.

These concepts contribute to a nuanced and individualized approach, aligning closely with the intricacies of nutrition-related health challenges.

Currently, various studies have been carried out on the development of nutrition recommendation systems. Generally, recommendation systems are grouped into content-based, collaborative filtering-based (CF), knowledge-based and deep-learning methods. content-based nutrition provides personalized recommendation by analyzing the attributes and constituents of dietary products as well as the dietary needs and preferences of users.

Gutiérrez et al, (2017) presented an augmented-reality assistant which reads food products' barcodes in order to make recommendations based on the quality of food and user preferences. Shandilya et a, (2022) proposed a content-based recommender system which prioritizes the users' current preferences over past ones, thereby, adapting to changing user needs. Their research concentrated on recommending diet based on the preferences of users and nutritional advice, making sure that the user's day-to-day nutritional needs are satisfied.

Ge et al, (2015) developed a mobile app for diet recommendation based on matrix factorization. This system provides personalized dietary recommendation by modelling user preferences through their tags and ratings. Yuan et al, (2019) introduced another tailored nutrition recommendation. The system applies k-means clustering technique to initially group nutrients into subsets before using user-based collaborative filtering to recommend diet in alignment with the user's preferences and balance diet, putting standard recipes into consideration.

Toledo et al (2019), introduced a method for planning daily meal which integrates both nutrition and preference factors. In this work, sorting algorithm was employed to filter the initial food selection based on the characteristics of user. After which, an optimization phase provides a diet plan that prioritizes few currently consumed foods, ensuring it aligns with user preferences and nutritional needs.

Silver et al (2022) conducted a test on the ability of user-based and item-based algorithms to generate top-N suggestions by placing food items based on projected ratings. The test results indicated that the user-based algorithm performs better than the item-based algorithm in accuracy and coverage.

Rostami et al (2023) developed a two-phase food recommendation system, that initially uses time-aware collaborative filtering to recommend nutrition depending prior consumption of the user and then forecasts nutritional ratings based on nutritional information. the system uses clustering technique in grouping comparable users and nutritional products, thus improving the accuracy of recommendation.

Mckensy-Sambola et al (2022), proposed a knowledge-based diet recommendation system which utilizes user data in deducing the best nutrients and then recommends various recipes to satisfy the nutritional requirements of users. It uses dietary recommendation ontology to obtain the most suited components in the field of diet recommendations, including diets, ingredients, recipes, food allergies and anthropometric indices.

Chen et al (2023) in their research work, used a collaborative recipe knowledge graph (CRKG) which integrates user's interactions and nutrition-related information in developing a novel food recommendation model. The work employed a health-matching score and a knowledge-aware attention graph convolutional neural network in combining user preferences and health needs in order to generate healthy tailored recommendations.

Stefanidis, et al (2022), introduced a knowledge-based recommendation platform for precise dietary planning in different user groups, including ailing and healthy individuals. The platform is composed of two main layers known as **a qualitative layer** which employs expert-derived rules and an ontology (Neuhaus and Brodaric, 2022) used for validation of ingredients and **a quantitative layer** that employs optimization techniques in creating day-to-day diet plans based on specified nutritional requirements.

Stuart, 2020 proposed a Real-time Analysis and Adaptive Systems, stating that real-time analysis is a critical factor in ailing human nutrition. The work embraced the principle of adaptive systems, enabling the expert system to adjust recommendations dynamically in reaction for changes in the health profile of an individual. This is in alignment with the dynamic nature of individual's health situations and nutritional habits. The incorporation of real-time analysis and adaptive systems in this work enhanced the responsiveness of the system to dynamically changing health condition of individuals profiles and dietary habits.

Stuart, 2020, emphasized that an adaptive system embraces a dynamic feedback approach which enables the expert system regulate recommendations based on immediate health situation. Hence, Users receive real-time feedback on their nutritional choices, offering awareness and promoting timely interventions for optimum health results.

Stuart, 2020, introduced an expert system that accommodates user-initiated inputs in real-time. This allows people to provide immediate updates on their health condition, symptoms, or nutritional changes. The user-initiated input promotes the ability of the system to gather important information for tailored and adaptive recommendations.

According to Stuart, 2020, Adaptive systems portray algorithmic flexibility that allows the expert system to regulate its analytical method based on the changing nature of the data and user interactions. This flexibility helps to ensure the system's continuous effectiveness in capturing and responding to the complex issues in ailing human nutrition.

Gibney et al. (2020) examined the current trends in customized nutrition, explaining methods of personalizing nutritional recommendations to suit individual needs. It emphasized the benefits of tailored dieting in addressing ailing human nutrition.

## OPERATION OF THE SYSTEM

The system, is an expert system that analyzes nutritional deficiencies in individuals and recommends appropriate diets accordingly. In this system, the user provides essential health-related information such as

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age, gender, physical attributes like weight and height, dietary patterns and frequency, symptoms where applicable and any other relevant details like water intake frequency and dietary habits.

The system applies the user's age in tailoring recommendations based on age-specific nutritional needs, as different life stages require different nutrient needs. It also analyzes the user's specified meal patterns e.g. once, twice or thrice a day and calculates the users Body Mass Index (BMI) using the provided weight and height of the user with this formula:

$$BMI = kg/M^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where kg is a person's weight in kilograms and M is their height in meters. A BMI of 25.0 or more is overweight while the healthy range is 18.5 to 24.9, anything below 18.5 is underweight. The system also checks out for any physical symptom, nutritional habit and water intake frequency inputted by the user. It then incorporates all these information provided by the user and applies expert knowledge in generating a comprehensive nutritional recommendation tailored to the individual dietary requirements.

## HIGH LEVEL MODEL OF THE SYSTEM

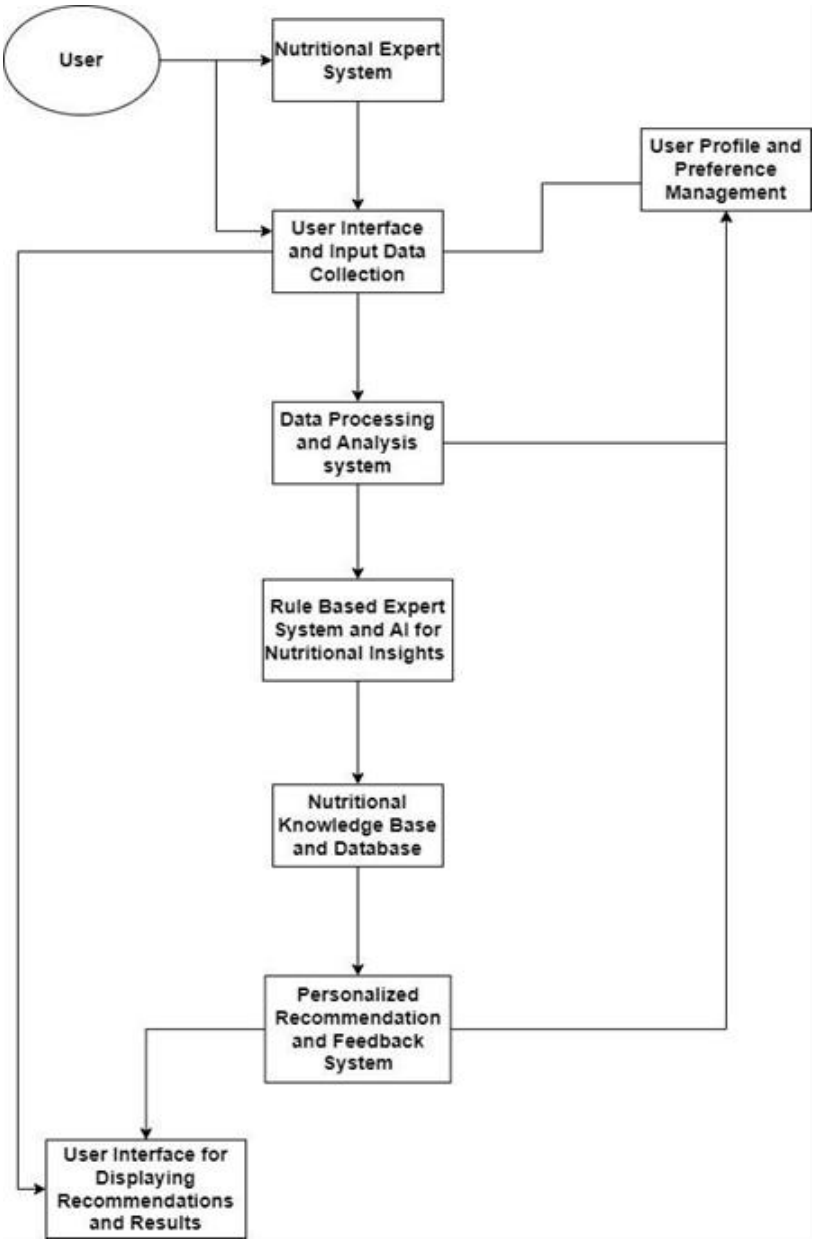


Figure 1: High level model of the proposed system

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The high level model presents the following modules:

User Interface and Input Data Collection Module: This is the point of interaction between users and the system. It includes input forms for users to enter their health-related data (weight, height, symptoms, etc.). it also displays personalized nutritional recommendations and status reports.

Data Processing and Analysis System Module: Here, the user's health data are gathered from the interface, processes and validated.

RuleBased Expert System: This utilizes artificial intelligence and rule-based logic for in-depth analysis of health data. It determines the nutritional status of the user based on the collected information and generates personalized recommendations and insights.

Nutritional Knowledge Base: This is database of expert insights, nutritional guidelines and health-related information. It supports the expert system in making informed recommendations.

User Profile Management Module: This manages the user profiles and stores user preferences, health history as well as progress tracking data.

Personalized Recommendation and Feedback system: This module Presents the user with tailored recommendations and feedback based on their individual health data inputs. It fosters a personalized experience for every individual.

## SAMPLE OUTPUT

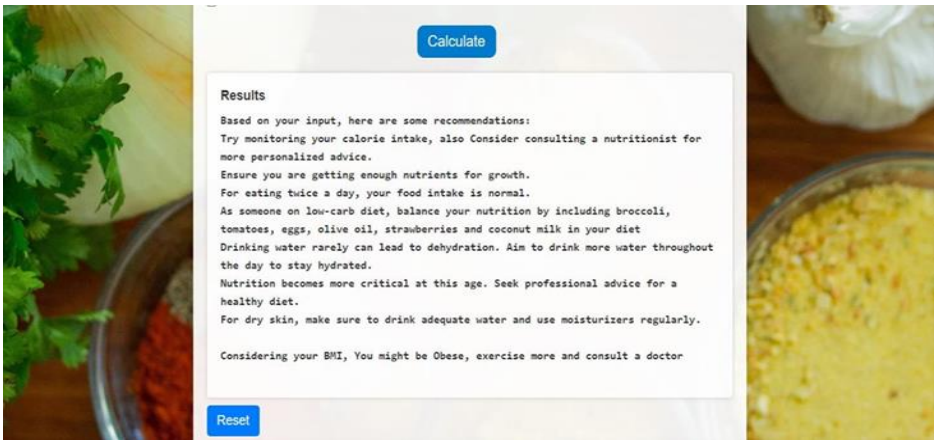


Figure 2: The Recommendations Page

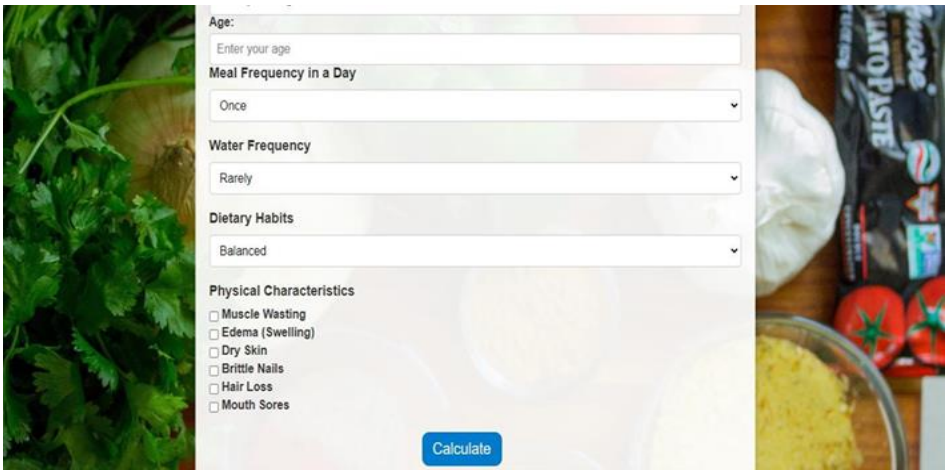


Figure 3: The Patient Input Page

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## CONCLUSION

The development of the Nutritional Expert System for Ailing Human marks a great stride towards tailored health and nutrition management. The system meticulously integrated user-provided health data and expert knowledge to provide a sophisticated tool that can offer personalized recommendations in various health situations. The system is able to provide this intuitive and practical guidance in making informed health decisions by considering factors like as age, meal patterns, symptoms and dietary habits.

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