Dietary Recommendation System Based on Machine Learning

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Abstract: In order to make nutrition recommendations based on machine learning, this research employs a Decision Tree Classifier. Dietary restrictions, physical activity levels, age, gender, BMI, disease type, severity, and training data are all inputs into the model. The system accurately predicts outcomes, encodes categorical factors, and partitions the dataset for testing and training. Diet recommendations tailored to the user's input can be made in real-time by saving the trained model. For optimal health, the model suggests tailored meal patterns that include Low-Carb, Low-Sodium, and Balanced foods.

1 INTRODUCTION

In today's fast-paced world, it is crucial for well-being to eat healthily. It is rare for traditional diet regimens to account for a person's unique health status, food restrictions, and way of life. Poor diet adherence and the risk of chronic diseases are outcomes of many people's struggles to choose meals that fulfil their health demands. More than ever before, there is a demand for tailored, data-driven dietary advice.

Better patient outcomes can be achieved by data-driven healthcare decision-making made possible by machine learning. By analysing large amounts of health data, machine learning algorithms can spot patterns and provide reliable forecasts. Incorporating body mass index (BMI), disease kind and severity, degree of physical activity, and dietary preferences into personalised nutrition plans might be a machine learning-based approach. People are better able to achieve their health goals and benefit from nutritional interventions as a result.

A Decision Tree Classifier is employed in the proposed method to provide dietary recommendations according to health criteria. A huge dataset including demographic information (gender, age, weight, blood pressure, glucose, and food restrictions) is used to train the algorithm. Following training, the model might recommend a Balanced, Low-Carb, or Low-Sodium diet depending on the patient's condition. Quickly and accurately, this automated diet planner provides guidance.

An important advantage of this technology is its ability to quickly assess user input and provide dietary recommendations. Customers receive practical and attainable dietary guidance from the system in the form of personalised meal plans based on the anticipated diet category. Over time, the model becomes better at delivering accurate and useful suggestions as it learns from new data.

Fast, quick, and tailored healthy eating is now a reality with this technology that suggests diets based on machine learning. It improves people's quality of life by using modern data science to better manage their health and food. By offering individualised meal plans grounded in scientific research, this method contributes to the promotion of long-term health.

2 LITERATURE SURVEY

2.1 Personalized Diet Recommendation System Using Machine Learning:

Individuals can get health and nutrition advice from the "Personalised Diet Recommendation System" using machine learning. Using user-supplied data, this project constructs an ML model to provide dietary and health-related suggestions tailored to each individual.

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The model takes into account factors such as age, gender, dietary goals, activity intensity, and weight loss targets. The next step is for it to say if the user is slim or not. After doing the necessary analysis, the system will provide meal plans for the day. You may find nutritional information and cooking directions for individual meals in these programs. It is advised that at each meal, favoured foods be selected from a variety of categories. The system takes a person's dietary consumption into account and displays the results graphically in a pie chart. User preferences, body mass index (BMI), and physical characteristics inform our project's output designs.

2.2 AI Nutrition Recommendation Using a Deep Generative Model and ChatGPT:

Advanced AI nutrition systems have recently emerged, thanks to recent advancements in AI, to enhance tailored dietary guidance and overall health and wellness. There are concerns regarding the accuracy and reliability of AI systems' nutritional recommendations because to the absence of professional norms. A state-of-the-art AI nutrition advising system that adheres to dietary rules is developed using new complex loss functions in conjunction with the speed and explainability of deep generative networks. Make accurate predictions about users' anthropometrics and medical conditions in descriptive latent space using a variational autoencoder and an optimiser to alter meal portions depending on energy demands, the system provides customised, healthy, and highly accurate weekly meal plans. The proposed method has the potential to increase meal diversity, accuracy, and generalisability using ChatGPT's unparalleled library of meals from many cuisines. The suggested diet recommendation method can be readily incorporated into upcoming diet recommendation systems and produces weekly meal plans that fulfil users' dietary and energy requirements, according to extensive trials conducted on 84000 daily meal plans for virtual users and 3000 real users with 7,000 daily meal plans.

2.3 A Food Recommender System Considering Nutritional Information and User Preferences

Health problems that do not spread from person to person are on the rise, according to the World Health Organisation. These include cancer, diabetes, and premature heart disease. Poor dietary habits are associated with several diseases. Individuals' unique physical, physiological, and personal traits inform a novel area of research known as "personalised nutrition," which provides dietary recommendations. Specifically, by integrating user data with nutritional information, several recent research have created computer models for customised meal selection. Unlike previous attempts, this research presents a global framework for recommendation of daily meal plans that handles information on preferences and nutrition at the same time. The idea uses AHPSort, a method for multi-criteria decision analysis, to screen out foods that won't work for the people using the concept right now. A daily meal plan that takes into account the user's preferences, eating habits, and nutritional requirements is generated through an optimization-based stage. Using a case study, the recommender system is tested.

2.4 AI-Driven Nutritional Assessment Improving Diets with Machine Learning and Deep Learning for Food Image Classification:

For optimal health and to stay away from food-borne illnesses, a well-balanced diet is a must. In order to address this critical public health concern, we employ DL techniques and ML to categorise food photos and anticipate important attributes. For effective good and bad food product classification, our approach employs a sophisticated hybrid model that mixes a deep learning CNN with a SVM. Using the SVM classifier for classification, the CNN-based method streamlines feature extraction. Using a tailored dataset, we evaluated our approach. With a 97% and 94% accuracy rate, respectively, our hybrid model outperforms the CNN model in the experiments. Improvements in recollection, f1-score, and accuracy are also seen.

2.5 Intelligent Personalized Nutrition Guidance System Using IoT and Machine Learning Algorithm

There has been a global uptick in dietary issues. Problems like diabetes, obesity, and weight gain can stem from a poorly balanced diet. The system is able to assess food images in novel ways to suggest better eating habits thanks to the integration of image processing. To get useful information out of food photo data, we combine machine learning, the internet of things (IoT), and image processing. Images of food taken using smartphones and other specialist cameras are uploaded to the cloud for analysis. This study proposes a novel approach to building a system that gives individualised dietary recommendations by utilising SVM and IoT technology. SVM searches for correlations, trends, and dietary requirements in this data. All eating habits are saved in our database on the cloud. Calories and nutrients may be calculated using this method, which makes use of image processing and segmentation. The nutritional value, serving size, and food type labels provide the algorithm with a wealth of dietary data from which to learn. This trained SVM model is utilised by the system to evaluate the nutritional requirements, deficiencies, and personalised dietary goals of users.

3 METHODOLOGY

3.1 Proposed System

The proposed system utilizes machine learning, specifically a Decision Tree Classifier, to generate personalized diet recommendations based on an individual's health attributes. By analyzing various parameters such as age, BMI, disease type, severity, physical activity level, and dietary restrictions, the system predicts the most suitable dietary plan, including Low-Carb, Low-Sodium, or Balanced Diets. The model is trained on a diverse dataset to ensure accurate classification and effective meal suggestions tailored to the user’s specific health needs.

To enhance efficiency, the system automates data processing, encodes categorical values, and performs real-time analysis to deliver instant dietary recommendations. Users simply input their health information, and the model evaluates their data to suggest an appropriate meal plan. Unlike traditional methods that require manual consultation, this AI-driven approach provides quick, reliable, and scientifically backed dietary advice.

Among the many benefits of this approach is its ability to generate customized meal plans, ensuring that individuals receive practical and actionable dietary guidance. The automation reduces human intervention, making it a more accessible and scalable solution for personalized nutrition planning. By continuously learning from new health data, the system refines its recommendations over time, leading to improved adherence and better health outcomes for users.

3.2 System Architecture

The architecture of the suggested AI-driven diet recommendation system consists of multiple stages, ensuring efficient processing and accurate dietary predictions (figure 1). Initially, user input is collected, including health attributes such as age, BMI, disease type, severity, physical activity level, and dietary restrictions. This data undergoes preprocessing, where missing values are handled, categorical variables are encoded, and numerical features are normalized for optimal model performance.

The Decision Tree Classifier is then applied to analyze the processed data, identifying patterns and relationships between health parameters and dietary requirements. Based on the classification, the model predicts an appropriate diet plan, such as Low-Carb, Low-Sodium, or Balanced Diets. The system then generates personalized meal plans, ensuring users receive actionable dietary guidance tailored to their specific health conditions.

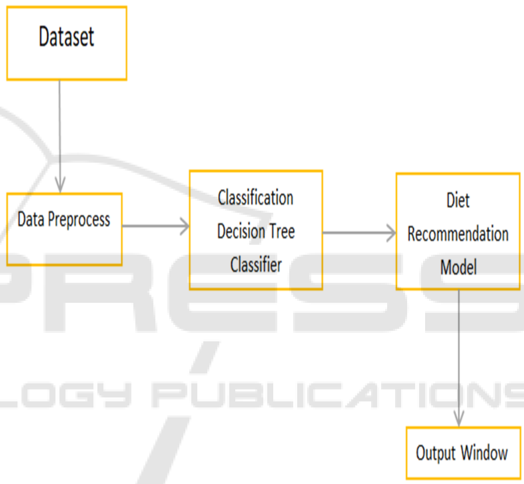

Figure 1: Proposed Architecture.

3.3 Modules

3.3.1 User

In this application user is a module, should register with the application then only he can login into his/her account. After successful login he/she can able to enter the input data and can view recommended diet and diet plan and logout.

3.3.2 Admin

Here admin is a module can login directly with his predefined username and password after successful login he can able to upload dataset into the application, and applying preprocess to get all categorical columns and applying label encoding then split data into training and testing, building decision tree model and save model and logout.

3.4 Algorithms - Decision Tree Classifier

The Decision Tree Classifier is used in this project to predict personalized diet recommendations based on various health parameters. It operates by recursively splitting the dataset into nodes, where each node represents a decision based on a specific feature (such as BMI, disease type, or activity level). The tree structure allows the model to classify users into different diet categories, such as Low-Carb, Low-Sodium, or Balanced Diets, based on their unique health profiles.

During training, the algorithm processes a dataset containing age, gender, BMI, disease severity, physical activity level, and dietary restrictions as input features. The Decision Tree Classifier uses entropy or Gini index to determine the best feature for splitting the data at each step. A final dietary recommendation is given when the tree reaches a node in the leaf canopy.

Once trained, the model can quickly classify new user inputs by traversing the decision tree and selecting the most appropriate diet plan. For example, if a user has high BMI, diabetes, and low physical activity, the model may classify them under the Low-Carb Diet category. Similarly, a user with hypertension and moderate activity levels may be recommended a Low-Sodium Diet.

The key advantage of using a Decision Tree Classifier is its ability to provide clear, interpretable recommendations while efficiently handling categorical and numerical data. Additionally, the model can be continuously updated with new dietary data, improving accuracy over time and ensuring users receive the most relevant nutritional guidance.

4 EXPERIMENTAL RESULTS

Accuracy: How well a test can differentiate between healthy and sick individuals is a good indicator of its reliability. Calculate the proportion of true positives and negatives to evaluate the reliability of the test. After doing the maths:

$$\text{Accuracy} = TP + TN / (TP + TN + FP + FN) \quad (1)$$

Precision: The accuracy rate of a classification or number of positive cases is known as precision. Accuracy is determined by applying the following formula:

$$\text{Precision} = TP/(TP + FP) \quad (2)$$

Recall: The recall of a model is a measure of its capacity to identify all occurrences of a relevant machine learning class. A model's ability to detect class instances is shown by percent of correctly anticipated positive observations relative to total positives.

$$\text{Recall} = TP/TP+FN \quad (3)$$

F1-Score: A high F1 score indicates that a machine learning model is accurate. Improving model accuracy by integrating recall and precision. How often a model gets a dataset prediction right is measured by the accuracy statistic.

$$\text{F1 Score} = 2 / ((1 / \text{Precision}) + (1 / \text{Recall})) \quad (4)$$

$$\text{F1 Score} = (2 \times \text{Precision} \times \text{Recall}) / (\text{Precision} + \text{Recall}) \quad (5)$$

Upload dataset, View dataset, Enter input data and results pages are shown from figures 2-5 respectively.

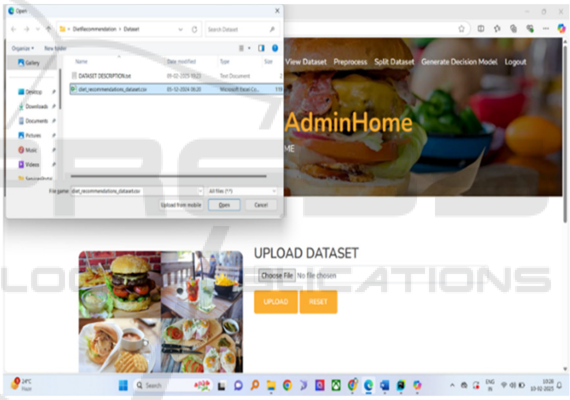

Figure 2: Upload dataset.

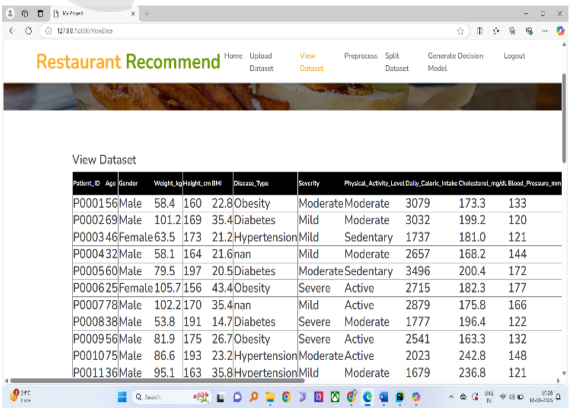

Figure 3: View dataset.

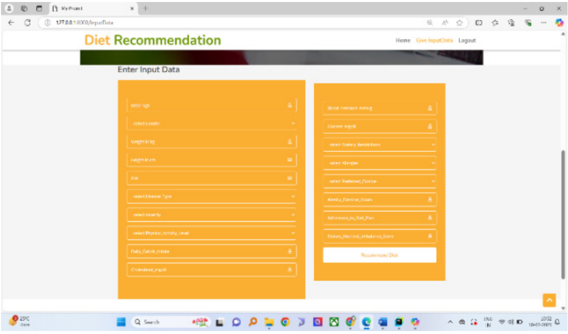

Figure 4: Enter input data.

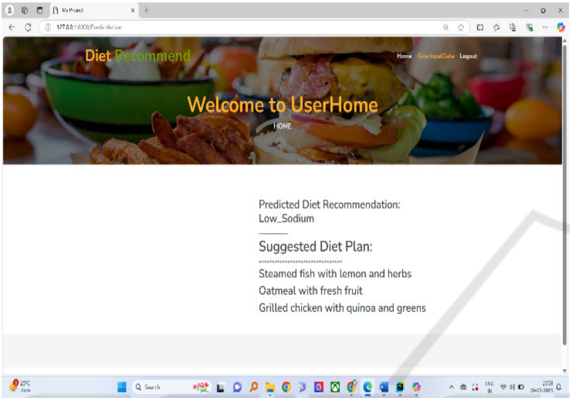

Figure 5: Results.

5 CONCLUSIONS

Customised diet plans could be radically altered by AI-powered meal recommendation systems. Dietary recommendations are generated by these systems using decision trees, which take into account health measures, dietary preferences, and medical issues. When compared to more conventional methods, AI-generated recommendations are superior for managing chronic diseases like diabetes and hypertension, as well as for ensuring patient adherence. With the advancement of AI and real-time data monitoring, these systems will be able to better encourage healthy eating habits and provide improved health outcomes.

6 FUTURE SCOPE

The diet recommendation system can be enhanced by integrating wearable devices to track real-time health metrics like heart rate, calorie expenditure, and physical activity. Future developments may incorporate deep learning models for improved accuracy in dietary predictions and personalized recipe generation based on user preferences, allergies, and cultural habits. Adding voice assistant support can make the system more interactive and user-friendly. AI-powered food recognition technology can help users monitor their daily food intake automatically. Additionally, deploying the system as a mobile or cloud-based application will improve accessibility, allowing users to receive real-time diet recommendations anytime, anywhere. These advancements will make AI-driven nutrition planning more precise, adaptive, and effective in promoting long-term health and wellness.

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