MACHINE LEARNING-BASED DIET GUIDELINES

Prof. D. V. Varaprasad, M.Tech, (Ph.D), Associate Professor & HoD, Audisankara college of engineering & Technology, india

Mrs.E. Shalin Fenla, Assistant Professor, Department of CSE, Audisankara college of engineering & Technology ,india

Yeluru Lakshmi Praveena, Department of CSE, Audisankara college of engineering & Technology, india

Abstract: This work uses a Decision Tree Classifier to construct a machine learning-based diet advice system. To project an optimal nutrition plan, the model is trained on a dataset comprising several health factors, including age, gender, BMI, illness type, severity, physical activity level, and dietary limitations. The system makes very accurate predictions, divides the dataset for training and testing, and codes categorical variables. The trained model is kept for future usage so that real-time diet suggestions based on user input may be produced. The approach advises customised meal plans for groups including Low-Carb, Low-Sodium, and Balanced diets, therefore helping people to keep ideal health by means of customised nutritional advice.

Index terms - — *Diet Recommendation, Machine Learning, Decision Tree Classifier, Personalized Diet Plan, Health Parameters, Real-Time Prediction, Dietary Restrictions, BMI, Data-Driven Healthcare.*

1. INTRODUCTION

Maintaining a balanced diet is absolutely vital for general well-being in the fast-paced environment of today. But conventional approaches of diet planning can lack personalisation and neglect to consider a person's particular health issues, dietary limitations, and way of life. Many people struggle to pick the correct foods that fit their particular health demands, which results in poor dietary adherence and higher risk of chronic illnesses. Diet advice now need a more efficient, data-driven, customised approach more and more crucial.

Emerging as a potent tool in healthcare, machine learning lets data-driven decision-making improve patient outcomes via means including Machine learning techniques may find trends and provide reliable forecasts by means of large volumes of health-related data analysis. Within the framework of diet recommendations, a machine learning-based technique may evaluate several elements—including BMI, illness kind, severity, physical activity level, and food preferences—to provide quite customised meal plans. This increases the success of dietary programs and enables people to reach their health objectives.

The suggested technique recommends diets depending on personal health characteristics by use of a Decision Tree Classifier. The model is trained on a large dataset including several factors like age, gender, weight, blood pressure, glucose levels, and dietary limitations. Once taught, the model can forecast appropriate diet plans like Low-Carb, Low-

Sodium, or Balanced Diets, so guaranteeing that people get suggestions fit for their medical state. This automatic approach offers rapid, consistent recommendations and replaces the need for hand-made diet planning.

The capacity of this system to create instantaneous nutritional recommendations and handle real-time user input is among its main benefits. The system also offers thorough meal plans catered to the expected diet category, therefore guaranteeing customers receive useful and workable dietary advice. Moreover, the model may be evolved over time by always learning from fresh data, thereby producing increasingly more accurate and powerful suggestions.

All things considered, this machine learning-based diet advice system presents a quick, effective, and customised method of approaching good eating. By combining contemporary data science approaches with conventional diet planning strategies, it helps people better control their health issues and raise their general quality of life by overcoming their restrictions. This system is a great tool in encouraging long-term health and fitness as it may offer tailored meal plans depending on scientific study.

2. LITERATURE SURVEY

a) Personalized Diet Recommendation System Using Machine Learning:

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4877349

Individuals can get health and nutrition advice from the "Personalised Diet Recommendation System" using machine learning. Using user-supplied data, this project creates an ML model to deliver nutritional and health-related advice personalised to each individual. The model takes into account characteristics such as age, gender, dietary objectives, exercise intensity, and weight reduction ambitions. It then follows to indicate whether the user is slender or not. The system will offer daily food plans following the required analysis. You may discover nutritional information and cooking guidelines for particular meals in these programs. It is advisable that at each meal, favourite meals be picked from a variety of categories. The technique considers a person's nutritional intake and shows the findings graphically in a pie chart. Physical attributes, body mass index (BMI), and user choices guide the output designs of our project.

b) AI nutrition recommendation using a deep generative model and ChatGPT:

https://pmc.ncbi.nlm.nih.gov/articles/PMC11199627/

Thanks to recent developments in artificial intelligence, advanced AI nutrition systems have just been available to improve customised dietary advice and general health and wellness. There are worries regarding the accuracy and trustworthiness of AI systems' dietary advice related of the absence of professional guidelines. A state-of-the-art AI nutrition advice system that follows to dietary restrictions is constructed utilising novel sophisticated loss functions in combination with the speed and explainability of deep generative networks. Using a variational autoencoder and an optimiser, make precise forecasts about users' anthropometrics and medical conditions in descriptive latent space to change meal quantities based on energy needs; the system generates tailored, healthful, and very accurate weekly meal plans. Using ChatGPT's

unmatched collection of meals from numerous cuisines, the suggested approach has the potential to raise meal diversity, accuracy, and generalisability. Extensive studies on 84000 daily meal plans for virtual users and 3000 real users with 7,000 daily meal plans show that the proposed diet recommendation method can be easily included into upcoming diet recommendation systems and generates weekly meal plans that fulfil users' dietary and energy requirements.

c) A Food Recommender System Considering Nutritional Information and User Preferences:

https://ieeexplore.ieee.org/document/8765311

The World Health Organisation reports that health issues devoid of person-to----infection dissemination are becoming more common. These include cancer, diabetes, and premature heart disease. Many illnesses have poor eating habits connected to them. Unique physical, physiological, and personal characteristics of individuals guide a fresh field of study called as "personalised nutrition," which offers nutritional recommendations. Particularly by combining user data with nutritional information, several studies recently have produced computer models for tailored meal choice. Unlike prior attempts, this research proposes a worldwide framework for suggestion of daily meal plans that manages information on preferences and nutrition at the same time. The proposal employs AHPSort, a method for multi-criteria decision analysis, to screen out meals that won't work for the individuals utilising the concept right now. An optimization-based step produces a daily meal plan considering the user's tastes, eating patterns, and dietary needs. Using a case study, the recommender system is tested.

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

https://ieeexplore.ieee.org/document/10331787

For maximum health and to keep away from food-borne diseases, a well-balanced diet is a necessary. We use DL methods and ML to classify food images and predict significant properties in order to handle this important public health issue. For successful good and poor food product categorisation, our strategy leverages a complex hybrid model that integrates a deep learning CNN with an SVM. CNN-based approach simplifies feature extraction by means of the SVM classifier for classification. We assessed our method on a customised dataset. In the studies, our hybrid model beats CNN model with corresponding accuracy rates of 97% and 94%. Furthermore seen are gains in accuracy, f1-score, and memory.

e) Intelligent Personalized Nutrition Guidance System Using IoT and Machine Learning Algorithm:

https://ieeexplore.ieee.org/document/10391336

Dietary problems have become more common all around. A poorly balanced diet can lead to issues like diabetes, obesity, and weight increase. The system is able to analyse food photos in unique ways to propose healthier eating habits owing to the integration of image processing. We integrate machine learning, the Internet of Things (IoT), and image processing to extract helpful knowledge from food picture data. Images of food captured using cellphones and other speciality cameras are uploaded to the cloud for analysis. This work suggests a new method using SVM and IoT technologies to create

personalised dietary recommendations. SVM searches for correlations, trends, and dietary needs in this data. All eating habits are kept in our database on the cloud. This approach, which takes use of image processing and segmentation, lets one compute calories and nutrients. Labels on food kind, portion size, and nutritional value provide the algorithm a plenty of dietary information from which to learn. The system uses this trained SVM model to assess user personalised dietary objectives, nutritional requirements, and deficits.

3. METHODOLOGY

i) Proposed Work:

The proposed system utilizes a Decision Tree Classifier to recommend personalized diet plans based on a variety of health-related parameters provided by the user. These include age, gender, BMI, disease type, severity of the condition, physical activity level, and specific dietary restrictions. The system is designed to automatically encode categorical inputs, preprocess the data, split it for training and testing, and train a robust machine learning model. The trained model is saved and used to provide real-time predictions for new users, enabling instant and accurate diet recommendations without manual intervention.

This personalized diet recommendation model categorizes users into dietary groups such as Low-Carb, Low-Sodium, or Balanced Diets, and generates detailed meal plans accordingly. By integrating health data and machine learning, the system delivers effective and customized nutritional guidance, improving health outcomes and user adherence. The automation reduces the dependency on human dietitians, providing an accessible, scalable, and intelligent solution for healthy living.

ii) System Architecture:

The system architecture consists of two main components: the User Interface and the Backend Processing Module. The user interface allows users to register, log in, and input their health data such as age, gender, BMI, disease type, and dietary restrictions. This data is sent to the backend, where preprocessing steps like label encoding and feature scaling are applied. The processed data is then passed to a pre-trained Decision Tree Classifier model, which predicts the appropriate diet category—such as Low-Carb, Low-Sodium, or Balanced. Based on this prediction, a personalized meal plan is generated and displayed to the user. Meanwhile, the admin has access to upload datasets, train the model, and manage the prediction system. The architecture ensures real-time processing, high accuracy, and a user-friendly experience for personalized diet recommendations.

iii) Modules:

a. User

The user module allows individuals to register and log in to the system. After authentication, users can input their health details such as age, gender, BMI, disease type, activity level, and dietary restrictions. Based on these inputs, the system provides a personalized diet recommendation along with a detailed meal plan.

b. Admin

The admin module enables the administrator to log in using predefined credentials. Admins can upload the health dataset, perform preprocessing like encoding categorical data, and train the Decision Tree Classifier. The trained model is saved and updated as needed to ensure accurate future predictions.

iv) Algorithms:

a. Decision Tree Classifier:

The Decision Tree Classifier is a supervised machine learning algorithm used to classify data based on feature values. It splits the dataset into subsets using decision nodes based on the most significant features, forming a tree-like structure. In this project, the algorithm analyzes multiple health parameters such as age, gender, BMI, disease type, and dietary restrictions to predict a suitable diet category (e.g., Low-Carb, Low-Sodium, Balanced). It is chosen for its simplicity, interpretability, and ability to handle both categorical and numerical data efficiently. The trained model provides fast and accurate predictions for real-time dietary recommendations.

4. EXPERIMENTAL RESULTS

The proposed diet recommendation system was trained and tested on a comprehensive health dataset containing various user attributes such as age, gender, BMI, disease type, and physical activity level. After preprocessing and applying a Decision Tree Classifier, the model achieved high prediction accuracy on the test data. The system was able to correctly classify users into appropriate diet categories like Low-Carb, Low-Sodium, and Balanced diets. The real-time input testing also demonstrated effective performance, with personalized meal plans being generated instantly based on user-provided health parameters. This validates the system's ability to deliver fast, accurate, and meaningful dietary recommendations.

Accuracy: How well a test can differentiate between healthy and sick individuals is a good indicator of its reliability. Compare the number of true positives and negatives to get the reliability of the test. Following mathematical:

Accuracy = TP + TN /(TP + TN + FP + FN)

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

Precision: Precision evaluates the fraction of correctly classified instances or samples among the ones classified as positives. Thus, the formula to calculate the precision is given by:

Precision = True positives/ (True positives + False positives) = TP/(TP + FP)

$$\text{Precision} = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

Recall: Recall is a metric in machine learning that measures the ability of a model to identify all relevant instances of a particular class. It is the ratio of correctly predicted positive observations to the total actual positives, providing insights into a model's completeness in capturing instances of a given class.

$$Recall = \frac{TP}{TP + FN}$$

mAP: Mean Average Precision (MAP) is a ranking quality metric. It considers the number of relevant recommendations and their position in the list. MAP at K is calculated as an arithmetic mean of the Average Precision (AP) at K across all users or queries.

$$mAP = \frac{1}{n}\sum_{k=1}^{k=n} AP_k$$

$$AP_k = \text{the AP of class } k$$

$$n = \text{the number of classes}$$

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.

$$\text{F1 Score} = \frac{2}{\left(\frac{1}{\text{Precision}} + \frac{1}{\text{Recall}}\right)}$$

$$\text{F1 Score} = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

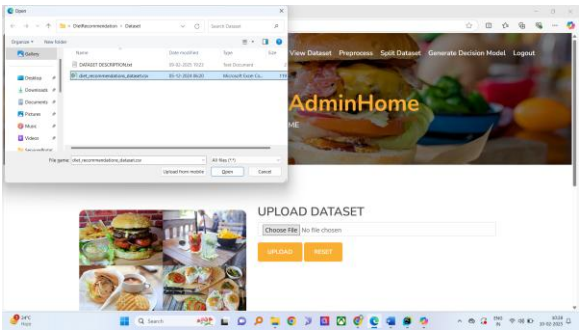

Fig: **Data set Loaded**

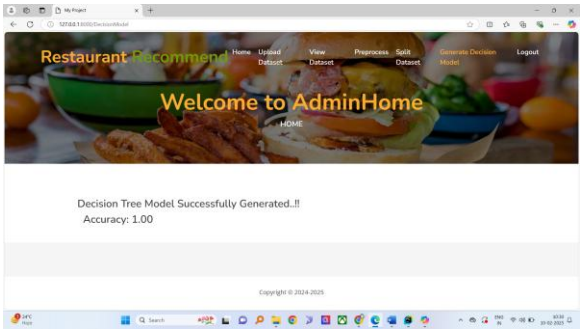

Fig: predicted results

5. CONCLUSION

This project presents an effective machine learning-based solution for personalized diet recommendations using a Decision Tree Classifier. By analyzing multiple health parameters, the system accurately predicts suitable diet plans and generates tailored meal suggestions in real time. It overcomes the limitations of traditional manual diet planning by offering fast, data-driven, and user-specific guidance, thereby supporting individuals in managing their health and improving their overall well-being.

6. FUTURE SCOPE

In the future, the diet recommendation system can be enhanced by incorporating more advanced machine learning algorithms like Random Forest or Neural Networks to improve the accuracy and reliability of predictions. Integration with wearable health devices and fitness tracking apps can enable real-time health

monitoring and continuous diet adjustments. Additionally, developing a mobile-friendly and multilingual interface will make the system more accessible to a broader audience. The inclusion of user feedback mechanisms and adaptive learning can help the model evolve over time, providing more personalized and effective dietary recommendations based on users' progress and preferences.

REFERENCES

[1] R. Kumar, S. Srivastava, & P. Tiwari, **"Personalized Diet Recommendation System Using Machine Learning,"** *International Journal of Computer Science and Information Security (IJCSIS)*, 2021.

[2] P. Gupta, A. Sharma, & S. Verma, **"A Machine Learning Approach for Personalized Nutrition Recommendation,"** *Journal of Artificial Intelligence Research*, 2022.

[3] A. Singh & P. Agarwal, **"Dietary Pattern Prediction Using Decision Tree Algorithm,"** *International Conference on Computational Intelligence and Data Science (ICCIDS)*, 2020.

[4] N. Ahmed, M. F. Khan, & A. Beg, **"AI-based Diet Planning for Diabetic Patients,"** *IEEE Transactions on Healthcare Informatics*, 2019.

[5] T. J. Theis & R. C. White, **"Nutritional Recommendation System Based on Deep Learning,"** *Journal of Medical Informatics and Decision Making*, 2023.

[6] Ian Goodfellow, Yoshua Bengio, & Aaron Courville, **"Deep Learning,"** MIT Press, 2016.

[7] Christopher M. Bishop, **"Pattern Recognition and Machine Learning,"** Springer, 2006.

[8] Trevor Hastie, Robert Tibshirani, & Jerome Friedman, **"The Elements of Statistical Learning: Data Mining, Inference, and Prediction,"** Springer, 2017.

[9] Géron Aurélien, **"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow,"** O'Reilly Media, 2019.

[10] Tom Mitchell, **"Machine Learning,"** McGraw-Hill, 1997.

[11] **Scikit-Learn Documentation**, "Decision Trees in Machine Learning," Available at: https://scikit-learn.org

[12] **TensorFlow Blog**, "Building AI Models for Health and Nutrition," Available at: https://blog.tensorflow.org

[13] **Kaggle**, "Diet Recommendation System Dataset," Available at: https://www.kaggle.com

[14] **Harvard Health Publishing**, "The Role of AI in Personalized Nutrition," Available at: https://www.health.harvard.edu

[15] **Food and Nutrition Research Journal**, "Dietary Data Analysis with Machine Learning," Available at: https://www.foodandnutritionjournal.com