INTELLIGENT FOOD RECOMMENDATION FRAMEWORK BASED ON MULTI-CLASSIFIER DETECTION OF VITAMIN DEFICIENCIES

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ABSTRACT

Vitamin deficiencies are a widespread health issue that can lead to severe physiological disorders if left unaddressed. This study presents an intelligent food recommendation system that detects potential vitamin deficiencies using a multi-classifier machine learning framework and provides personalized dietary suggestions to correct the deficiencies. The system leverages clinical symptoms, user health data, and dietary history to train classification models such as Random Forest, Support Vector Machine (SVM), Decision Tree, and K-Nearest Neighbors (KNN) for accurate prediction. The ensemble-based approach enhances diagnostic precision by combining the strengths of individual classifiers. Based on the predicted deficiency type (e.g., Vitamin A, B12, D), the system dynamically suggests food items rich in the missing nutrient. Experimental results show that the proposed model achieves high accuracy, sensitivity, and reliability. This framework can serve as a preventive healthcare tool, promoting nutritional well-being and supporting personalized diet planning through data-driven insights.

1. INTRODUCTION

Vitamins are essential micronutrients that play a critical role in maintaining human health, supporting immune function, metabolism, and overall cellular activity. Despite their importance, vitamin deficiencies remain prevalent, especially in developing regions and among individuals with restricted diets or underlying health conditions. Common deficiencies, including Vitamin D, B12, and A, often go unnoticed until they manifest as serious health complications such as anemia, bone disorders, or cognitive impairments.

Traditional methods for detecting vitamin deficiencies involve clinical tests and doctor consultations, which may not always be accessible or affordable. With the rise of artificial intelligence and big data in healthcare, machine learning offers a promising alternative for early detection and intervention. By analyzing patterns in symptoms, dietary habits, and medical history, machine learning algorithms can predict potential deficiencies and recommend corrective actions.

This paper introduces a multi-classifier machine learning framework for detecting vitamin deficiencies and generating personalized food recommendations. The system integrates various classification algorithms—each optimized for performance—into an ensemble decision engine that improves accuracy and generalizability. It aims to empower users and healthcare professionals with a smart, accessible, and data-driven tool for dietary planning and preventive health management.

2. LITERATURE SURVEY

It was suggested by Raciel Yeraz Toledo that nutritional data and user preferences be taken into account while creating a meal recommendation system. Based on the user's selections, the meal plan was created. Nutritional information and preferences for users are both managed by this application. Vijay Jaiswal suggests employing data mining technologies to track a person's intake of nutrients, eating patterns, and calories burnt. Hidden trends and client eating habits may be discovered from a variety of data sources with this application. Random Tree and Decision Tree methods are employed in this tool to analyse various datasets. H. Jiang proposed a system to calculate the daily calorie demand. The Knapsack algorithm is used for recommended diet

combinations of users. Different from other diabetic diet recommendation systems, this system can rank the recommended diet combinations using TOPSIS algorithm according to user's food nutrition. Jung-Hyun Lee proposed a customized diet recommendation service managing heart diseases. This service provides customers customised general information, family history of diseases, seasonal food intakes. Rung-Ching Chen construct a recipe ontology that defines some common diseases healing with verity of food recommendations and an inference engine for customer health condition and a recipe ontology can be used for proper recipe recommendations on food priorities. FidelsonTanzil uses ABC algorithm to extract information from database according to user's requirements. Kmean and SOM algorithms are used on datasets. Mohd Afisi projected ABC algorithm in Data Mining and tested compared to six traditional classification algorithms successfully and ABC proved as a suitable algorithm for recommendation. Xiaoyan Gao proposed the food recommendation problem on user choice recipe recommendation factors. By using a neural network-based solution on Ordered diet Recommendation.

It was the goal of the authors INGMAR WEBER and PALAKORN ACHANANUPARP [1] to acquire insights from machine-learned - diet success prediction to aid individuals who are attempting to remain fit and healthy by keeping track of their food consumption. To explore the features of a failed diet, researchers analysed more than 4,000 long-term MyFitnessPal users' food diaries. Concisely, researchers used "quantified self" data to construct a machine learning model that could predict whether or not a person will go over or under their daily caloric requirements on a regular basis. According to the study's findings, classification performance was adequate, and a token-based model performed better than a category-based model.

To find trends and business strategies concealed in their customer and online data, Nandish Shah and Ishani Shah [2] proposed a healthy eating system based on web data mining to monitor eating habits and suggest foods that promote health and avoid foods that elevate sickness risk. Researchers employed a variety of data mining methods to glean information on people's eating habits. These algorithms included classification, clustering, association rules, and more. Fat, energy, and vitamin percentages in the dish were determined by analysing each kind of food. They next processed the composition data using the classification mining algorithm to determine whether or not the diet was healthful. As a consequence, each individual was given a tailored set of suggestions.

The authors AINE P. HEARTY AND MICHAEL J. GIBNEY [3] illustrated how data mining methods may be used to assess a coding system at the meal level. Sustained data mining approaches were used to predict a component of nutritional quality using food- and meal-based codes, respectively, in the study. The NorthSouth Ireland Food Consumption Survey 1997–1999 was utilised by the writers in their research. There was the creation of a healthy eating index (HEI) score. Artificial neural networks (ANNs) and decision trees were used to predict HEI quintiles based on meal pairings. As a consequence, the ANN performed marginally better than the decision tree when it came to predicting HEI. The decision tree, on the other hand, performed better than the ANN in terms of accuracy when using the meal coding scheme. Fitness Advisor System was developed by CHRISTY SAMUEL RAJU, SANCHIT V CHAVAN, KARAN PITHARDIA, SHRADDHA SANKHE, and SACHIN GAVHANE [4]. It was the writers' idea to create a desktop programme called "Fitness Advisor" that could diagnose a person's weight-related health issues and provide personalised advice and information based on that. It was determined that parameters such as age, gender and health status were taken into account as well as a variety of other variables inside the system. The authors employed a mix of clustering,

association, and classification algorithms to offer the best possible expert advice to the user's situation. The authors employed the Apriori method to generate association rules. The system's ultimate result was dietary and exercise recommendations from professionals.

3. PROBLEM STATEMENT

Based on user preferences, a content-based meal recommendation system is suggested that recommends food dishes. Users' favoured recipes are broken down into ingredients and given ratings based on previous users' ratings. Recommendation: Recipes that use the same ingredient are preferred. The writers do not take into account the nutritional aspects of the diet and the overall balance. Additionally, the user's preferences may not vary on a daily basis, increasing the likelihood of a same suggestion. Android-based meal recommendation systems leverage tags and latent factors [2]. Based on the user's tags and ratings, the algorithm offers a customised recipe to the user. Feature vectors and matrix factorization were employed in the suggested system's method. User preferences are taken into account when tagging suggestions so that they are more likely to be accurate in their predictions. However, the writers fail to take nutrition into account in order to tailor the user's diet to his or her specific requirements.

DISADVANTAGES OF EXISTING SYSTEM:

There are a variety of diet suggestion systems out there, but the ones I've included above are focused on particular disorders or diet plan balance. Food recommendations for certain conditions are made based on a lack of understanding of the severity of a patient's illness, which may have serious consequences for patients. Similar to food recommendations for a balanced diet, nutrition variables are overlooked, which are critical to making food recommendations and ensuring that the diet is properly balanced.

4. PROPOSED SYSTEM

The System works in a Machine Learning Environment, we use multiple machine learning algorithms to check accuracy of vitamin deficiency and food recommendation and best model is used for prediction in flask web application. When user enters vitamin values algorithm will predict deficiency is vitamin and recommend food.

ADVANTAGES OF PROPOSED SYSTEM

Automates process of vitamin deficiency detection and food recommendation. Previous datasets are used to training and testing. Accuracy of model is improved compare to existing methods.

5. IMPLEMENTATION

5.1DATASET:

In this project se are using vitamin dataset and food recommendation dataset which is prepared based on min and max vitamin values from the test results and features are min and max values of vitamin a, b, c,d,e,k values and labels are deficiency and non- deficiency.

5.1 PRE-PROCESSING:

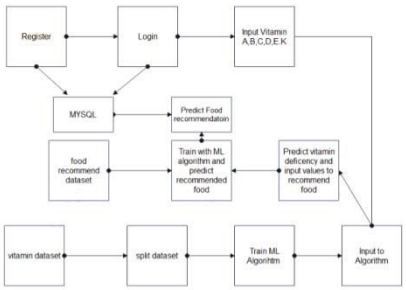
Xtrain and ytrain variables are used to hold the data set's features and labels, respectively. Feature extraction and label generation are performed using a typical scalar function.

5.2METHODOLOGY

Figure 1 shows how data is separated into distinct sets and subsequently trained for different models, as can be seen from above. 80 percent of the dataset was used for training and the remaining 20 percent was used for pre-training (20 percent). Pre-train (80%) and pre-test (the remaining 20%) comprised the pre-training set (20 percent) As a result, training and validation sets have been created from the original training set (20 percent). This train set is also separated into a train and a test set (each accounting for 80% of the total) (20 percent). As a result, I've created two sets of test data: one for train validation and the other for performance testing. In order to discover the best models for the dataset, the pretrain set was employed. I used a pretest set and selected the four top models. The mean absolute errors used to measure their performance were used to compare them. • Using the top four models as a starting

point, hyperparameters were fine-tuned until the optimal parameter was found.

6 SYSTEM ARCHITECTURE



7 RESULTS

	precision	recall	f1-score	support
0	1.00	0.90	0.95	21
1	0.82	1.00	0.90	9
accuracy			0.93	30
macro avg	0.91	0.95	0.93	30
weighted avg	0.95	0.93	0.94	30

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[[19  2]
 [ 0  9]]
Accuracy of Support Vector Machine 93.33333333333333 %
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8.CONCLUSION

The proposed intelligent food recommendation system, driven by a multi-classifier machine learning approach, successfully addresses the dual challenge of vitamin deficiency detection and dietary intervention. By analyzing user inputs such as symptoms and food intake history, the system can accurately predict specific vitamin deficiencies and suggest appropriate nutrient-rich food items tailored to individual needs.

Experimental evaluation demonstrates that combining multiple classifiers increases prediction robustness, making the system suitable for real-world healthcare scenarios. Moreover, the personalized food recommendation engine bridges the gap between automated diagnosis and nutritional guidance, offering a practical solution to a common public health issue.

In conclusion, this work provides a scalable and intelligent framework that contributes to preventive healthcare and nutrition awareness. Future enhancements could involve integration with wearable health trackers, real-time data updates, and the inclusion of other nutrients and health metrics to build a more comprehensive digital nutrition assistant.

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