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E-HEALTH MONITORING SYSTEM WITH DIET AND FITNESS RECOMMENDATION USING MACHINE LEARNING

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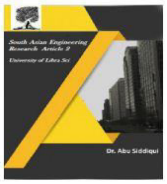
ABSTRACT

In today's fast-paced world, many individuals suffer from chronic diseases due to improper diet, lack of regular exercise, and neglecting health conditions because of their busy schedules. To address this issue, we propose a system designed to improve the health of patients by providing personalized diet and exercise recommendations based on their health parameters and the latest medical reports. Our system specifically focuses on individuals diagnosed with Diabetes, Blood Pressure, or Thyroid disorders and aims to assist doctors in tailoring health plans for their patients. The proposed system is divided into two primary modules: Health Monitoring and Diet & Exercise Recommendation. The Health Monitoring module ensures continuous tracking of health parameters and suggests follow-up sessions until the medical reports return to normal ranges. The Diet & Exercise Recommendation module utilizes a C4.5 Decision Tree algorithm to classify and recommend suitable diet plans and exercise routines. This algorithm effectively determines whether a specific food item or exercise is appropriate for an individual based on a customized dataset. By integrating machine learning into health management, our system offers an intelligent, data-driven approach to personalized healthcare, enhancing patient well-being and supporting medical professionals in making informed decisions.

Keywords: Diet Recommendation, Exercise Recommendation, Chronic Diseases, Diabetes, Blood Pressure, Thyroid, C4.5 Decision Tree, Machine Learning

I.INTRODUCTION

Health is a crucial aspect of human life, yet due to hectic schedules and workload, many individuals fail to prioritize their well-being. One of the major concerns in today's generation is physical inactivity, which significantly impacts overall health. Maintaining a proper daily routine that includes a balanced diet and regular exercise is essential for staying fit. However, diet and exercise plans vary depending on an individual's lifestyle, height, weight, gender, age, and activity level. Since diet and exercise are closely interrelated, managing calorie intake is essential, especially for individuals aiming to regulate their sugar levels. To address this issue, the proposed system assists doctors in recommending personalized diet and exercise plans for patients suffering from Diabetes, Blood Pressure, or Thyroid disorders, alongside their prescribed medications. This system is designed to provide quick and efficient recommendations during follow-up consultations. In this study, we have developed a Health Monitoring System integrated with a Diet and Fitness Recommendation module. The system specifically focuses on three widespread diseases—Diabetes, Blood Pressure, and Thyroid—which require continuous



monitoring and proper treatment. The recommendation system provides personalized advice based on user-specific requirements and constraints.

The proposed system is divided into two main modules: (1) Health Monitoring System and (2) Diet & Exercise Recommendation. For the recommendation module, we utilize the C4.5 classifier due to its advanced features such as pre-pruning, handling continuous attributes, managing missing values, and rule induction. These features enhance the model's accuracy compared to a standard decision tree classifier. A comparative analysis between ID3 and C4.5 was conducted, and C4.5 was found to be the most suitable algorithm for the recommendation system due to its superior capabilities and efficiency.

II. LITERATURE REVIEW

Health Monitoring Systems

Several studies have explored the development of health monitoring systems using machine learning techniques. In [1], a healthcare recommendation system was designed using an ontology framework for food and exercise recommendations, with a decision tree algorithm applied to extract user information from the dataset. In [2], four machine learning algorithms—k-nearest neighbors, Support Vector Machine, Random Forest, and AdaBoost—were compared for health monitoring. Among them, Random Forest demonstrated superior accuracy, ranging from 60% to 70%, in analyzing ECG data for patients with Long QT Syndrome (LQTS) and identifying those at high risk of cardiac events. Similarly, in [3], three algorithms—Random Forest, Gradient Boosting, and Logistic Regression—were evaluated for user authentication in Fitbit credentials. The Logistic Regression algorithm achieved the highest accuracy of 87%. In [6], different machine learning models, including Random Forest, Support Vector Machine, and Deep Learning, were used for remote health monitoring of elderly individuals. Furthermore, in [7], a system leveraging machine learning classified various stages of Chronic Kidney Disease (CKD) using data extracted from the UCI Chronic Kidney Disease dataset.

Diet and Exercise Recommendation Systems

Several research efforts have focused on developing personalized diet and exercise recommendation systems. In [8], a diet recommendation system based on the USDA Food Composition Database was proposed to cater to hypertensive patients, with classification performed using WEKA. Similarly, in [11], a web-based diet recommendation system was developed using the Health Calabria Food Database to enhance the well-being of individuals with chronic diseases. In [12], a recommendation system for both amateur and professional runners was designed, offering personalized diet and workout suggestions based on user input via the Social Semantic Web.

Algorithms for Health and Recommendation Systems

Various machine learning algorithms have been applied to optimize classification and recommendation systems. In [4], an enhanced version of the ID3 algorithm was introduced, demonstrating improved accuracy as the dataset size increased. With 1,232 records, the improved ID3 algorithm

achieved an accuracy of 92.6%, surpassing the standard ID3 algorithm's accuracy of 88.9%. Similarly, in [5], three algorithms—ID3 decision tree, k-means clustering, and Naïve Bayes—were evaluated, with the ID3 algorithm outperforming the other two by 6-7% in classification tasks. In [9], the J48 Decision Tree Algorithm was applied to an ARFF dataset to develop a classifier model for test data predictions, leveraging k-means clustering for class label assignment. In [10], a dataset containing celebrity death records from 2006 to 2016, comprising 11,200 reported deaths, was analyzed using lazy learning and decision tree classifiers. The decision tree model achieved an accuracy of 75.07%. In [13], a dataset on soil nutrients was used to build a soil quality prediction model based on the C4.5 decision tree algorithm, achieving an accuracy of 92.71%.

Research Gap and Contribution

The reviewed studies provided solutions for health monitoring and diet & exercise recommendations separately. Notably, only [10] developed a custom dataset, while the rest relied on existing datasets. Additionally, none of these studies focused on an integrated approach specific to managing Diabetes, Thyroid, and Blood Pressure collectively. While C4.5 was used in [13] for prediction tasks, it was not employed as a recommendation model.

The proposed system bridges these research gaps by integrating a comprehensive Health Monitoring System with a Diet and Exercise Recommendation module. It introduces customized datasets specifically tailored for patients with Diabetes, Blood Pressure, and Thyroid conditions. Moreover, C4.5 is utilized not just for prediction but for generating personalized diet and exercise recommendations, enhancing the effectiveness of health management solutions.

III.PROPOSED METHODOLOGY

The proposed system is a personalized healthcare recommendation model that provides diet and exercise suggestions based on a user's health profile and disease condition. The primary objective is to ensure that recommendations are adaptable, practical, and beneficial for users. The system is divided into two main modules:

Health Monitoring System

This module is responsible for tracking patient progress by analyzing their latest health reports for specific diseases, namely Diabetes, Blood Pressure, or Thyroid. The monitoring process follows these steps:

a) The user inputs personal details such as height, weight, age, gender, activity level, and the specific disease they are suffering from.

b) The patient submits the latest health report values related to their condition.

c) The system calculates the Body Mass Index (BMI) and required calorie intake using predefined formulas based on the provided personal details.

d) All user details are stored in the User Health Record for future reference.

e) The system compares the user's health parameters with predefined threshold values stored in the Doctor's Database to classify the severity of their disease.

f) Based on this classification, a customized diet and exercise plan is recommended through the Diet & Exercise Recommendation Module.

g) The system continuously tracks progress by comparing subsequent health reports with normal disease parameters. Based on a predefined threshold:

1. If the patient shows **90% improvement**, they are advised to continue with the current diet and exercise plan, and the process terminates.

2. If improvement is between **65% and 89%**, the patient is advised to return for a follow-up session after a set interval.

3. If improvement is **below 65%**, the patient is recommended to undergo additional monitoring and follow-up sessions.

h) For follow-up sessions, the patient's new health report is compared with both the standard disease parameters and their previous session's reports to track improvement. The process then continues from step (a).

i) This cycle of follow-ups is repeated until the patient's health report shows at least **90% improvement**, ensuring comprehensive health monitoring.

Diet & Exercise Recommendation System

This module generates personalized diet and exercise plans based on health monitoring outcomes and patient-specific parameters. The recommendation process follows these steps:

a) The system loads a customized diet and exercise dataset from the Diet and Exercise Database and maps relevant details from the User Health Record.

b) The dataset is divided into training and testing subsets, with 25% allocated for testing.

c) The **C4.5 decision tree classifier** is used to analyze relationships between variables, identify key attributes, and create new predictive features for personalized recommendations.

d) During the training process, the system builds a decision tree by selecting the best attributes using Attribute Selection Measures (ASM) such as Information Gain Ratio. The dataset is then divided into smaller subsets for further analysis.

e) The decision tree generation continues recursively for each child node until the tree structure is complete.

f) The trained model outputs a personalized diet and exercise plan based on the identified patterns.

g) The system integrates the trained model with test data to evaluate its effectiveness.

h) Model performance is assessed using metrics such as the **Confusion Matrix, Precision, and Recall** to determine accuracy. The performance of the C4.5 algorithm is then compared with **ID3** to identify the more efficient model for diet and exercise recommendations.

By integrating continuous health monitoring with machine learning-based diet and exercise recommendations, the proposed system provides a comprehensive and personalized healthcare solution for

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managing Diabetes, Blood Pressure, and Thyroid conditions effectively.

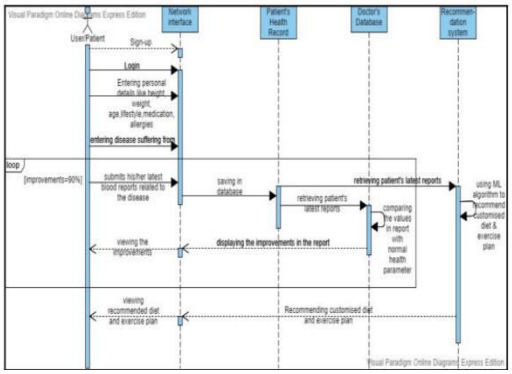

Fig1: System Architecture

IV.CONCLUSION

This study explores the application of Machine Learning in healthcare by developing a system that assists doctors in recommending personalized diet and exercise plans for patients. The system focuses on monitoring the health conditions of individuals suffering from Diabetes, Blood Pressure, and Thyroid disorders. By analyzing patients' latest health reports and tracking improvements over multiple follow-up sessions, the system provides tailored diet and exercise recommendations based on various health parameters such as height, weight, age, and activity level. The proposed system utilizes the C4.5 decision tree algorithm, which has demonstrated superior performance compared to the ID3 algorithm in handling classification tasks for both datasets used in this study. Although C4.5 is primarily a predictive model, its adaptability allows it to be effectively used for recommendation purposes with certain enhancements. Future improvements in the model can further refine its recommendation accuracy, making it even more effective in providing personalized healthcare solutions.

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