Diet Plan and Home Exercise Recommendation system using Smart Watch

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2023 International Conference on Artificial Intelligence for Innovations in Healthcare Industries (ICAIIHI) | 979-8-3503-3091-5/23/$31.00 ©2023 IEEE | DOI: 10.1109/ICAIIHI57871.2023.10489367

Abstract*—Obesity and sedentary lifestyles have become significant health concerns globally. To solve these issues, this system presents a Diet Plan and Home Exercise Recommendation System (SYP) that utilizes users' smartwatch data and pathological information to generate personalized diet plans and exercise recommendations. The proposed SYP system leverages the capabilities of modern smartwatches, which are equipped with various sensors to collect comprehensive health data. Additionally, it incorporates users' pathological data obtained through medical tests. By integrating these diverse datasets, the system can provide tailored recommendations based on an individual's specific health profile. The SYP system operates in two main phases: data collection and recommendation generation. During the data collection phase, the system collects and analyzes data from users' smartwatches and pathological records, such as heart rate, sleep patterns, blood pressure, glucose levels, and body mass index. The collected data is then processed to extract relevant features and construct a comprehensive health profile for each user. In the recommendation generation phase, the SYP system employs machine learning algorithms to analyze the user's health profile and generate personalized diet plans and home exercise recommendations. The generated recommendations are designed to be practical, feasible, and aligned with the user's health objectives.

Keywords: Diet Recommendation, Home Exercise, KNN Algorithm, Smartwatch data.

I. INTRODUCTION

In recent years, the rising prevalence of obesity and sedentary lifestyles has become a pressing global health concern. The negative impacts of these lifestyle choices on overall well-being and the increasing rates of chronic diseases have highlighted the urgent need for effective interventions to promote healthier habits. In response, researchers and healthcare professionals have turned to technology-driven approaches to solve these challenges. This paper introduces a Diet Plan and Home Exercise Recommendation System (SYP) that leverages users' smartwatch data and pathological information to provide personalized recommendations for diet plans and home exercise routines.

Smartwatches have gained popularity as wearable devices that monitor various aspects of users' health, including heart rate, physical activity, sleep patterns, and more. These devices have the potential to collect rich and continuous health data, making them valuable tools for health monitoring and intervention. Additionally, pathological data, such as medical history, body composition, and metabolic profiles obtained through medical tests or wearable devices, can offer deeper insights into an individual's health status.

The development of the Diet Plan and Home Exercise Recommendation System represents a significant advancement in personalized health management. By integrating smartwatch data and pathological information, this system provides individuals with tailored recommendations to support healthier lifestyles and facilitate the achievement of their health goals. The utilization of technology-driven approaches in healthcare, such as the SYP, holds promise for improving public health by empowering individuals to make informed decisions and take proactive steps towards better well-being.

II. LITERATURE SURVEY

Madhira *et al.* **[1]** studied a system that recommends a personalized diet plan. It suggests the diet plan based on individual's physical activity. The system utilizes the K-Means clustering algorithm to classify the data into three divisions, specifically breakfast, lunch, and dinner. It also uses Random Forest algorithm. The system considers factors like gender, age, weight, BMI and according to these readings it suggests appropriate food choices and calorie intake depending on user's goal.

B. Gouthami *et al.* **[2]** proposed a system which provides personalized diet recommendations. The system utilizes BMI to suggest suitable nutrition food options. The system uses data mining tools, decision tree learning algorithm, and recommendation algorithms like Knapsack and TOPSIS for diet recommendations.

R. Yera *et al.* **[3]** The paper conducted a case study to evaluate the performance of the proposed framework. The case study involved 100 users who were asked to provide their nutritional information, their preferences, and their food choices for a week. The system was then used to generate personalized recommendations for each user. The results of the case study showed that the system was able to generate recommendations that were both nutritionally sound and aligned with the users' preferences.

C. Türkmenoğlu *et al.* **[4]** The paper begins by reviewing the literature on meal planning and optimization. It then describes the proposed approach in detail. The approach is evaluated using a case study involving 100 users. The paper concludes by discussing the limitations of the proposed approach and the future research directions. One limitation of the approach is that it requires a large amount of data on food items, nutritional requirements, and user preferences. Another limitation is that the approach is not able to take into account the user's current dietary restrictions.

S. Abhari *et al.* **[5]** analyzed 25 studies sourced from multiple databases. The findings indicate that diet recommendation systems commonly utilize hybrid recommender systems and knowledge-based recommender systems.. The studies also highlighted the utilization of rule-based and ontology techniques. The researchers observed a strong focus on the potential of diet recommendation systems in improving nutrition and fostering a healthier way of life.

Muhib Anwar Lambay *et al.* **[6]** presented a framework that integrates big data analysis, natural language processing (NLP) concepts, and machine learning (ML) to provide personalized and health-conscious diet recommendations. Comprising three layers—the cloud layer for data storage and processing, the middle layer for coordinating recommendation methods, and the application layer serving as the interface—users can conveniently access food recommendations through this structured framework.

Raksha Pawar *et al.* **[7]** presented a personalized diet recommendation system that places emphasis on individual nutrition plans by incorporating users' health-related data. The main objective of the system is to offer tailored dietary recommendations based on various factors, including height, weight, nutritional deficiencies, and chronic diseases. Data collection is accomplished through web scraping, followed by data processing. Ultimately, the system generates recommendations utilizing the K-Nearest Neighbors (KNN) algorithm.

Jinyu Xie *et al.* **[8]** evaluated the performance of the recommender system was assessed through a simulation study involving 30 virtual subjects with T1D. The findings indicated a significant reduction in the risk of hypoglycaemia and an improvement in glycaemic control compared to two self-management approaches. The recommender system also demonstrated efficacy in decreasing the occurrences of hypoglycaemia events during and post-exercise. The technological innovation in the research lies in the use of a model-based recommender system, predicting blood glucose levels and suggesting optimal meal sizes to minimize clinical risks within specific constraints. Implemented as a software tool, the recommender system offers a practical solution for patients with T1D to enhance their clinical outcomes.

Ahmadian *et al.* **[9]** proposed a novel food recommender system that takes into account the health and nutrition of foods, as well as the user's preferences and the time of day. The system then combines these predictions to recommend a list of healthy foods to the user. The system was evaluated on a dataset of food ratings from Amazon. The system was also able to generate recommendations that were more aligned with the user's health goals.

F. Rehman *et al.* **[10]** presented a cloud-based food recommendation system called Diet-Right that aims to address the issue of selecting a proper diet to fulfill patient's nutritional requirements. Diet-Right utilizes a cloud-based approach and users pathological reports to generate optimal food recommendations. The experimental results demonstrate that parallel execution on the cloud reduces convergence time by approximately 12 times compared to single-node execution. Additionally, increasing the number of ants leads to improved accuracy. The paper introduces the Ant Colony Optimization (ACO) technique as a variant for food recommendation.

Ainsley Cardozo *et al.* **[11]** created a recommendation system to provide personalized meal suggestions aligned with individual nutritional knowledge. The paper introduces a comprehensive framework for daily food plan options and utilizes machine learning techniques, specifically employing K-means clustering and Random Forest classification methods. The system considers various factors, including physical traits, physiological data, and personal information, to tailor recommendations to the user's specific needs. The implementation incorporates tools and technologies such as Pandas, NumPy, Flask, Joblib, and machine learning algorithms. The dataset is processed using the K-Means algorithm to form clusters based on calorie content, and Random Forest classifiers are trained for specific functions, including weight loss, weight gain, and healthy recommendations.

S. Manoharan *et al.* **[12]** presented a system for offering personalized diet recommendations to patients based on their health conditions. It introduces a recommendation system that integrates deep learning classifiers and incorporates the K-clique algorithm to enhance precision and accuracy. The study aims to automatically suggest suitable foods for patients, considering factors such as health conditions, sugar level, blood pressure, protein intake, fat consumption, cholesterol level, age, etc. The system utilizes a dataset containing information from 50 patients with various diseases and a set of a thousand food products, each described by eight features.

III. EXISTING SYSTEM:

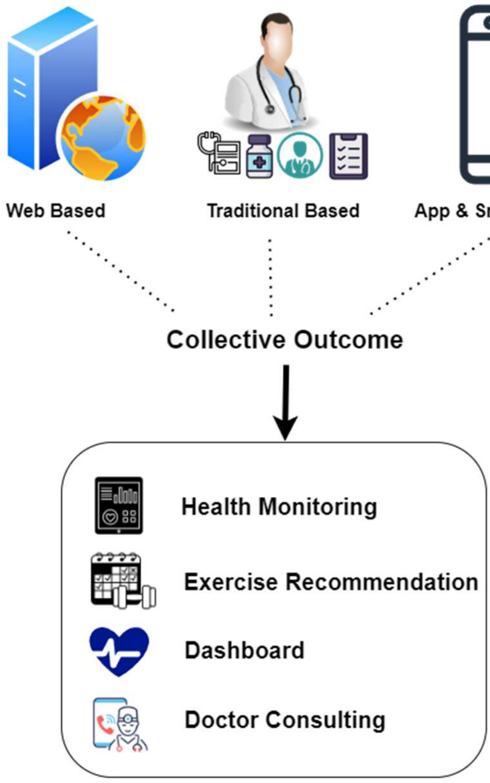

Fig. 1. Existing System

The current method of diet plan recommendation relies on several factors, including user's height, weight, food preference, activity levels and age. These elements are utilized to determine the person's calorie requirements and macronutrient needs. Subsequently, a diet plan is crafted to meet these requirements and supply the necessary nutrients for maintaining good health.

There are various techniques for creating diet plans. One commonly employed approach involves using tools like the food pyramid or dietary guidelines to establish a foundational framework for healthy eating and formulate a well-balanced diet. Another method entails the development of a personalized diet plan, which is typically created by a registered dietitian or a qualified healthcare professional. This tailored plan is designed to align with the specific needs of the individual.

A range of technologies is available for delivering diet plan recommendations, including websites, mobile apps, and wearable devices. These technological solutions offer convenient and accessible means for users to access their diet plans and monitor their progress.

The existing system of diet plan recommendation boasts several strengths. It is firmly rooted in scientific principles, ensuring that it addresses an individual's nutritional requirements. Furthermore, it is generally straightforward to access and utilize.

Nonetheless, there are notable weaknesses in the current system. Personalization is a key issue, as diet plans are not always finely tuned to an individual's unique needs. This lack of personalization can hinder the plan's effectiveness in aiding individuals in achieving their health goals. Additionally, the system may lack user-friendliness, making it challenging for individuals to access and implement their diet plans.

Despite these shortcomings, the existing system of diet plan recommendation remains a valuable tool for helping individuals pursue their health objectives. By continued research and development efforts, the system has the potential to become more effective and user-friendly in the future.

TABLE 1 Taxonomy Table

Features / Papers	Exercise Recommendation	Personalized Diet Plan	Stress Management Techniques	Smartwatch Integration	Doctor / Dietician consultation
Diet and Exercise Recommender System	✓	✓	✗	✗	✗
Healthy and time-aware food recommender system.	✗	✓	✓	✗	✗
A systematic review of smart watch uses for health and wellness	✗	✓	✗	✓	✓
Food Recommender System Considering Nutritional Information	✓	✓	✗	✗	✗
Diet Stress and Mental Health	✗	✓	✓	✗	✗
Food Recommender System	✗	✓	✗	✗	✗
Diet Right	✗	✓	✗	✓	✗
NUTRITION DIET RECOMMENDATION SYSTEM USING USER'S INTEREST	✓	✓	✗	✗	✓
SYP	✓	✓	✓	✓	✓

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IV. PROPOSED SYSTEM

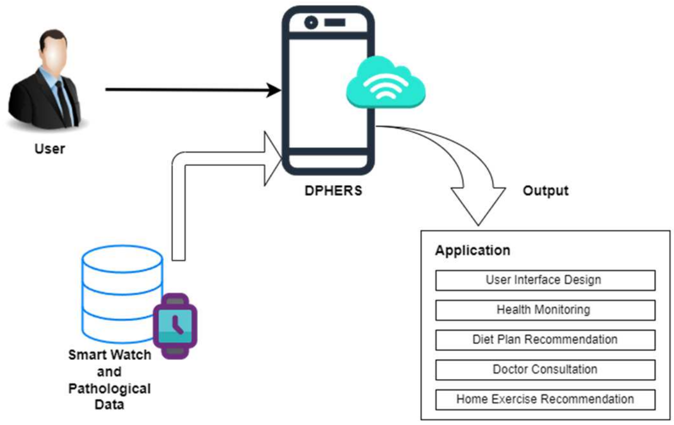

Fig. 2. Proposed System

The depicted diagram illustrates a comprehensive health management system that leverages wearable technology, mobile applications, and cloud-based data storage to provide users with tailored insights and practical guidance for enhancing their overall health and well-being.

At its core, this integrated system encompasses various critical components. It begins with data collection using a smartwatch, which continuously tracks blood pressure and heart rate. This real-time data is wirelessly transmitted to a connected mobile device, serving as the central hub for data storage, visualization, and user interaction.

The health monitoring system processes this data, identifying trends and potential health issues. It seamlessly integrates with other health-related data sources, including electronic health records and personal health trackers, to offer a comprehensive perspective on the user's health status.

The system also includes a Diet Plan Recommendation feature. It assesses the user's health data, activity levels, and dietary. Considerations like calorie requirements, macronutrient balance, and specific health conditions are factored in to optimize the diet plan for improved health outcomes.

Additionally, the system facilitates secure and convenient communication between users and healthcare professionals through its Doctor Consultation capability. This enables users to schedule virtual consultations, share health data with doctors, and receive customized medical advice and treatment plans.

Moreover, the Home Exercise Recommendations system tailors exercise plans based on the user's fitness level, health goals, and available exercise equipment. It offers comprehensive guidance, including clear instructions, video demonstrations, and tools for monitoring progress, motivating users, and maximizing the effectiveness of their exercise routines.

The user interface design of the system is user-friendly, presenting health data in a clear, concise, and visually appealing manner. This empowers users to conveniently track their progress, set goals, and receive personalized recommendations for enhancing their health behaviors.

Finally, all user health data, encompassing vital signs, activity levels, diet plans, exercise logs, and medical records, is securely stored in a cloud-based database. This centralized storage ensures data accessibility from any device and enables the system to provide personalized insights and recommendations that evolve over time.

Through the integration of wearable technology, mobile apps, cloud data storage, and intelligent algorithms, this all-encompassing system equips individuals to take charge of their health, make informed decisions, and progress toward their wellness goals.

V. METHODOLOGY

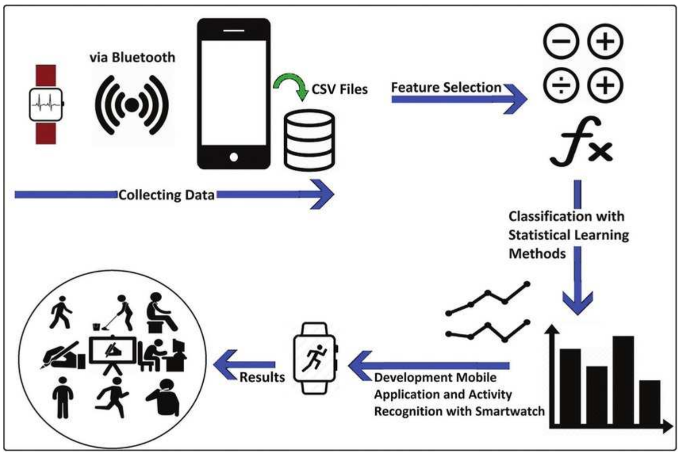

Fig. 3. Proposed Workflow

1. Project Initiation: Assess the need for a mobile app to collect, process, and analyze smartwatch data.
2. Data Collection: Gather data from smartwatches via Bluetooth connectivity.
3. Feature Selection: Select and organize relevant data features into CSV files.
4. Classification: Use statistical learning techniques to categorize user behaviour and generate insights, such as health data and activity summaries.
5. Mobile App Development: Develop a mobile app with user-friendly interfaces and Bluetooth connectivity.
6. Activity Recognition: Focus on using smartwatch data to recognize and analyze user activities.
7. Project Conclusion: Culminate in a fully functional mobile app that effectively leverages smartwatch data for a variety of user-focused applications.

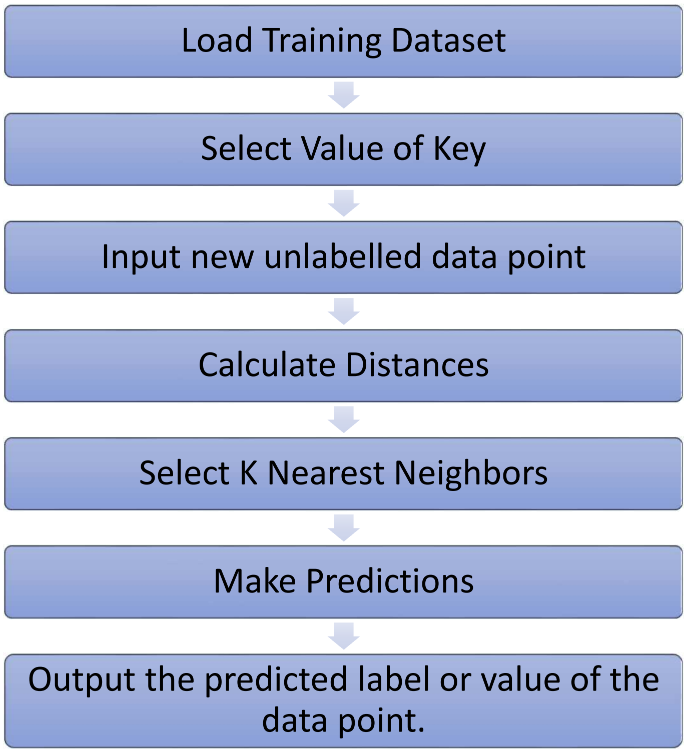

Fig. 4. KNN Algorithm

The K-Nearest Neighbour's (KNN) algorithm is a supervised machine learning method applied to classification and regression tasks. Operating as a non-parametric algorithm, it refrains from assuming specific data distributions and relies on the proximity of data points for predictions.

In KNN, the "K" represents the number of nearest neighbors considered when making predictions. When faced with a new, unlabeled data point, the algorithm computes distances between this point and all labeled data points in the training set. While the Euclidean distance is commonly used as the metric, alternative distance measures may also be employed. Following distance calculations, the algorithm identifies the K nearest neighbors based on the shortest distances.

For classification tasks, the algorithm attributes the label of the majority class among the K neighbors to the new data point. In regression tasks, it computes the average or weighted average of the target values from the K neighbors to predict the target value of the new data point. Importantly, the choice of K significantly influences the algorithm's performance, with smaller K values increasing sensitivity to noise and outliers, and larger K values smoothing out decision boundaries but potentially sacrificing local information.

Despite its simplicity and interpretability, the KNN algorithm does not develop a specific model during training. While computationally efficient, particularly for smaller datasets, its effectiveness diminishes with larger datasets due to the need to calculate distances for each new data point against all training datapoints.

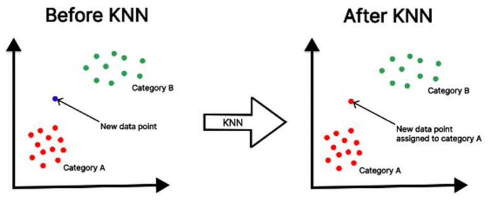

Fig. 5 Working of KNN

Euclidean Distance

The Euclidean distance functions as a metric for the distance between two points in Euclidean space, denoting the length of the straight-line segment connecting them. Its widespread use in machine learning and data science underscores its significance as a prominent measurement.

$$d\left(x,y\right)=\sqrt{\sum_{i=1}^{n}\left(x_i-y_i\right)^2}$$

Manhattan Distance

The Manhattan distance, also known as taxicab distance or city block distance, is a metric employed to determine the distance between two points by summing the absolute differences of their Cartesian coordinates.

$$d\left(x,y\right)=\sum_{i=1}^{n}\left|x_i-y_i\right|$$

Minkowski Distance.

The Minkowski distance functions as a measure for assessing the distance between two points in a real-valued vector space. In a normed vector space, distances are represented by vectors with lengths that are non-negative.

$$d\left(x,y\right)=\left(\sum_{i=1}^{n}\left(x_i-y_i\right)^p\right)^{\frac{1}{p}}$$

VI. CONCLUSION:

The Diet Plan and Home Exercise Recommendation System (SYP) presented in this research paper demonstrates the potential of utilizing users' smartwatch data and pathological information to provide personalized diet plans and home exercise recommendations. The system offers a promising solution for addressing the challenges of obesity and sedentary lifestyles by tailoring interventions to individuals' specific needs, preferences, and health conditions. The findings highlight the effectiveness of the SYP system in promoting behaviour change and improving overall health outcomes. As technology continues to advance, further refinements and integration of additional health data sources can enhance the system's capabilities and contribute to personalized health management. The SYP system holds significant promise in empowering individuals to take charge of their health and embark on a path towards a healthier lifestyle.

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