FitNoQuit: Diet and Workout Recommendation System using Machine Learning

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***Abstract*—In today’s fast-paced world, it is not uncommon for people to experience mental and physical illness. Various scientific studies have shown that a wholesome diet and any form of physical activity helps in relieving health issues and progress towards a healthy lifestyle both physically and mentally. However, not everyone has the appropriate knowledge to help them reach their fitness goal. Thus, in this paper, we propose a Diet and Workout recommendation system developed using Machine Learning named “FitNoQuit”. FitNoQuit takes into account various parameters like height, weight, age and then calculates the current BMI & BMR of the user, food preferences like vegetarian/Non-vegetarian/Vegan, and chronic health conditions like diabetes, PCOS, thyroid, etc. Based on these user inputs the system provides a nutritional diet and workout plan which enables the user to reach his/her end fitness goal.**

***Keywords—Recommendation System, Diet, Workout, Fitness, Linear Regression, Machine Learning.***

I.INTRODUCTION

One thing that the pandemic taught us all was the importance of healthy living. What is healthy living? Healthy living is all about maintaining a healthy lifestyle by making correct choices while you eat and incorporating a little physical activity into your daily routine. Healthy living has many benefits like reducing mental stress and making you feel better mentally, improving your quality of life by relieving various health issues, and last but not least allowing you to take charge/control of your life. [1] Thus, it is very important to maintain a fit lifestyle.

While it is true that the benefits of living a healthy lifestyle apply to all, every human being has a different body with different requirements, and thus as the saying goes “one size may not fit all”, a single diet and workout routine would not serve all. To solve this issue, “FitNoQuit” aims to provide its users with personalized diet and workout recommendations. Using machine learning algorithms, we aim to provide our users with a customized diet and workout routine that best suits them. These algorithms take into context user details like height, weight, age, gender, food preference like veg, non-veg and vegan, and common medical conditions like diabetes, thyroid, PCOS, kidney failure and lactose intolerance. These details enable the algorithm to formulate a plan that is accurate and easy to follow for the users. We also provide users with a workout plan which would complement their diet in their fitness journey. The users can also browse through the blog section where a plethora of information concerning current diet and workout trends, myths regarding health and so on is available. The user is recommended with related blogs from a category/author that the users previously showed interest in.

1. LITERATURE REVIEW

The paper “An e-Health Monitoring System with Diet and Fitness Recommendation using Machine Learning” [1] proposes a system that aims to improve the health of patients that suffer from various diseases. Based on analysis and monitoring of health parameters obtained from the patient's latest reports related to the disease, the system recommends a healthy diet and exercise plan. The paper includes diseases like Diabetes, Blood Pressure, and Thyroid and implements the C4.5 decision tree algorithm on the reports and credentials like height, weight, age, etc. However, the system suggests diet and workout by taking into account parameters and values related to diseases only. As a result, it is not suitable for other sets of users who have no such health conditions. FitNoQuit on the other hand covers the complete spectrum of users irrespective of whether they have any health conditions or not and suggests all types of users with a healthy diet and workout plan.

The system proposed in “A Food Recommender System Considering Nutritional Information and User Preferences​” [2] covers a general framework to not only recommend daily meal plans but also the management of nutritional and preference-aware information parallelly. The system filters out foods that do not match the current user characteristics using the AHPSort and then uses an optimization algorithm to generate a daily meal plan which satisfies the user's daily nutritional requirements. However, the system proposed does not take into account the health conditions of the users, if any. On the contrary, FitNoQuit takes into consideration health diseases like diabetes, thyroid, PCOS, etc, and provides a suitable diet and workout plan for such users as well.

The paper “Diet-Right: A Smart Food Recommendation System“ [3] discusses a cloud-based food recommendation system that suggests diet based on user’s pathological reports. Using an ant colony algorithm and according to the values obtained from pathological reports, the model generates an optimal food list and suggests an appropriate diet. However, Diet-Right as compared to FitNoQuit does not recommend workouts to its user along with diet recommendations.

The main aim of the system proposed in the paper “A Personalized Healthy Diet Recommender System”​ [4] is to develop a method to provide all users with meals of their choice and also ensure that it satisfies the required proportion of nutrients needed for the given individual. This is done by developing a diet recommendation system that recommends a healthy and appropriate food quantity to ​users.​ The system presented consists of two parts: the first part provides content-based diet recommendations while the second part uses Pearson Correlation Coefficient to compare food nutrients and recommends alternative food items, thus allowing users to make choices. Thus, a system that considers an individual’s daily energy requirement in order to maintain a healthy weight and reduce the risk of chronic diseases has been developed by considering the food preferences of the user. However, unlike FitNoQuit, the system does not consider any existing health issues that a user might be dealing with.

The objective of this study presented in “Website on Diet Recommendation Using Machine Learning​” [5] is to consider various important aspects of the user's lifestyle while recommending a healthy and nutritious diet for the user and encouraging the user to incorporate physical activity in their lifestyle.​ This system has 3 phases: Information Collection Phase, Learning Phase, and Recommendation Phase. The learning phase makes use of two ML Algorithms: K-Means and Random Forest to predict food items based on user inputs. The system will recommend a diet in 3 categories: Breakfast, Lunch and Dinner. The users then have to choose from the multiple recommendations and a comparison of calories to design a diet plan.​

Based on the literature review that we conducted we found certain faults in the proposed systems as listed above. Many existing products focus on improving and promoting a healthy lifestyle like Fittr, Cure Fit and Google Fit. The table listed below highlights how FitNoQuit is different from these existing systems.

|  |  |  |  |
| --- | --- | --- | --- |
| **Existing Systems​** | **Features of the system** | **Potential problems with existing systems.** | **How FitNoQuit solves the issue?** |
| Fittr | Fittr is a fitness community where people share, learn and discuss fitness. It provides articles, recipes and nutrition facts to users. | These articles are just facts and are not customized to the user’s needs. | FitNoQuit would provide users with customized diets and workouts to reach a certain fitness goal, along with articles on fitness and nutritional facts. |
| Cure Fit | cure.fit is a health and fitness company offering digital and offline experiences across fitness. They provide in-class and group workouts with a live trainer. | 1. Workout needs to be carried out during the working hours of the trainers so timings are less flexible.  2. No personalized diet recommendations are provided. | 1. With FitNoQuit users get customized workout plans, which they can follow at a time convenient to them.  2. FitNoQuit also provides customized diet plans which are one of the most important ingredients to a healthy life, becoming a one-stop destination to achieve your health goals. |
| Google Fit | Google Fit helps achieve your fitness goals through customized coaching and actionable tips based on your health and activity history | It is more of an Activity Tracker, does not give any recommendations. | FitNoQuit would provide users with customized diets and workouts to reach a certain fitness goal, along with articles on fitness and nutritional facts. |
| HealthifyMe | It is a lifestyle tracker, which allows you to track your nutrition and plan your diet. | Healthify me gives users a workout plan for their goals but asks the user to select the no. of calories they wish to burn. | FitNoQuit considers that a user might not have to know how many calories to lose. Thus it calculates the number of calories they need to burn based on their fitness goal and BMI and provides various workout options to choose from. |

Thus, we focus on solving the above problems by providing a system that provides customized diet recommendations and a workout plan to accompany it along with a blog section that provides users with articles and blogs based on fitness, healthy living and nutritional facts making FitNoQuit your one-stop fitness destination.

III. METHOD

We have developed this web application on Django, which is a Python-based free and open-source web framework. The authors chose Django primarily for the following reasons:

1. It is built on python which is simple to learn and use

2. Wide range of libraries available

3. Reliable and official documentation along with tutorials are available for Django

4. As Django is an open-source framework and available for free, it is supported by active volunteers who constantly provide updates and resources on djangoproject.com and on Github

5. It offers Customizable Framework

Django has been used in the application for both frontend and backend. The frontend consists of HTML pages which along with CSS and JavaScript make up the user interface of FitNoQuit.

As for the backend, the machine learning models developed for Diet and Workout recommendation have been implemented using Django since it is python-based and offers a plethora of libraries that enable smooth development and execution of machine learning algorithms.

Further, Django communicates with the database for the insertion, retrieval, updating, and deletion of data and displays it to the users on the frontend. The database used in this application is PostgreSQL. It is a free and open-source relational database management system that underlines extensibility and SQL compliance. The authors chose PostgreSQL as the database primarily because of the following reasons:

1. **Procedural language support:** Python and many other programming languages can be used as a procedural language in PostgreSQL.
2. **JSON Support:**Jsonb was added in Postgres 9.4. So it doesn't require extra NoSQL DB.
3. **Data type changes**:Postgresql allows developers to change the data type of a column without rewriting the table. Changing the data type has been sped up since Postgres 9.1.
4. **Low maintenance and administration** for both embedded and enterprise use of PostgreSQL.
5. **PostgreSQL source code is freely available under an open-source license**: This allows developers the freedom to use, modify, and implement it as per the business needs.

IV.IMPLEMENTATION

**DIET:  PENDING**

Dataset description (No.of items, no.categories for each meal [sweet,breadsetc], source of dataset, description of each column of dataset)

Three datasets are used in this project. One for breakfast, one for lunch and dinner and one for snacks. The breakfast dataset is further divided into multiple sections like the main meal, sweets, nuts and fruits. The lunch and dinner dataset is divided into multiple sections like the main meal, roti, rice and salads. Also, different diseases like diabetes, thyroid, PCOS, kidney disease and lactose intolerance are also considered to suggest users suffering from the above diseases the food that suits them. Furthermore, users are given more choices to incorporate their preferences like veg, non-veg or vegan, north Indian, south Indian and general category for cuisine preferences.

Sizes of different datasets:

**Breakfast:**

    Main Meal - 23

    Fruits - 22

    Seeds and nuts - 9

    Sweets - 3

**Lunch and Dinner:**

    Main Meal - 36

    Rice and Roti -  4

    Salads – 7

Description of columns in the dataset:

**Name** - Name of the food item.

**Quantity** - Quantity considered for the food item.

**Protein** - Amount of protein in the food item for the considered quantity.

**Carbs** - Amount of carbohydrates in the food item for the considered quantity.

**Fats** - Amount of fats in the food item for the considered quantity.

**Fiber**- Amount of fiber in the food item for the considered quantity.

**Type (Veg / Non-Veg)** - Is the food item veg or non-veg?

**Cuisine (North Indian/ South Indian/ General)** - Which Indian cuisine does the food item belong to?

**Diabetes** - Mentions if the food item is suitable for people with diabetes?

**Thyroid** - Mentions if the food item is suitable for people with thyroid disease?

**PCOS** - Mentions if the food item is suitable for people with PCOS?

**Kidney** - Mentions if the food item is suitable for people with kidney disease?

**Lactose intolerance** - Mentions if the food item is suitable for people who are lactose intolerant?

**Vegan** - Mentions if the food item is suitable for people who are vegan?

* Source of Dataset:

The entire dataset has been made by the members of this project with the help and approval of a certified dietician.

* Calorie calculation and distribution between meals based on BMI, BMR etc
* Steps for creating ML Model
* Description of each step in detail
* Description of libraries used if any
* Accuracy (Describe how accurate it is or how it is validated [Dhwani dietician])
* Contents of final output

**WORKOUT:**

Dataset description (No.of items, no.categories for each meal [sweet,breadsetc], source of dataset, description of each column of dataset)

The dataset[6] used for building the workout recommendation model consists of 88 cardio activities that can be performed on a daily basis to burn calories and stay fit. The dataset originally consists of the following 6 columns:

1. Activity, Exercise or Sport: This column mentions the name of different activities.
2. 130 lb: Calories burned by a person weighing 130lb and performing a given activity for 1 hour.
3. 155 lb: Calories burned by a person weighing 130lb and performing a given activity for 1 hour.
4. 180 lb: Calories burned by a person weighing 130lb and performing a given activity for 1 hour.
5. 205 lb: Calories burned by a person weighing 130lb and performing a given activity for 1 hour.
6. Calories per kg: Calories burned per kg by performing the given activity.

The dataset is further modified and made suitable as per our needs to build a workout recommendation module.

Calorie calculation and buffer

Steps for creating ML Model

To develop the machine learning model for workout recommendation, we first deleted the original “Calories per kg” and added our own Calories per kg column named “CPK”. The CPK values for each row are calculated by first converting the values of the following 4 columns “130 lb, 155 lb, 180 lb, 205 lb” from Calories per Lb to Calories per Kg and then taking an average of these 4 columns.

Next, using the values from the above 4 columns, we calculate the coefficient “c” (which is the intercept in terms of the Linear Regression equation) for each of the 4 columns and then take the average of them to get a single value of coefficient “c”.

Now using the coefficient “c” and the column “CPK” we can predict the calories burned in one hour for a given exercise using the following equation:

**Y (calories burnt) = M(CPK) \* X(Weight) + C(Constant)**

The above equation is applied on each row of the dataset and the Y value obtained is respectively multiplied by the time for which it is performed. The time duration considered are 30 mins, 45 mins, and 1 hour. The final value of each row is then compared with the target calories required to burn and if it lies in the buffer region of the target calories, the given activity is recommended to the user along with the time duration.

Description of libraries used if any

To develop the model, 4 python libraries have been used. They are as follows:

1. Pandas [ ]: This is an open-source python package that is greatly useful for data analysis and machine learning tasks. Pandas is used in our project to read a CSV file and generate a data frame for the same. It is on this data frame all the operations are performed to build the machine learning model.

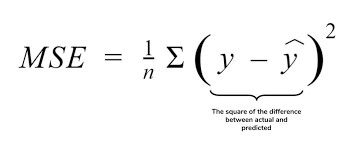
1. Numpy [ ]: Stands for Numerical Python. It is a library that helps deal with multidimensional array objects and a collection of routines to operate with those arrays. Numpy is used in our project to create arrays using which the coefficient “c” is calculated.

1. Math [ ]: A module that provides a wide range of mathematical functions defined by the C standard. This library is used to call the ceil() function in order to round up a real number to the next largest integer.

1. Mean\_squared\_error from Sklearn.metrics [ ]: The sklearn.metrics library provides several scores, loss, and utility functions to measure classification performance. The mean\_squared\_error function is imported from this library to calculate the MSE or Mean Squared Error of the workout recommendation model.

Accuracy (Describe how accurate it is or how it is validated [Dhwani dietician])

The accuracy of the developed model is calculated using the Mean Squared Error. The formula for MSE is as follows:



(Needs to be converted to text)

The MSE of the model is 21.078. Since the calorie values in the dataset are in the range of 200 and upwards, an error of around 22 calories is considered to be negligible and the model developed is accurate in recommending workouts to users.

Contents of final output

Upon consideration of all factors and information provided by the user, the final output of the workout recommendation model suggests several workout options consisting of 3 things.

1. The name of the workout activity/sport
2. The duration for which the given workout needs to be performed. (30 mins, 45 mins or 1 hour)
3. The calories burned by performing the workout for the mentioned duration of time.

Based on the list of workouts suggested, the user can select and perform the workout that best suits him/her. Also, the user can add variations to his workout regime and perform different exercises on different days of the week.

V.RESULT - PENDING

1. CONCLUSION - PENDING
2. FUTURESCOPE - PENDING
3. REFERENCES ­
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