Nutritional Diet Recommendation System

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***Abstract*— The right amount of nutrients and a healthy diet is pivotal for a long and fulfilling life. But in today's tech-savvy yet busy world people are engaged in poor eating habits. This is all because of their limited knowledge about the intake of nutrients, vitamins, and a healthy diet. There are many websites and applications which help people with their workout sessions and diet. Though very few help one to personalize their diet. This system with the help of Data mining and Machine Learning helps an individual to personalize their diet according to the calories and nutrients their body needs. The diet recommended by our system would be based on the location of the user, the season and the seasonal fruits or vegetables growing in the consumer's whereabouts and the body mass index of the consumer. This makes it easy for an individual to plan their diet around locally grown foods as it is proved that they are healthier and fresher. Consumption of locally grown crops and vegetables benefits the environment and supports the national economy as well.**

***Keywords*— BMI, nutrients, diet, calories, machine learning, data mining, healthy.**

I. INTRODUCTION

This paper aimed at designing an application that can recommend a healthy diet plan by taking into consideration various factors like crops produced in that state, season, the likeliness of consumption of that crop, carbohydrates, fats, proteins, and vitamins it contains. We have used a random forest classification algorithm in order to decide the inclusion of a particular item in the diet. To lead a healthy life physical and mental wellbeing is essential and a good diet is an integral part of it. Every food has not only a type of nutrients. For example, 100 grams of rice provides 175 kilocalories, 4 grams of proteins, and 40 grams of carbohydrates. It also contains some essential vitamins like B1, B6, and E. Thus, while including a particular item in a diet all these are considered. There are different crops available in the market but deciding a crop that ensures holistic development of the body is essential. The main features of the system are: 1) recommendation of the diet by taking into consideration the kind of crops produced in the state and suitability of consumption. 2) Flexible: functionalities can be expanded by integrating different modules.

II. LITERATURE REVIEW

For one to lead a healthy lifestyle, good nutrition is the key. Along with some physical activity, your diet can not only help your body to get the right nutrients in the right proportions but also assist in reaching a healthy weight and reduce your risk of chronic illnesses (like diabetes, high blood pressure and various types of cancers). [2]G. Agapito, P. H. Guzzi, and M. Cannataro proposed a model named DIETOS(DIET Organizer System), a recommender system for the amount of nutrient intake based on the person's health profile, his past health-related history and according to his geographical location. The system collects the health information of the user which is then archived into the MYSQL database. The foods compatible with a particular condition were then eliminated based on the user input thus visualizing the list of suitable/unsuitable foods based on the user's profile.[1]Shital V. Chavan, Aniruddha Joshi and S. S. Sambare in 2016 proposed a method to recommend a diet based on the current season of the location in which the user is residing. They were of the opinion that seasonal variations and seasonal food has a great impact on the human body. The method was proposed using Type-2 Fuzzy Logic to handle uncertainty and Ontology is integrated with fuzzy logic to represent food knowledge.Dataset for the model was taken from different websites where dieticians recommend food on the basis of season.The result of the method was a full meal plan for the individual based on the seasonal food/crops in his geographical location [5]. In an article *Machine learning techniques in eating behaviour e-coaching* , published by Gerasimos Spanakis, Gerhard Weiss, Bastiaan Boh, Lotte Lemmens and Anne Roefs proposed a framework of how Machine Learning techniques can effectively be used to exploit the data collected from an application Think Slim designed to access eating behaviors using sampling methods. Machine Learning algorithms like Classification and Clustering were used to build an adaptive feedback module for one's heating behaviour and recommending healthier substitutes prior to unhealthy eating events. The result revealed clusters of users based on their eating behaviour and the specific rules that discriminate which conditions lead to unhealthy eating, which were then utilized to provide adaptive semi-tailored feedback to users. This method assisted those users who were prone to more unhealthy habits of eating causing their health to deteriorate.

III. METHODOLOGY

A. Dataset Creation

The system requires the use of two datasets.

The first dataset reveals the important feature of this system. It contains location-wise crops grown and the nutritional values of each crop. The original dataset had the following nutritional fact values:

Calories, Calories from Fat, Total Fat, Sodium, Potassium, Total Carbohydrate, Dietary Fiber, Sugars, Protein, Vitamin A, Vitamin C, Calcium, Iron, Saturated Fat, Cholesterol, Food Type.

After applying data preprocessing on this dataset, the most relevant features were selected. So, the final attributes in the first dataset are Location, Food Type, Calories, Protein, Fat, and Carbohydrates.

The second dataset is used for supervised learning. The attributes in this dataset are State, food type (crops), season, likeliness, category, allergic/not, and the outcome or the decision. The dataset includes all the crops grown in different states of India with the season in which those crops are grown like Kharif, rabi, whole year, so on. These input parameters form the primary selection criteria of whether a food item will be recommended in an individual's diet chart.

B. System Design

The input to the system is user details like age, state, gender, weight, height, allergies if any, the likeness of a particular food item. All these details are stored in a database. The system is divided into two phases:

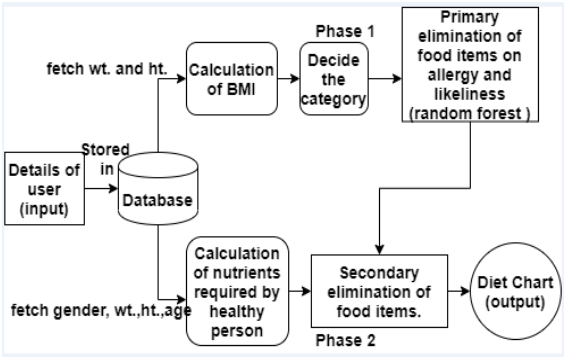

Fig. 1: Block diagram of System

1) Phase 1:

During this phase, the Body Mass Index(BMI) of the user is calculated by system. BMI is used to find out whether the person is underweight, healthy, overweight, or obese. BMI is a reliable indicator of fitness and is used to decide the weight category of person. The formula for Body Mass Index calculation is:

$$BMI = W/H^2 \quad (1)$$

According to the WHO following is the classification:

TABLE I
CLASSIFICATION ON BMI

BMI (kg/m^2)	Classification
<18.5	Underweight
18.5 - 22.9	Normal
23.0 - 24.9	At-risk of obesity
25.0 - 29.9	Obese I
≥30.0	Obese II

Depending upon the category in which a person falls, allergies if any, and likeliness of food primary elimination of food items is done. Suppose a person belongs to Maharashtra state, all crops grown in Maharashtra are selected from the Dataset containing state-wise crops grown and other attributes for primary elimination and thus, primary elimination is carried out. Let's take an example of rice which is Kharif season crop.

Different classification algorithms have been tried but the accuracy was best with the random forest algorithm. Classification is the technique in data mining that predicts categorical class labels. Accurately determining the target class for each label is the ultimate goal of classification. Classification is also called supervised learning where training dataset is used to learn the classifier.

TABLE II
SAMPLE ATTRIBUTES OF TRAINING ALGORITHM

food item	likeness	Category	allergic	decision
Rice	High	Healthy	No	Yes
Rice	Medium	Healthy	No	Yes
Rice	Low	Healthy	No	No
Rice	High	Underwt	No	Yes
Rice	Medium	Underwt	No	Yes
Rice	Low	Underwt	No	No
Rice	High	Overwt	No	Yes
Rice	Medium	Overwt	No	No
Rice	Low	Overwt	No	No
Rice	High	Healthy	Yes	No
Rice	Medium	Healthy	Yes	No
Rice	Low	Healthy	Yes	No
Rice	High	Underwt	Yes	No
Rice	Medium	Underwt	Yes	No
Rice	Low	Underwt	Yes	No
Rice	High	Overwt	Yes	No
Rice	Medium	Overwt	Yes	No
Rice	Low	Overwt	Yes	No

The decision tree with random forest is shown below in fig.2. Likewise, for other food items grown in the state, the decision tree is made and we can achieve a reduced list of all the food items which can be included in the diet chart.

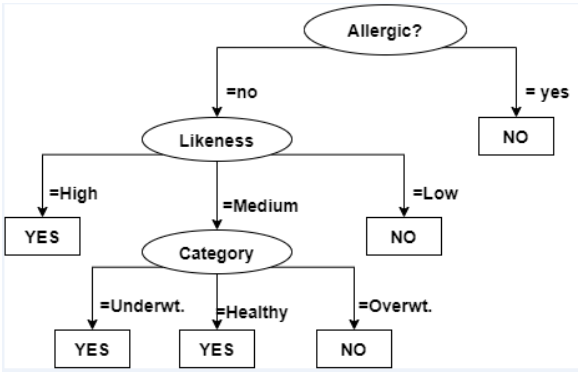

Fig. 2 Decision Tree

2) Phase 2:

In this phase, the nutrients required by a person are calculated. The calories, proteins, fats, and carbohydrates required by a person each day are calculated. Now, if the person is underweight or overweight then a diet chart should be recommended in order to bring him under normal weight/ healthy. The BMI is checked, if the person is underweight then the weight is incremented in such a way that BMI of the person falls under healthy weight (weight is a variable whereas height is considered as constant) and that weight is considered for recommending a diet. Similarly, if a person is overweight then the weight is decremented in such a way that BMI of the person falls under normal weight/ healthy and that weight is used for diet chart recommendation. Lastly, if a person is already under a healthy category then its actual weight is considered for calculations of nutrients and thus, a healthy diet chart is recommended in order to maintain.

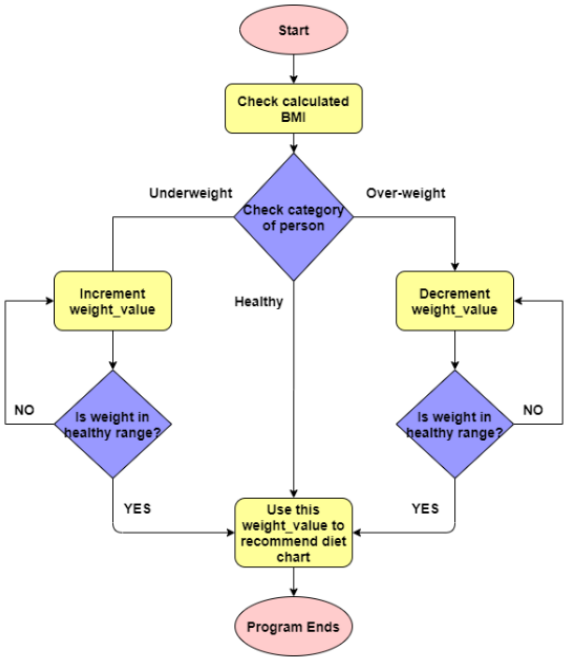

Fig. 3 Flowchart to determine healthy weight

Nutrition need:

There are various formulae used to calculate the nutritional needs in a day [7]:

1. Calories

$$C = 66 + (13.7 *W) + 5 (H) – (6.8 * A) \quad (2)$$

Where C denotes calories, W is weight, H is height and A is age of user. This formula is for males.

$$C = 655 + (9.6 *W) + (1.7 * H) – (4.7 * A) \quad (3)$$

Where C denotes calories, W is weight, H is height and A is age. This formula is for females.

2. Protein

$$C = (NC / 150) * 6.25 \quad (4)$$

Where C denotes calories and NC is the need of calories.

3. Fat

$$C = 0.25 * NC \quad (5)$$

Where C denotes calories and NC is the need of calories.

4. Carbohydrates

$$C = 0.70* NC \quad (6)$$

Where C denotes calories and NC is the need of calories.

Based on age group, weight (kilogram=kg), height (centimeter=cm), energy(kilocalories=kcal),Protein (gram=gr), and activity, the calories needed for male and female are different.

C. Results

The following flow diagram explains how the diet chart will be designed for an individual. From phases 1 and 2, we have known the required nutrients and the desired weight of a person. The dataset containing state-wise foods and their nutritional values will be used here. First, a random food item will be selected from this dataset. If the food fits in the diet chart, that is, if the food item is satisfying the nutritional value required by a user, then that item will be added in the plan. So, iteratively the items will be selected from the dataset until all the user's requirements are proportionately satisfied.

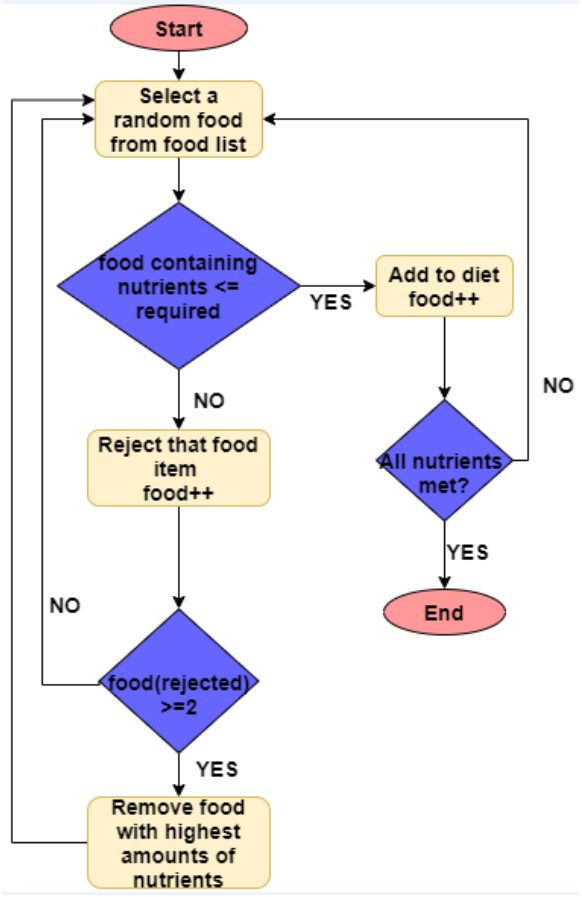

Fig. 4 Flowchart to generate food list

However, it may happen that the addition of an item rich in one macronutrient may exceed the upper limit of another macronutrient. For instance, if the protein requirement is being satisfied using paneer, but the addition of paneer is exceeding the fat limits set for the user, then paneer has to be rejected. Care has been taken here that if the food item is rejected more than once, then only that will be dropped and other items will be added to compensate for those nutrients. Like here, paneer can be replaced with other proteinaceous but low-fat food like soybean. In this way, a proper balance will be maintained between all the required macronutrients.

IV. FUTURE SCOPE

The system, for now, focuses on the basic diet plan recommending based on the current health status of the user and the availability of food in his location. On top of this, many advanced models can be developed. For instance,

- The dataset contained the foods available in different states of India. However, it can be expanded to consider different regions of the world.
- The system can also be made to consider the user's additional choice. For example, a person can be healthy but still desires to gain muscles and hence, the overall weight. In that case, additional parameters and the required processing can be integrated into the system to suggest diet accordingly.

V. CONCLUSIONS

To stay healthy and survive for a longer period of time nutritional food is of utmost importance. Random forest algorithm helps in classifying and taking a decision whether to include a particular food item in someone's diet plan. Consumer's Body Mass Index is calculated and allergies and preferences of food are taken into consideration. Adopting this system is very pocket friendly and saves the time. As our focus is on recommending locally grown-seasonal food it helps the farmers and local economy to boom. So the system helps society as well as the consumer.

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