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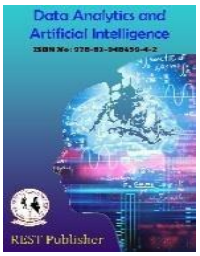

Machine Learning Algorithms in Identifying Balanced Diet Plan for Healthy Life style

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Abstract: *The present generation of all ages is terribly facing the challenges of obesity in recent times. The people suffering from this disorder practice different diet plans for weight reduction without considering the balanced proportion of nutrients in their diet. This paper aims in highlighting the ill effects of unbalanced diet plans and proposes a machine learning (ML) model based on support vector machine to make decisions on the balanced nature of the diet. The efficiency of the proposed ML model is compared with other ML algorithms. The accuracy results of the proposed model are more convincing in comparison with other ML algorithms. The proposed ML model is applied to deterministic type of secondary data sets and this shall be extended by applying to fuzzy data sets. This research work applies the algorithms of machine learning to health-based decision-making systems.*

Keywords: *Machine Learning, Balanced Diet, SVM*

1. INTRODUCTION

In medical encyclopaedia, obesity is a condition characterized by excess body weight caused by the accumulation of fat in the body. A person gets enlisted under the category of obese if the Body Mass Index is 30 or more. The problem of obesity is emerging as a global pandemic and the factors associated with genetic, environment and lifestyle are the main reasons for this disorder. The condition of obesity is the root cause of several major health problems such as stroke, heart diseases, diabetics, blood pressure. Lack of physical activity and modified eating habits increases the risks of obesity. According to the statistical reports on obesity, one out of four persons in India is overweight and almost 50% of increase in obesity exists among Indians. The medical experts have given alarming reports on consequential impacts of obesity and at the same time they have also suggested healthy diet plans of weight reduction. Presently people practice different diet plans for instant weight loss forgoing the balanced proportion of the essential nutrients. Some of the diet plans that are most commonly practiced are Mediterranean, low-carb, dash, plant-based, intermittent fasting and many other. In these diet plans the constituents of the essential nutrients such as carbohydrates, protein, fats, minerals and vitamins are not in proportion to that of the balanced diet. For instance, a diet is characterized as balanced if it contains 50 % carbohydrates, 35% fats, 12 % proteins, 3 % minerals and vitamins and sufficient water. For instance, in Paleo diet, the major constituents is protein with a very minimum intake of carbohydrates. Although this diet plan helps in weight loss, the prolonged practice of this diet affects the internal functioning of the human health. A diet plan of any kind must primarily fulfil the objective of health sustainability with conservation of essential nutrients. The erratic weight loss with unbalanced diet causes several health consequences in course of time. Hence the people practicing diet plan for weight loss must take into account of the balanced proportion of the nutrients. The balanced nature of the diet shall be tested using biological methods but it consumes lot of time and energy. Researchers have also applied machine learning algorithms in making recommendations of diet plans based on the Body Mass Indexes and the physical attributes of the patients. The classification type of algorithms are not applied to categorise the diet plan as balanced and unbalanced and this is the research gap identified in this paper. The construction of such ML based models will facilitate the persons to comprehend the nature of their diet plans followed for weight loss. This research work proposes ML based decision-making models to determine the nature of the diet plans using the algorithms of Support vector machines and Decision

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trees. This ML based decision models will certainly bridge the research gaps and assist in practicing healthy life styles. The remaining contents of the paper is structured into the following sections. Section 2 presents the state of art of the applications of Machine learning algorithms in diet recommendations. Section 3 sketches the steps involved in support vector machine algorithm. Section 4 describes the decision-making problem and applies the SVM algorithm. Section 5 discusses the results and the last section concludes the work with future works

2. LITERATURE REVIEW

Machine learning is a branch of Artificial Intelligence comprising many robust and feasible algorithms for making predictions and decisions on forecasting. The machine learning algorithms are predominantly data-driven. These machine learning algorithms are classified into supervised, unsupervised, semi-supervised, reinforcement and deep learning. These algorithms are extensively applied in several fields such as image and speech recognition, natural language processing, recommendation systems, fraud detection, autonomous vehicles, healthcare diagnostics, and many more. Machine learning algorithms are widely used in healthcare analytics to diagnose diseases and to make predictions on disease prevalence. The ML algorithms are applied to make early diagnosis of diabetics, stroke, cardiac diseases and other health related issues. The applications of these algorithms of different kinds will prevent the occurrence of the diseases and eases the treatment. The ML algorithms are also applied in making recommendations of the diet plans to the patients of diabetics, hypertension, COVID 19. The diet plans are also proposed used ML algorithms to restore the deficiencies of vitamins, carbohydrates and many other nutrients. Jain et al [1] applied predictive learning approaches to recommend meals for the persons based on their body mass index. Hemaraju et al [2] applied K means clustering algorithm proposed ML model for recommending diet plans based on their physical attributes. Kardam et al [3] employed K-means algorithm and random forest algorithm in recommending diet and fitness plans. Rout et al [4] and Golagana et al [5] used the ML algorithms to frame diet plans for battling the problems of obesity. Oleksiv et al [6], Mogaveera et al [7] applied machine learning technology in making recommendations of diet plans. Lee et al [8], Banerjee et al [9] used Ml based algorithms to frame suitable diet plans for children. From the above-mentioned literature works, the ML based algorithms of binary classification of the nature of the diet do not exist to the best of our knowledge. Hence this research work proposes such genre of decision-making ML models.

3. METHODOLOGY

This section presents the brief description of support vector machines (SVM) and its working modality in making optimal decisions. SVM is a supervised machine learning algorithm used in performing classification and regressions. This algorithm is basically applied to make binary classification and also extended to make multi-class classification. In this case, the hyperplane acts as a means of data separation and the training data points lying closer to hyperplane are called as support vectors. This ML algorithm is more efficient in handling linearly separable and non-linearly separable data sets. The regularization parameter is denoted by C which characterizes trade-off between maximizing the margin and minimizing the misclassification of training. This algorithm is widely used in various fields of decision making and it is highly versatile in nature. SVM is more robust in handling small and large data sets more efficiently, however the applicability of this algorithm to very large data sets is more challenging.

TABLE 1. The steps involved in SVM are as follows

Sequential Order	Phases Involved	Description
Step 1	Data pre-processing	Initial step involving data cleaning, handling of missing values and outliers
Step 2	Feature selection	Identification and selection of suitable features or attributes of decision making
Step 3	Training data preparation	Division of data sets for testing and training
Step 4	Choice of kernel function	Suitable choice of kernel function to handle linear and non-linear relationship existing between the data
Step 5	Model training	Training of model to determine the optimal hyperplane
Step 6	Hyperparameter tuning	Optimizing the regularization parameter
Step 7	Model evaluation	Determining the evaluation metrics to find the efficacy of the model
Step 8	Prediction	Making predictions with new data sets

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4. APPLICATION OF SVM IN DECISION MAKING ON DIET PLANS

This section applies the SVM algorithm to the decision-making problem of binary classification of the diet plan as balanced and unbalanced. Problem Description Weight management is essential to lead a healthy life style and to overcome the health consequences of obesity. People practice different diet plans with the only intention of weight loss and forgoing the balanced nature of the diet. As people are ignorant of the status of their diet plans, the health of the people gets affected in course of time. To prevent such instances, a decision-making model based on SVM is developed to classify the diet plans into two classes namely balanced and unbalanced. Data Collection The data of the persons with different diet plans comprising the essential nutrients of carbohydrates, proteins, fats, minerals and vitamins are collected from the people belonging to the age group of 25-45 with the help of dieticians. Evaluation Metrics the R package of "e1071" is used and the following results indicating the efficacy of the SVM algorithm are presented in the following Table 4.1.

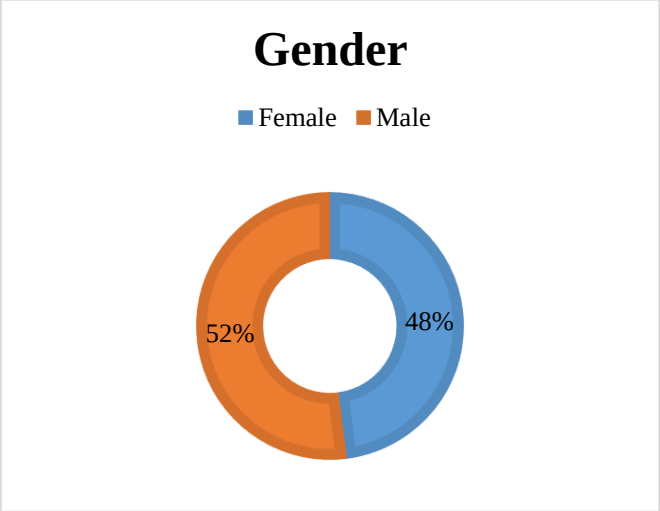

FIGURE 1. Gender Distribution

TABLE 2. Efficiency Metrics

Accuracy	F1 Score	Precision	Recall
94.56	94.23	94.48	95.23

5. RESULTS & DISCUSSION

The results obtained using SVM is compared with decision trees and the respective values are presented in Table.4.2

TABLE 3. Efficiency Comparison

Algorithm	Support Vector Machine	Decision Trees
Efficiency	94.56	92.12

This shows that the SVM is more efficient in making optimal decisions on diet plans data. The efficacy of SVM shall be compared with other machine learning based algorithms too.

6. CONCLUSION & FUTURE WORKS

This research work proposes a decision-making model based on machine learning algorithm of support vector machines in determining the nature of the diet. This paper strongly emphasizes the need of such model in testing whether the diet is balanced or not. The model is so viable and feasible in facilitating the persons to maintain a proportionate diet by making inferences on their daily intake. The proposed model shall be tested by making attempts with other machine learning algorithms. The prediction on efficacy of diet is essential to maintain a healthy life style.

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