Machine Learning based Fitness application using BMI value

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Abstract. One of the foremost emerging and important aspect people were following these days are fitness. The people are suffering from obesity which led to extreme medical disease. The body Fat Percentage (BFP) is one of the most widely used method used to calculate the fitness level of the human. This study proposes the method to predict the BFP using the regression method. It also prescribes how people can maintain proper diet for being healthy and stay fit. Based on the prediction result, the web application provide people with the prescribed module like gym, proper diet, doctor consultation etc. The people can choose their respective module according to their fitness level. Also, the doctor consultant module is implemented using support vector machine (SVM) which classify the people according to the level of fitness and also the appropriate choice of doctor. The prediction result reveals the proposed model efficiency

Keywords: Fitness, BFP, SVM, Linear Regression, Correlation coefficient)

1. Introduction
Recent years the deadly diseases are reported worldwide. Obesity is the major factor that are the base causes for these diseases. It has been reported that excess body fat can increase the risk of six different types of cancers, including bowel, esophagus, pancreas, kidney, endometrium, and breast cancers, respectively. The extreme level of the fat are considered to be dangerous. The High BFP that may led to atherosclerosis, a heart disease and low BFP may led to less brain function. It is required to maintain proper BFP. The data set considered for this problem is the real time data that contain estimates of the percentage of body fat determined by underwater weighing and various body circumference measurements for 252 men. Percentage of body fat for an individual can be estimated once body density has been determined. Accurate measurement of body fat is inconvenient/costly and it is desirable to have easy methods of estimating body fat that are not inconvenient/costly. To address this issue, lots of technical oriented innovations are emerging. In this work it is proposed to use the technologies and software’s make people efficient and simplify. This study is one among them to create web application service to provide health related content to the customers with the prediction report generated by machine learning based data analytics. The unique feature of the proposed method include the BMI calculation formula. Apart from BMI calculator, the other modules are calorie value of the food item entered by the user which gives a better understanding of the life of user with a balance in its daily nutrition intake with the calories burnt throughout the day. The user is classified based on the
classification category, user is redirected to consultation module that helps to fix the appointment with the doctor or the trainer or the dietitian. Also, the articles bulletin board module provides the user specific health articles every day to make them more attentive and health conscious which are genuine and required content from their own trainer/ dietitian/ doctor.

The rest of the sections are arranged as follows: section II survey the exiting application. In section III the proposed system is discussed. In section IV the proposed modules are described. Section V presents the results section VI presents the conclusion.

2. Literature Survey

Fitness apps are a dime-a-dozen now. Last year, Economics published a paper estimating that there were 100,000 fitness and health apps between the Google Play and App Store. There are many top companies along with their fitness applications in the market. Every company has come up with their ideologies and created software or android applications and launched them, but each one have their own individual ideas some prefer to target only muscles, some to only diet and others have their own, but combining all together at one with the enrichment in prediction is expected. To address this, this work focus on increasing the accuracy of the BMI calculation values proposed by the existing applications. A web application is reliable and universal internet based application accessible all through the internet world. Also, the reviews of certain application says that the conventional method of calculating BMI using fat weight rather than muscle gain is acceptable. The standard formula for BMI calculator does not have included enough parameters for addressing the health and fitness. There is no calorie calculation of user’s daily intake of foods which compares with amount of calorie burnt in order to maintain a perfect balance between the intake of the diet and the total out work throughout the day. This work includes a module to prefix doctor consultations by taking the users earlier medications and precautions to cure the diseases.

Apps created for muscle growth: Muscle growth fitness-based apps are for cardio-based training and diet tracking — calories in and out, heart rate, steps taken, miles logged, etc. — and the options for heavy lifters are few and far between. Part of the problem is that weight lifting is hard to track without manually inputting the information yourself. While your phone can accurately track your steps using the built-in accelerometer, the technology doesn’t exist yet that can estimate how much you’re lifting, for how long, or correct bad form; a few wearable exist out there that measure your “muscle quality,” but those cans be expensive, if not unreliable.

Apps created for diet maintenance/calorie calculating: As the name suggests, the main function of these kinds of applications is to count the calories. In this the user enters his/her goal which is usually the weight. Later they add other information such as their activities and the food they ate. It measures the number of calories absorbed and burnt and then suggests them with dietary recommendations. Moreover, the accuracy of the result is unexpected.

3. Proposed system

The work present the web application that include popular fitness maintenance categories with the data analytics. In this web application, the users are provided with all diet and calories about the products which users have entered. It calculates the BMI. It uses machine learning approach to perform predict the consultation of either doctor/trainer/dietitian. The prediction module include the earlier data to train on diets and classification which has taken from the people who had already suffered with the same problems. Fig 1 shows the data flow of the proposed work of building the health web application service.
Fig. 1. Data Flow Diagram

It illustrates the details of data flow throughout the web app and all its modules to another module in order to inter-link them together and make them connected.

- Sign-up module — Individual basic data for authentication purpose.
- Calorie module — A complete balance in user’s diet and the calories burnt throughout the day.
- BMI calculation module — Categories the users and prescribe the requirement accordingly.
- Consultation Module — Daily diet of users, analysis of historic and current diet data, prescribe the either doctor/dietitian/trainer consultation or requirement of change in diet chart.
- Notification module — Doctor/dietitian/trainer approved notification specific to the user. Caution information about current global diseases.
- Database module — All data’s need to be stored in the third-party cloud server for access through internet.

The formula for the BMI calculation:

Body fat percentage (BFP) formula for males:

$$BFP = 495 / (1.032 - 0.19077 \times \log_{10}(\text{waist-neck}) + 0.15456 \times \log_{10}(\text{height})) - 450$$  \hspace{1cm} (1)

Body fat percentage (BEF) formula for females:

$$BFP = 495 / (1.29579 - 0.35004 \times \log_{10}(\text{waist+hip-neck}) - 0.22100 \times \log_{10}(\text{height})) - 450$$  \hspace{1cm} (2)

4. Methodology used

The data set consist of 14 input features attributes and one multi class output value. It has 253 records of data. Split the dataset into training and testing in 80:20 ratios. The classification of the users is performed by the training and testing model. To test the model, the prediction accuracy is verified.
Fig. 2. Heatmap of the Dataset

Fig 2 presents 2 dimensional representations of data values of the considered feature values. The x axis presents the density value and the y axis presents the variable considered in the dataset. The multiple linear regression model is applied to train and test. The prediction of density value is performed and the regression score is obtained as the output to prove the accuracy of the proposed model of prediction.

| Attribute Value | Coefficient value |
|-----------------|-------------------|
| Age (years)     | 0.000029          |
| Weight (lbs)    | 0.000033          |
| Height (inches) | 0.000029          |
| Neck circumference (cm) | 0.000026 |
| Chest circumference (cm) | 0.000116 |
| Abdomen circumference (cm) | -0.000205 |
| Hip circumference (cm) | 0.000107 |
| Thigh circumference (cm) | -0.000014 |
| Knee circumference (cm) | -0.000003 |
| Ankle circumference (cm) | -0.000247 |
| Biceps (extended) circumference (cm) | -0.000242 |
| Forearm circumference (cm) | 0.000037 |
| Wrist circumference (cm) | 0.000447 |
| Body Fat        | -0.002193         |

The coefficient value of each of these are calculated and presented. The prediction of the density value made with the testing data values. The regression Coefficients values are obtained as [3.40367248e-05, 6.87183508e-05, 2.77865888e-06, 1.33389104e-05, 1.32815834e-04, -2.20327211e-
The validation of the prediction result is obtained by comparing the prediction model output of the test input feature attribute with the test output value. The regression score is obtained as 0.9698983348600305 which is approximated as 97%. Fig 3 shows bar chart for the actual and predicted value. To make this proposed work as a hybrid model, an efficient classification model such as Support Vector Machine (SVM) is used. The Consultation module uses this classification technique to provide the suggestions and prescription of the doctor/dietitian/trainer. Based on the body Density value, the SVM act as the decision plane which divides the data values based on its class.

5. Results and discussions

Fig. 3. Actual Vs. Predicted values for a sample 10 records

Fig. 4. Application user interface for getting input from the user
Fig 4 represents the Graphical User Interface for the user through which they provide the input to the application for calculating the input calories for the day.

![Fig. 5. Consultant suggestion specific for the user](image)

Fig 5 provides the consultation from the dietitian suggestion for the user. Similarly, the other consultant such as fitness trainer, Doctor will provide the suggested content specific to the user according to the class.

![Fig. 6. Application user interface for getting input from the user](image)

Fig 6 is the interface that permits the user who is classified under Doctor Class. This module allows the user to fix the appointment with any of the three consultants based on the class to which the user belongs.

![Fig. 7. Application user interface for getting input from the user](image)

The height and weight of the user is obtained to calculate the BMI value. Fig 7 shows the application user interface that validate the input values and calculate the BMI value as output.

6. Conclusion
This work presents the fitness application that uses the user input values to calculate the body fat. For the purpose, the work consider the time in public forum shared by StatLib and Roger W. Johnson. Also, the application include the analytics by using the historic data by training and testing the multiple regression model. This model is used as the prediction module to predict the user class. The class involved here is multi class classification. The consultation module implements the SVM classification to redirect the users with the corresponding consultant such as doctor/dietitian/Trainer. This hybrid method of analytics is performed for the web application with an accuracy of 97% in prediction of the body fat. Thus, this work provide solution for the fitness-freak user expectation of all in one environment is being satisfied with the analytics background.

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