Body Fat Estimator Using Ensemble Methods

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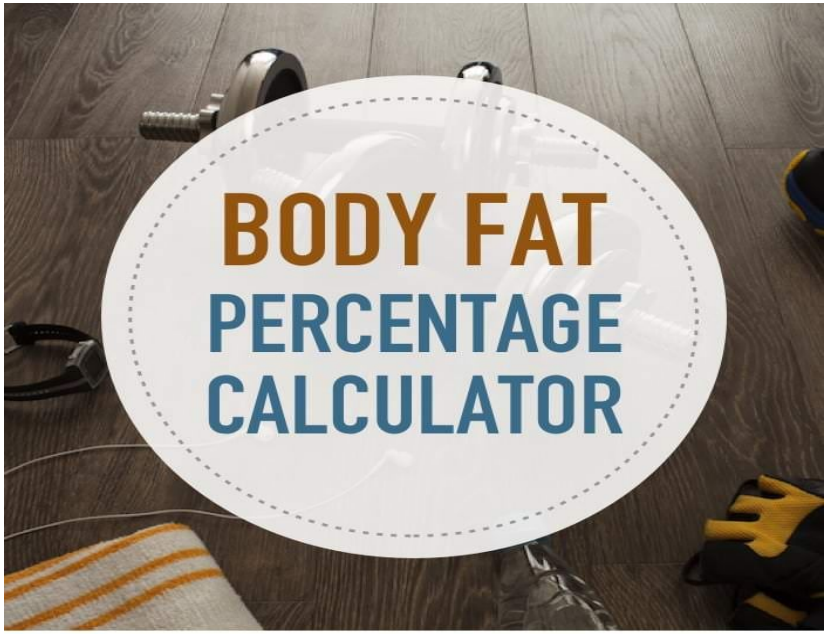
Overview

Introduction

- Obesity or excessive body fat is a critical public health problem that can cause several health issues like mood disorders, cardiovascular diseases, respiratory aliments, and digestive issues.



Courtesy: www.amazon.com

Literature Survey

S. No	Title of the paper	Author(s)	Description
1	Body Fat Prediction using Various Regression Techniques	Nikhil Mahesh, Peeta Basa Pati, K. Deepa, Suresh Yanan - 2023	In this paper, they compare the performance of several machine learning models based on Regression, to predict the body fat percentage.
2	Classification of Obesity Using Several Machine Learning Techniques	Jyothi Parsola - 2022	The 3D Scanner techniques like Computed Tomography and machine learning algorithms used for determining the body fat percentage.

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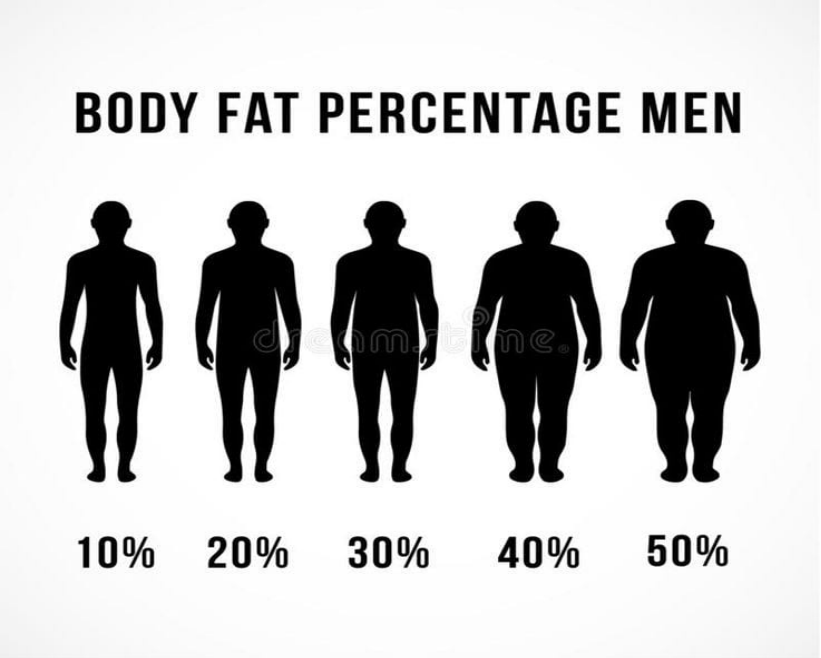
3	Hybrid Machine Learning Model for Body Fat Percentage Prediction Based on Support Vector Regression and Emotional Aritificial Neural Network	Solaf A. Hussain, Nadire Cavus, Boran Sekeroglu - 2021	In this paper, they have used the data selection technique the "left-out" approach and integrated the physical and emotional characteristics for body fat prediction.
4	Prediction of Women Obesity using Naive Baye's Algorithm	Dr. Naveen N, Rakshitha Kiran P - 2019	The Naive Baye's Algorithm is used and Women dataset is collected, based on the risk factors the algorithm worked to predict the body fat percentage.

Problem Statement

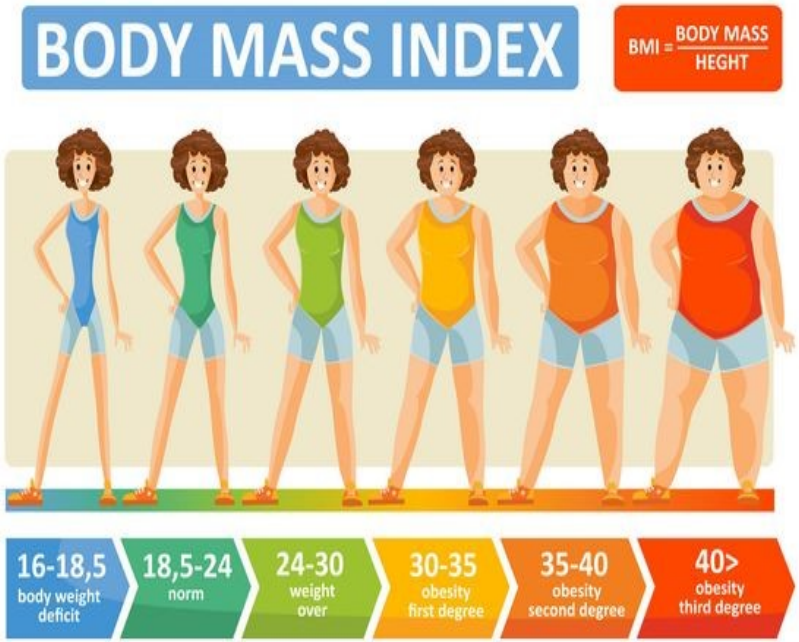
- Body fat estimator using ensemble methods for accurate predictions with basic user inputs like age, gender, weight, measurements and calculate the body mass index for facilitating personalized health management and fitness planning .



Courtesy: https://images.app.goo.gl

Proposed Method

- Developing a novel machine learning model that integrates SVR(Support Vector Regression), Random Forest and boosting algorithms (AdaBoost, Gradient Boosting Machine, XG-Boost) for precise and cost-effective body fat percentage prediction.



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Dataset

- The dataset preparation process includes collecting data from diverse sources and performing tasks such as Data Cleaning, Feature Selection, Target Variable Definition, Normalization, Splitting the dataset, Feature Scaling to make it suitable for training.

Dataset columns	Proposed Algorithms
Density	Decison tree
Abdomen	Random forest
Chest	Gradient boosting
Hip	Adaptive boosting
Weight	Support vector regressor, ANN

Modules

- **Support Vector Regression :** Support Vector Regression (SVR) is a machine learning algorithm used for regression tasks, to predict a continuous target variable.
- **Random Forest :** Random forest is a meta estimator that fits a number of decision tree classifiers on various sub-samples of the dataset and uses averaging to improve the predictive accuracy.
- **AdaBoost (Adaptive Boosting) :** The final prediction is made by a weighted sum of the individual weak learner predictions.
- **XGBoost (Extreme Gradient Boosting):** It incorporates regularization techniques, parallel processing, and a custom loss function to improve model performance.

Results

S. No	Model	R2 Score	RMSE	rRMSE
0	Decision Tree	0.946860	1.994615	0.114983.
1	Random Forest	0.983676	1.105510	0.063729
2	AdaBoost	0.973841	1.399452	0.080674
3	Gradient Boosting	0.992671	0.740730	0.042701
4	Support Vector Regressor	0.370609	6.864490	0.395715
5	Neural Network	0.262621	7.430079	0.428319

Table: Performance metrics of different models

S. No	$Model_Name$	$Best_Score$
0	Random Forest	-5.367842
1	Decision Tree	-8.268757
2	SVM	-29.416049
3	AdaBoost	-2.396577
4	GradientBoosting	-1.665798
5	Neural Network	-26.015821

Table: Best Scores of various machine learning algorithms

S. No	Density	Abdomen	Chest	Hip	Weight	Actual	Predicted Result
0	1.0708	85.2	93.1	94.5	154.25	12.3	12.300483.
1	1.0853	83.0	93.6	98.7	173.25	6.1	6.099918
2	1.0414	87.9	95.8	99.2	154.00	25.3	25.295529
3	1.0751	86.4	101.8	101.2	184.75	10.4	10.399574
4	1.0340	100.0	97.3	101.9	184.25	28.7	28.699710
247	1.0736	83.6	89.2	88.8	134.25	11.0	11.035981
248	1.0236	105.0	108.5	104.5	201.00	33.6	33.600074
249	1.0328	111.5	111.1	101.7	186.75	29.3	29.450171
250	1.0399	101.3	108.3	97.8	190.75	26.0	26.135649
251	1.0271	108.5	112.4	107.1	207.50	31.9	31.899727

Table: Gradient Boosting Models Evaluation Results

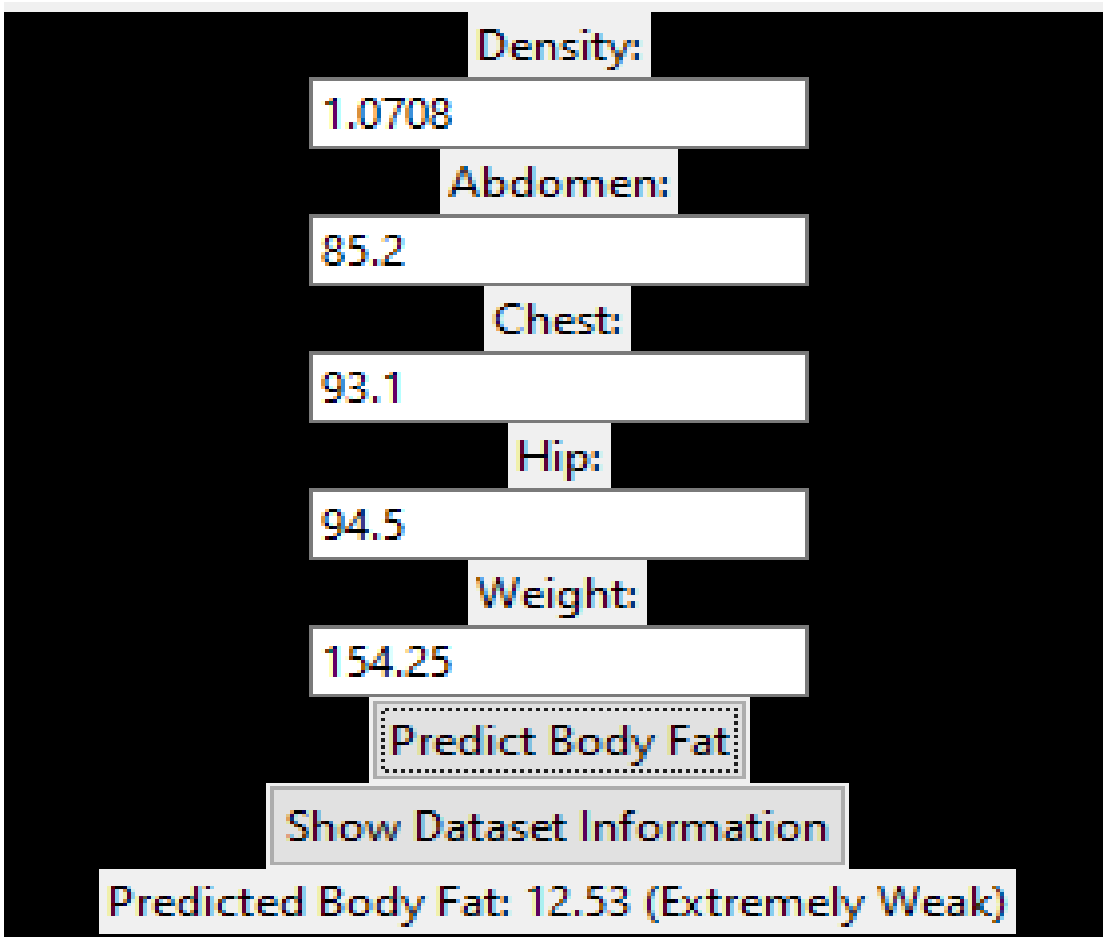

Figure: Body Fat Percentage Output

Conclusion & Future Scope

- **Conclusion :** Using Ensemble methods for body fat estimation can provide the improved results and robustness, with potential applications in fitness, healthcare, and feature importance analysis. Careful data preprocessing and model selection are key to their success.

- **Future Scope :** Future the prediction of body fat percentage using the proposed model includes assessing the optical data-based model's performance, investigation of gender effects on BFP, and testing its efficiency for predicting body fat percentage in obese children.

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Thankyou