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Calories Burnt Prediction System Using Machine Learning: A Survey

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Abstract—Due to a growing number of obese and overweight people, a healthy lifestyle must be adopted and maintained. The prediction of calories burned during exercise using machine learning approaches is the main topic of this research. This study examines and contrasts a number of machine learning regression models, including Random Forest, Ridge, LightGBM, XGBoost, and Linear, Lasso, and Logistic to evaluate their prediction performance in terms of calories burned, which can be applied in systems like fitness recommender systems that encourage a healthy way of life. My project demonstrates that LightGBM provides customers with dependable suggestions with a good accuracy of 1.27 mean absolute error when forecasting calorie burn. The suggested strategy has a decent chance of helping users meet their fitness goals by providing accurate and customized guidance.

Index Terms—Calories Burnt prediction, XG Boost, Light GBM

I. Introduction

Understanding the intricacies of calorie burn is paramount in navigating the realms of health, fitness, and well-being. While calories are commonly associated with dietary considerations and weight management, they represent a fundamental unit of heat energy, essential for sustaining various bodily functions and activities. Calorie burn is influenced by a myriad of factors, including age, height, weight, gender, heart rate, body temperature, and duration of activity. According to [1], the environment and lifestyle factors, like physical activity and eating habits, are also thought to be of vital relevance, even though genetics play a significant part in obesity. In addition, people who are less active may experience muscle deterioration and slowed metabolism, which makes it more difficult for them to maintain a healthy Body Mass Index (BMI). There are ways to reduce overweight and obesity such as engaging in regular physical activity for 150 minutes a week for adults [2]. Therefore, exercise is very important to everyone, especially for those who are obese and overweight. However, it can be difficult and confusing to anticipate how many calories would be burned during diverse activities. In order to overcome this obstacle, scientists and health enthusiasts have created cutting-edge techniques for estimating calorie expenditure based on several variables like body weight, exercise type, duration, and intensity. These techniques are intended to provide people with a better knowledge of how much energy they use and to help them set reasonable fitness goals, create efficient workout schedules, and monitor their progress.

According to the World Health Organization (WHO) [3], Malaysia has the highest rate of obesity and overweight among Asian countries with 64 percentage of men and 65 percentage of women being fat or overweight. As stated in [4], overweight and obesity cases are rising throughout the nation at an alarming rate right now. Exercise is an essential part of a healthy lifestyle and to have a good BMI. Exercise increases energy expenditure, which directly affects the number of calories burned by the body. Regular exercise can help balance calorie intake, regulate weight, and enhance general health.

Knowing how many calories are burned while exercising might help people make more informed diet and exercise choices. Calories burned can be estimated by a number of methods such as metabolic equations [5], heart rate [5], wearable fitness trackers [6], and advanced sensors [7] by taking into account characteristics such as age, gender, weight, height, activity type, heart rate, exercise duration and intensity. Our research objectives encompass gathering data from diverse sources, preprocessing for accuracy, developing and evaluating machine learning models, and interpreting results to draw meaningful conclusions. By focusing on activities like walking, running, and cycling, we aim to provide practical

insights into calorie expenditure during common forms of physical activity. Through the utilization of machine learning techniques, such as XG Boost regression, we seek to develop models capable of accurately predicting calorie burn based on a comprehensive set of input parameters.

II. LITERATURE REVIEW

Ratnakar et al. [8] discussed the prediction of the number of calories burned by applying machine learning (ML) with an XG boost regression model.

More than 15,000 data points are given into the model, and its mean absolute error is 2.7, which will improve over time by adding more data to the XG regression model.

Valmiki et al. [9] used machine learning techniques like linear regression and the XG Boost regressor to address the problem. The findings showed that when it comes to estimating the number linear regression, the XGBoost regressor, and the amount of calories burned during exercise perform better than alternative methods.

Sudheesh et al. [10] researched on machine learning applications in the health and fitness domain. The XG Boost model achieved the maximum training and testing accuracy of 99.67

Pawar et al. [11] developed a machine learning system to calculate the amount of calories burned after exercise in the human body. It took certain attributes as input and gave an approximate calorie burned value worth, which will inspire individuals to exercise more and will show their daily growth. With almost 15,000 data points, the project's MAE (Mean Absolute Error) is 1.48, and it will continue to improve over time for improved outcomes.

Guna Sheela et al. [12] discussed the techniques to predict calorie from input images. They used some digital image processing techniques such as image acquisition, RGB conversion, feature extraction and image enhancement so on. They segmented input images and used techniques and then combined segmented images, finally calorie has been predicted.

Vinoy et al. [13] predicted calories burnt during the workout using machine learning algorithms such as XGBoost regressor and Linear regression models. The calories burnt during physical activities have been investigated. Their mean absolute error value was almost 2.71 in XGB regressor and 8.31 for linear regression. They used 7 attributes such as age, height, weight, duration, heartrate, biosystems and calorie. Their dataset was in 15000 CSV with 7 attributes. The model accuracy was not mentioned.

Despite notable advancements in the field of calorie prediction through machine learning, several challenges persist, including the need for standardized methodologies, robust validation protocols, and integration with real-time monitoring systems. By fostering interdisciplinary collaborations and leveraging emerging technologies, researchers can continue to advance the frontier of calorie prediction, ultimately facilitating more effective interventions for promoting health and well-being on a global scale.

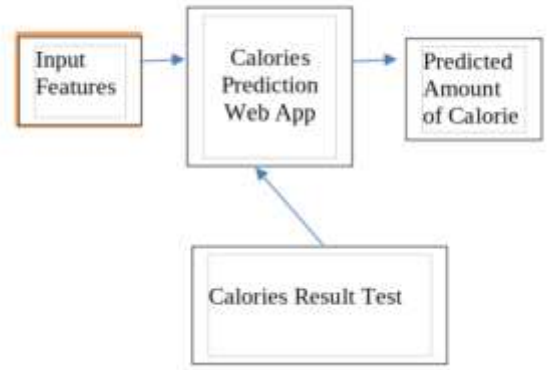

Fig. 1. Calories Burnt

III. PROBLEM STATEMENT

After conducting the literature review, it was found that there are two limitations that need further improvement. One is the lack of machine learning models to predict calories burned during exercise and another one is the lack of comparison between every machine learning model. Lack of machine learning models in prediction of calories burned is a very crucial problem as there might be another better machine learning algorithm that can make a more accurate prediction for calories burned. Other than that, comparison between every machine learning model is very important in order to find the difference and the best machine learning model to predict the calories burned. In a previous paper by [8], XGB Regression is often being compared with only one other machine learning algorithm. After identifying the limitations in previous research, the proposed work aims to provide a solution to the challenges. An existing machine learning repression algorithm, LightGBM, is proposed in this work to predict the calories burned. Based on our literature search, LightGBM regression has not been used for such a purpose. Additionally, we contrast the suggested regression model with six additional models: XGBoost, Linear, Random Forest, Lasso, Logistic, and Ridge.

IV. SOLUTION STATEMENT

Comparison of Machine Learning Models:In addition to LightGBM regression, six other machine learning models are selected for comparison: XGBoost, Linear Regression, Random Forest, Lasso Regression, Logistic Regression, and Ridge Regression. Each model offers unique strengths and weaknesses, and comparing them will help identify the most suitable model for predicting calories burned during exercise.

Experimental Design:

A carefully designed experiment is conducted to evaluate the performance of each machine learning model. This involves selecting appropriate datasets containing information on exercise activities and corresponding calories burned. The datasets may include a diverse range of activities to ensure the models' robustness across various exercise types.

Feature Engineering: Relevant features such as exercise type, duration, intensity, heart rate, and participant demographics are considered for inclusion in the predictive models. Feature engineering techniques may be applied to extract useful information and enhance the models' predictive capabilities.

Model Evaluation: Each machine learning model is trained and evaluated using standard evaluation metrics such as mean squared error, mean absolute error, and R-squared. Cross-validation techniques may be employed to ensure the reliability of the model performance estimates.

Comparison and Selection of the Best Model:The performance of each machine learning model is compared based on their predictive accuracy and computational efficiency. The model that consistently demonstrates the highest accuracy in predicting calories burned across various activities is selected as the optimal solution.

V. CONCLUSION

The main purpose of this project was to create a precise machine-learning model that could predict a specific outcome variable based on a series of characteristics. various machine learning algorithms to predict calorie burn during exercise as well as the advantages and disadvantages have been compared. To assist people in establishing and maintaining a healthy lifestyle, precise estimations of calories burned during physical exercise are required due to the rising incidence of obesity and overweight around the world. The literature review provided insights into various machine learning regression models for predicting calories burned, each with advantages and disadvantages in terms of performance, handling of missing data, scaling, and handling of outliers. This work proposed using the LightGBM regression model, which has demonstrated excellent results in handling huge datasets to solve the limitations of earlier studies. The methodology included collecting data from Kaggle, preparing the data to ensure data quality, analyzing the data to learn more about the dataset, choosing a model, and then training the model using the selected machine learning algorithms. The accuracy and efficiency of the models were evaluated using metrics, namely mean absolute error.

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