Domain:Applied data science

Machine learning based vehicle performance analyser

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Abstract

With the increasing population demographics and the dependency of man on motor vehicles as the primary source of transportation, the number of motor vehicles being registered for commercial as well as non-commercial activities on a daily basis is massive and yet continues to increase at an alarming rate. This has a direct and an unambiguous effect on the amount of fossil fuels being utilized globally and its subsequent environmental effects, which is of great concern in the present situation. Several attempts from various research sectors are ongoing in order to overcome this global issue and promising results are expected. This project is one such attempt at identifying the performance of small passenger cars in terms of fuel efficiency and map them with factors affecting it using machine learning techniques. The commencing activity while carrying out any such research activity will be the identification of the problem and all its possible sources. In this case, two potential sources can be identified and they are; the vehicle characteristics and the driver/driving behaviour.

Introduction

Predicting the performance level of cars is an important and interesting problem. The main goal of the current study is to predict the performance of the car to improve certain behavior of the vehicle. This can significantly help to improve the systems fuel consumption and increase the efficiency. The performance analysis of the car based on the engine type, no of engine cylinders, fuel type and horsepower etc.These are the factors on which the health of the car can be predicted. It is an on-going process of obtaining, researching, analyzing and recording the health based on the above three factors. The performance objectives like mileage, dependability, flexibility and cost can be grouped together to play a vital role in prediction engine and engine management system. This approach is the very important step towards understanding the vehicles performance.

Literature Survey

- The primary objective of the research was to develop a model using machine learningtechniques which precisely predicts the fuel efficiency and to propose the optimum drivingstyle and vehicle characteristics to achieve better fuel efficiency.
- A review on the literaturerelated to the research exposed the techniques that could be used to build the modeland the analysis to be carried out to meet the objectives. Machine learning techniques 18like Multiple Linear Regression, Support Vector Machine, Artificial Neural Network andXGBoost was chosen to develop the model.
- Data pre-processing and data transformationlike normalisation was carried out before building the model. Five models were built usingthe machine learning techniques Multiple Linear Regression, Support Vector Machine,Artificial Neural Network and XGBoost.

- The parameter was selected by running GridSearch for few algorithms like SupportVector Machine and XGBoost and for the other algorithms through parametric analysis.
- Throttle position and speed are examined with the predicted fuelefficiency to evaluate their relationship with the fuel consumption. Analysis on mass air flow rate, intake air temperature and other vehicle characteristics with the predicted fuel efficiency is also carried out which gives deeper insight and better recommendations tomitigate fuel consumption.
- One limitation was the hardware resource available becauseof which the GridSearch was unable to run on all algorithms for all parameters. Another limitation was the availability of the data required, although the car manufacturing companies collect all the data related to the car, it is limited.

Reference

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Conclusion

As discussed in section 6 the models developed have promising results in predicting the fuel efficiency with the XGBoost model outperforming all other models by constantly predicting better for all the experiments conducted with different train and test split ratio. The XGBoost model’s performance is low only when there is low fuel efficiency repeatedly but in comparison with other models developed XGBoost model’s performance is exceptional and the values obtained for RMSE, MAE and R2 is also acceptable. Although this model was run on the data collected from small passenger car, the model is not limited only to that class and can be generalised for any vehicle with the driving data and vehicle characteristics available.