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Machine learning based Vehicle Performance Analyzer

Literature Survey.

Team Members:

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1. Machine methods for vehicle predictive maintenance using off-board and on-board data.

Authors: Rune Prytz.

Published Month & Year: September 2014.

Project/paper description:

Vehicle uptime is getting increasingly important as the transport solutions become more complex and the transport industry seeks new ways of being competitive. Traditional Fleet Management Systems are gradually extended with new features to improve reliability, such as better maintenance planning. Typical diagnostic and predictive maintenance methods require extensive experimentation and modelling during development. This is unfeasible if the complete vehicle is addressed as it would require too much engineering resources.

This thesis investigates unsupervised and supervised methods for predicting vehicle maintenance. The methods are data driven and use extensive amounts of data, either streamed, on-board data or historic and aggregated data from off-board databases. The methods rely on a telematics gateway that enables vehicles to communicate with a back-office system. Data representations, either aggregations or models, are sent wirelessly to an off-board system which analyses the data for deviations. These are later associated to the repair history and form a knowledge base that can be used to predict upcoming failures on other vehicles that show the same deviations. The thesis further investigates different ways of doing data representations and deviation detection. The first one presented, COSMO, is an unsupervised and self-organised approach demonstrated on a fleet of city buses. It automatically comes up with the most interesting on-board data representations and uses a consensus-based approach to isolate the deviating vehicle. The second approach outlined is a supervised classification based on earlier collected and aggregated vehicle statistics in which the repair history is used to label the usage statistics. A classifier is trained to learn patterns in the usage data that precede specific repairs and thus can be used to predict vehicle maintenance. This method is demonstrated for failures of the vehicle air compressor and based on AB Volvo's database of vehicle usage statistics.

2. Performance of Motor Vehicle based on Driving and vehicle Data using Machine learning.

Author: Punith Kumar Nagaraje Gowda.

Published Month and Year: December 2019.

Project Details: 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. The relevant data for this analysis was taken from the public source, Kaggle which is the data collected from the OBD of the car and models are built using techniques like Multiple Linear Regression, XGBoost, Support Vector Machine and Artificial Neural Network and their performance is compared to discover the first rate technique in predicting the fuel efficiency and to propose the optimum driving behaviour in terms of throttle position to achieve better fuel efficiency.

The results reveal that XGBoost model outperforms all other models developed in predicting the fuel efficiency for the different split ratios evaluated and comparing the throttle position with the predicted fuel efficiency explains that to achieve better fuel efficiency the throttle position must be around 70 to 80 on a scale of 100, referred to as full throttle position. The knowledge discovered from the research could be used by car manufacturers to design cars in future to mitigate the fuel consumption.

3. Car-Performance-Prediction

Authors: Sudeepa Kolli ; Lohith Viswa .

Published Month and Year: July 2020.

Project Details:

Car Performance Prediction is a project that focuses on improving the present data analysis methods of car performance and service updates.
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.

It is an important to analyse the factors using number of well-known approaches of machine learning algorithms like linear regression, decision tree and random forest to improve the vehicle performance efficiency.The range, durability and longevity of automotive traction batteries are ‘hot topics’ in automotive engineering. And here we consider a performance in mileage. To solve this problem, we will develop the models, using the different algorithms and neural networks. We will then see which algorithm predicts car performance(Mileage) with higher accuracy.

4. Vehicle Acceleration Prediction Based on Machine Learning Models and Driving Behavior Analysis.

Author: Yajie Zou; Lusa Ding; Hao Zhang ; Ting Zhu; Lingtao Wu

Published Month and Year: May 2022 **.**

Project Description:

Driving behaviourD is one of the most critical factors in traffic accidents. Accurate vehicle acceleration prediction approaches can promote the development of Advanced Driving Assistance Systems (ADAS) and improve traffic safety. However, few prediction models consider the characteristics of individual drivers, which may overlook the potential heterogeneity of driving behaviour.

In this study, a vehicle acceleration prediction model based on machine learning methods and driving behaviour analysis is proposed. First, the driving behaviour data are pre-processed, and the relative distance, relative speed, and acceleration of the subject vehicle are selected as feature variables to describe the driving behaviour. Then, a finite Mixture of Hidden Markov Model (MHMM) is used to divide the driving behaviour semantics. The model can divide heterogeneous data into different behavioural semantic fragments within different time lengths. Next, the similarity of different behavioural semantic fragments is evaluated using the Kolmogorov–Smirnov test.

In total, 10 homogenous drivers are classified as the first group, and the remaining 20 drivers are classified as the second group. Long Short-Term Memory (LSTM) and Gate Recurrent Unit (GRU) are used to predict the vehicle acceleration for both groups. The prediction results show that the proposed method in this study can significantly improve the prediction accuracy of vehicle acceleration

5. Machine learning based real-time vehicle data analysis for safe driving modelling

Authors: Pamal Yadav ; Sangsu Jung ; Dhananjay Singh.

Published Month and Year: April 2019.

Project details:

This paper identifies a necessity to evaluate the Meta features of vehicles which could be helpful in improving the vehicle driver's skill to prevent accidents and also evaluate the change in the quality of cars over passing time. This paper does an analysis of the vehicle data using supervised learning based linear regression model that is used as an estimator for Driver's Safety Metrics and Economic Driving Metrics.

The data collected was obtained from fifteen different drivers over a span of one month which accumulated over 15000 data points. And the metrics that we have devised have potential application in automotive technology analysis for developing an advanced intelligent vehicle.

Also, we have presented a system for performing the real-time experiment based on the Onboard-Diagnosis version II (OBD-II) scanner data. Finally, we have analysed and presented the parameter accuracy over 80% for the driver's safety solution in real-world scenario**.**