PREDICTION AND ANALYSIS OF FUEL CONSUMPTION IN HEAVY VEHICLES

B.BHARGAVA RAM, G.NAGA SRI MANJU, CH.RECHAL SRIYA,

G.CHANDRA SEKHAR, Student, Department of CSE, NRI INSTITUTE OF TECHNOLOGY, Vijayawada, A.P., India.

Mr. Y.N.S SATYANARAYANA, Assistant Professor, Department of CSE, NRI INSTITUTE OF TECHNOLOGY, Vijayawada, A.P., India.

ABSTRACT: Machine learning models are beneficial for calculating fuel consumption based on the distance travelled, as opposed to the prior method of measuring fuel consumption based on the time period. This approach is used in conjunction with seven predictors derived from vehicle speed and road grade to produce a highly predictive neural network model for average fuel consumption in heavy vehicles. The number of stops, stops time, average moving speed, characteristic acceleration, aerodynamic speed squared, change in kinetic energy, and change in potential energy are all employed in conjunction with this strategy. It generates a neural network model for average fuel usage in heavy trucks that is highly predictive.

INTRODUCTION

Fuel consumption models for vehicles are of interest to manufacturers, regulators, and consumers. They are needed across all the phases of the vehicle life-cycle. In this paper, we focus on modeling average fuel consumption for heavy vehicles during the operation and maintenance phase. In general, techniques used to develop models for fuel consumption fall under three main categories:

• Physics-based models, which are derived from an in depth understanding of the physical system. These models describe the dynamics of the components of the vehicle at each time step using detailed mathematical equations• Machine learning models, which are data-driven and represent an abstract mapping from an input space consisting of a selected set of predictors to an output space that represents the target output, in this case average fuel consumption. Statistical models, which are also data-driven and establish a mapping between the probability distribution of a selected set of predictors and the target outcome.

Manufacturers, regulators, and customers are all interested in car fuel consumption models. They are required during all stages of the vehicle's life cycle. We will model typical fuel usage for heavy vehicles during operation and maintenance in this project. Physics-based models, Machine learning models, and statistical models are the three primary categories of methodologies used to construct fuel consumption models.

There have been several previous models developed for both instantaneous and average fuel use. Because they can represent the dynamics of the system's activity at multiple time steps, physics-based models are best suited for estimating instantaneous fuel usage.

LITERATURE SURVEY

An Enhanced Fuel Consumption Machine Learning Model in Vehicles:

In the present world, some of the people are not able to pay expenses for petrol/diesel. The model which we are generating will be useful for many people. The system which we are generating is a data summary approach will be based on distance rather than traditional conventional time period when developing personalized machine learning model for fuel consumption. This system is utilized within conjunction with vehicle pace Also seven predictors inferred starting with way review to prepare a neural system model utilizing machine Taking in that predicts Normal fuel utilization done vehicles. The proposed model can be easily developed for each individual vehicle and fitted into one fleet to optimize fuel consumption over entire fleet. The model's predictors are comprehensive on fixed window sizes and on the distance travelled. Different window sizes are evaluated and the results mean that the 1km window can estimate the fuel consumption with a coefficient of 0.91 and it also means less than 4% peak to peak percentage error for routes that include both city and highway duty cycling sections.

Fuel Consumption Prediction Model using Machine Learning:

In the paper, we are enhancing the accuracy of the fuel consumption prediction model with Machine Learning to minimize Fuel Consumption. This will lead to an economic improvement for the business and satisfy the domain needs. We propose a machine learning model to predict vehicle fuel consumption. The proposed model is based on the Support Vector Machine algorithm. The Fuel Consumption estimation is given as a function of Mass Air Flow, Vehicle Speed, Revolutions per Minute, and Throttle Position Sensor features. The proposed model is applied and tested on a vehicle's On-Board Diagnostics Dataset. The observations were conducted on 18 features. Results achieved a higher accuracy with an RSquared metric value of 0.97 than other related work using the same Support Vector Machine regression algorithm. We concluded that the Support Vector Machine has a great effect when used for fuel consumption prediction purposes. Our model can compete with other Machine Learning algorithms for the same purpose which will help manufacturers find more choices for successful Fuel Consumption Prediction models.

A Machine Learning model for Average Fuel Consumption in Heavy Vehicles:

This paper advocates a data summarization approach based on distance rather than the traditional time period when developing individualized machine learning models for fuel consumption. This approach is used in conjunction with seven predictors derived from vehicle speed and road grade to produce a highly predictive neural network model for average fuel consumption in heavy vehicles. The proposed model can easily be developed and deployed for eachindividual vehicle in a fleet in order to optimize fuel consumption over the entire fleet. The predictors of the model are aggregated over fixed window sizes of distance traveled. Different window sizes are evaluated and the results show that a 1 km window is able to predict fuel consumption with a 0.91 coefficient of determination and mean absolute peak-to-peak percent error less than 4% for routes that include both city and highway duty cycle segments.

EXISTING SYSTEM

In existing, approach was also used in and after the predicted fuel rates are translated into fuel consumption, the model is able to predict total fuel consumption with an accuracy of 2% over an entire trip covering a distance of 365 km. However, an analysis of how well point-wise predicted fuel rates in this study track measured fuel rates showed a low coefficient of determination(<0.3). The input and output of the existing models are in the time domain. They were evaluated on fixed window sizes of distance travelled.

Existing model that can be easily developed for individual heavy vehicles in a large fleet is proposed. Relying on accurate models of all of the vehicles in a fleet, a fleet manager can optimize the route planning for all of the vehicles based on each unique vehicle predicted fuel consumption thereby ensuring the route assignments are aligned to minimize overall fleet fuel consumption. This approach is used in conjunction with seven predictors derived from vehicle speed and road grade to produce a highly predictive neural network model for average fuel consumption in heavy vehicles. Different window sizes are evaluated and the results show that a 1 km window is able to predict fuel consumption with a 0.91 coefficient of determination and mean absolute peak-to peak percent error less than 4% for routes that include both city and highway duty cycle segments.

DISADVANTAGES:

It is based on only one parameter (i. e distance travelled).

Less accurate results.

It is distance metric specified model not the generalized model.

Fixed window sizes

PROPOSEDSYSTEM

In this paper proposed system depends on 7 factors to predict the average fuel consumption. Seven factors such as num_stops, time_stopped, average_moving_speed, characteristic_acceleration, aerodynamic_speed_squared, change_in_kinetic_energy, change_in_potential_energy are recorded from each vehicle travel up to 100 kilo meters like number of times vehicles stopped, total stopped time taken etc.. All these values are collected from heavy vehicle and use as dataset to train ANN model.

In this study, the input is aggregated in the time domain over 10 minutes intervals and the output is fuel consumption over the distance traveled during the same time period. The complex system is represented by a transfer function F(p) = o, where F(·) represents the system, p refers to the input predictors and o is the response of the system or the output. The ANNs used in this paper are Feed Forward Neural Networks (FNN). Training is an iterative process and can be performed using multiple approaches including particle swarm optimization and back propagation. Other approaches will be considered in future work in order to evaluation their ability to improve the model's predictive accuracy. Each iteration in the training selects a pair of (input, output) features from Ftr at random and updates the weights in the network. This is done by calculating the error between the actual output value and the value predicted by the model.

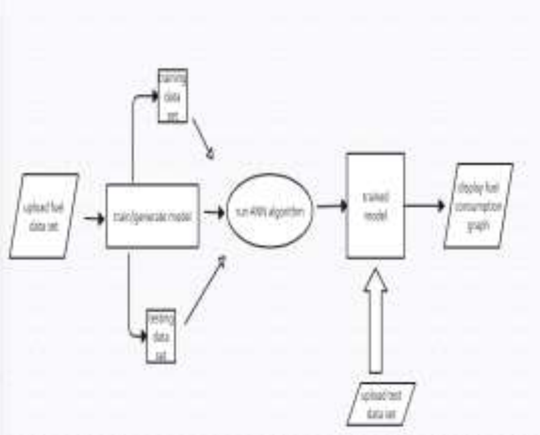
ADVANTAGES:

The output is based on seven factors hence better accurate results are produced.

The predictors in the model are able to capture the impact of both the duty cycle and the environment on the average fuel consumption of the vehicle (e.g., the number of stops in an urban traffic over a given distance).

Generalized on seven factors.

SYSTEM ARCHITECTURE



IMPLEMENTATION

1. Upload Heavy Vehicles Fuel Dataset: Using this module we can upload train dataset to application. Dataset contains comma separated values.

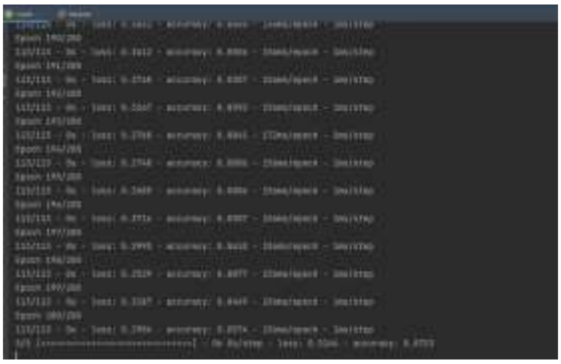
2. Read Dataset & Generate Model: We'll use this module to read a comma-separated dataset and then create a train and test model for an ANN using the values from that dataset. The dataset will be separated into two sections, with 80 percent being used to train the ANN model and 20 percent being used to test it. Run

3. ANN Algorithm: Using this model we can create ANN object and then feed train and test data to build ANN model.

4. Predict Average Fuel Consumption: We will upload new test data to this module, and ANN will apply a train model to that data in order to predict average fuel usage for those test records. 5. Fuel Consumption Graph: Using this module we will plot a fuel consumption graph for each test record

5. display fuel consumption graph: The final predicted output is displayed in the graph.

SAMPLE RESULTS



CONCLUSION

Machine learning model that can be conveniently developed for each heavy vehicle in a fleet. The model relies on seven predictors: number of stops, stop time, average moving speed, characteristic acceleration, aerodynamic speed squared, change in kinetic energy and change in potential energy.

The last two predictors are introduced in this paper to help capture the average dynamic behavior of the vehicle. All of the predictors of the model are derived from vehicle speed and road grade.

These variables are readily available from telemetric devices that are becoming an integral part of connected vehicles. Moreover, the predictors can be easily computed on-board from these two variables.

Future enhancement

Future work also includes investigating the minimum distance required for training each model and analyzing how often does a model need to be synchronized with the physical system in operation by using online training in order to maintain the prediction accuracy of the model.

REFERENCES

[1] A. A. M. S. Medashe Michael Oluwaseyi "Specifications and Analysis of Digitized Diagnostics of Automobiles: A Case Study of on Board Diagnostic (OBD II)," vol. 9, 1 ed: IJERT, 2020.

[2] T. A. Nikolaos Peppes, Evgenia Adamopoulou and Konstantinos Demestichas, "Driving Behaviour Analysis Using Machine and Deep Learning Methods for Continuous Streams of Vehicular Data," vol. 4704, Machine Learning Applied to Sensor Data Analysis end: MDPI: sensors, 2021.

[3] A. K. S. Siddhanta Kumar Singh, and Anand Sharma, "OBD - II based Intelligent Vehicular Diagnostic System using IoT," ed. ISIC'21: International Semantic 53 Intelligence Conference: Mody University of Science and Technology, Lakshmangarh, Sikar, Rajasthan, India, 2021.

[4] M. P. The odoros Evgeniou, "WORKSHOP ON SUPPORT VECTOR MA CHINES: THEORY AND APPLICATIONS," vol. 2049, ed. Conference: Advanced Course on Artificial Intelligence (ACAI 1999) :Machine Learning and Its Applications , Lecture Notes in Computer Science, 2001, pp. 249-257.

[5] M. D. d. L. N. L. da. Costa, R. Barbosa, "Evaluation of feature selection methods based on artificial neural network weights," vol. 168, ed. Expert Systems with Applications (2020), 2020..

[6] Y. Yao, Zhao, X., Liu, C., Rong, J., Zhang, Y., and Z. Dong, & Su, Y., "Vehicle fuel consumption prediction method based on driving behavior data collected from smartphones," vol. 2020, ed. Journal of Advanced Transportation, 2020.

[7] E. Moradi, & Miranda-Moreno, L., "Vehicular fuel consumption estimation using real-world measures through cascaded machine learning modeling. ," vol. 88, ed. Transportation Research Part D: Transport and Environment, 2020.

[8] S. Wickram manayake, & Bandara, H. D., "Fuel consumption prediction of fleet vehicles using machine learning: A comparative study. ," ed. In 2016 Moratuwa Engineering Research Conference (MERCon) IEEE., 2016.

[9] W. Zeng, Miwa, T., & Morikawa, T., "Exploring trip fuel consumption by machine learning from GPS and CAN bus data. ," vol. 11, ed. Journal of the Eastern Asia Society for Transportation Studies, 2015, pp. 906-921. 54

[10] F. Perrotta, Parry, T., Neves, L. C., & and M. Mesgarpour, "A machine learning approach for the estimation of fuel consumption related to road pavement rolling resistance for large fleets of trucks.," ed. The Sixth International Symposium on Life Cycle Civil Engineering (IALCCE 2018), 2018.

[11] F. Perrotta, Parry, T., & Neves, L. C., "Application of machine learning for fuel consumption modelling of trucks.," ed. In 2017 IEEE International Conference on Big Data (Big Data) IEEE, 2017, pp. 3810- 3815.