LITERATURE SURVEY

1. A Survey of Deep Learning Applications to Autonomous Vehicle Control [Sajjad Mozaffari, Omar Y. Al-Jarrah, Mehrdad Dianati, Paul Jennings, and Alexandros Mouzakitis 23 Dec 2019].

Designing a controller for autonomous vehicles capable of providing adequate performance in all driving scenarios is challenging due to the highly complex environment and inability to test the system in the wide variety of scenarios which it may encounter after deployment. However, deep learning methods have shown great promise in not only providing excellent performance for complex and non-linear control problems, but also in generalising previously learned rules to new scenarios. For these reasons, the use of deep learning for vehiclecontrol is becoming increasingly popular. Although important advancements have been achieved in this field, these works have not been fully summarised. This paper surveys a wide range of research works reported in the literature which aim to control a vehicle through deep learning methods. Although there exists overlap between control and perception, the focus of this paper is on vehicle control, rather than the wider perception problem which includes tasks such as semantic segmentation and object detection. The paper identifies the strengths and limitations of available deep learning methods through comparative analysis and discusses the research challenges in terms of computation, architecture selection, goal specification, generalisation, verification and validation, as well as safety. Overall, this survey brings timely and topical information to a rapidly evolving field relevant to intelligent transportation systems.

2. Yadav, P., Jung, S. and Singh, D., 2019, April. Machine learning based real-time vehicle data analysis for safe driving modeling. In *Proceedings of the 34th ACM/SIGAPP symposium on applied computing*.

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**.**

3. Mozaffari, S., Al-Jarrah, O.Y., Dianati, M., Jennings, P. and Mouzakitis, A., 2020. Deep learning-based vehicle behavior prediction for autonomous driving applications: A review. ***IEEE Transactions on Intelligent Transportation Systems*****.**

In this paper, the behaviour prediction function of an autonomous vehicle predicts the future states of the nearby vehicles based on the current and past observations of the surrounding environment are used. This helps enhance their awareness of the imminent hazards. However, conventional behaviour prediction solutions are applicable in simple driving scenarios that require short prediction horizons. Most recently, deep learning-based approaches have become popular due to their promising performance in more complex environments compared to the conventional approaches. Motivated by this increased popularity, they provide a comprehensive review of the state-of-the-art of deep learning based approaches for vehicle behaviour prediction in this paper. they firstly give an overview of the generic problem of vehicle behaviour prediction and discuss its challenges, followed by classification and review of the most recent deep learning based solutions based on three criteria: input representation, output type, and prediction method. The paper also discusses the performance of several well-known solutions, identifies the research gaps in the literature and outlines potential new research directions.

4. Gowda, P.K.N., Performance of Motor Vehicle based on Driving and Vehicle Data using Machine Learning (2019).

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.

5. Kunanoppadol, J., 2013. The Concept to Measure the Overall Car Performance. ***Journal of Science and Technology MSU, 34,*** **pp.24-29.**

The overall car performance investigating on-road experiments is necessary for research and development in automotive engineering is focused. Car acceleration capability is a final result depending on engine performance, transmission system design, suspension optimization, shape and dimension, aerodynamic, friction reduction technology, driving skill, and other factors. The purpose of this research is to present the concept to measure the overall car performance from acceleration capacity. They found that this concept is possible and convenient because we can collect digital input signals from an existing electronic control unit and transfer it to additional processor to analyze and display the final result in every mobile display, such as laptop, tablet, and smart phone.