

A DRIVING DECISION STRATEGY (DDS) BASED ON MACHINE LEARNING FOR AN AUTONOMOUS VEHICLE

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ABSTRACT

A current autonomous vehicle determines its driving strategy by considering only external factors (Pedestrians, road conditions, etc.) without considering the interior condition of the vehicle. To solve the problem, this paper proposes "A Driving Decision Strategy(DDS) Based on Machine learning for an autonomous vehicle" which determines the optimal strategy of an autonomous vehicle by analyzing not only the external factors, but also the internal factors of the vehicle (consumable conditions, RPM levels etc.). The DDS learns a genetic algorithm using sensor data from vehicles stored in the cloud and determines the optimal driving strategy of an autonomous vehicle. This paper compared the DDS with MLP and RF neural network models to validate the DDS. In the experiment, the DDS had a loss rate approximately 5% lower than existing vehicle gateways and the DDS determined RPM, speed, steering angle and lane changes 40% faster than the MLP and 22% faster than the RF..

1 INTRODUCTION

However, as the performance of self-driving cars improves, the number of sensors to recognize data is increasing. An increase in these sensors can cause the in- vehicle overload. Self-driving cars use in-vehicle computers to compute data collected by sensors. As the amount of the computed data increases, it can affect the speed of judgment and control because of overload. These problems can threaten the stability of the vehicle. To prevent the overload, some studies have developed hardware that can perform deep- running operations inside the vehicle, while others use the cloud to compute the vehicle's sensor data. On the other hand, collected from vehicles to determine how the vehicle is driving. This paper proposes a Driving Decision Strategy(DDS) Based on Machine learning for an autonomous vehicle which reduces the in-vehicle computation by generating big data on vehicle driving within the cloud and determines an optimal driving strategy by taking into account the historical data in the cloud. The proposed DDS analyzes them to determine the best driving strategy by using a Genetic algorithm stored in the Cloud

1.1 MOTIVATION

Currently, global companies are developing technologies for advanced self-driving cars, which is in the 4th stage. Self driving cars are being developed based on various ICT technologies, and the principle of operation can be classified into three levels of recognition, judgment and control. The recognition step is to recognize and collect information about surrounding situations by utilizing various sensors in vehicles such as GPS, camera, and radar. The judgment step determines the driving strategy based on the recognized information. Then, this step identifies and analyzes the conditions in which the vehicle is placed, and determines the driving plans appropriate to the driving environment and the objectives. The control step determines the speed, direction, etc. about the driving and the vehicle starts driving on its own. An autonomous driving vehicle performs various actions to arrive at its destination, repeating the steps of recognition, judgment and control on its own.

1.2 OBJECTIVES

The DDS learns a genetic algorithm using sensor data from vehicles stored in the cloud and determines the optimal driving strategy of an autonomous vehicle. This paper compared the DDS with MLP and RF neural network models to validate the DDS. In the experiment, the DDS had a loss rate approximately 5% lower than existing vehicle gateways and the DDS determined RPM, speed, steering angle and lane changes 40% faster than the MLP and 22% faster than the RF.

2. LITERATURE SURVEY AND RELATED WORK

Y.N. Jeong, S.R.Son, E.H. Jeong and B.K. Lee, "An Integrated Self- Diagnosis System for an Autonomous Vehicle Based on an IoT Gateway and Deep Learning," *Applied Sciences*, vol. 8, no. 7, July 2018

This paper proposes "An Integrated Self-diagnosis System (ISS) for an Autonomous Vehicle based on an Internet of Things (IoT) Gateway and Deep Learning" that collects information from the sensors of an autonomous vehicle, diagnoses itself, and the influence between its parts by using Deep Learning and informs the driver of the result. The ISS consists of three modules. The first In-Vehicle Gateway Module (In-VGM) collects the data from the in-vehicle sensors, consisting of media data like a black box, driving radar, and the control messages of the vehicle, and transfers each of the data collected through each Controller Area Network (CAN), FlexRay, and Media Oriented Systems Transport (MOST) protocols to the on-board diagnostics (OBD) or the actuators. The data collected from the in-vehicle sensors is transferred to the CAN or FlexRay protocol and the media data collected while driving is transferred to the MOST protocol. Various types of messages transferred are transformed into a destination protocol message type. The second Optimized Deep Learning Module (ODLM) creates the Training Dataset on the basis of the data collected from the in-vehicle sensors and reasons the risk of the vehicle parts and consumables and the risk of the other parts influenced by a defective part. It diagnoses the vehicle's total condition risk. The third Data Processing Module (DPM) is based on Edge Computing and has an Edge Computing based Self-diagnosis Service (ECSS) to improve the self-diagnosis speed and reduce the system overhead, while a V2X based Accident Notification Service (VANS) informs the adjacent vehicles and infrastructures of the self-diagnosis result analyzed by the OBD. This paper improves upon the simultaneous message transmission efficiency through the In-VGM by 15.25% and diminishes the learning error rate of a Neural Network algorithm through the ODLM by about 5.5%. Therefore, in addition, by transferring the self-diagnosis information and by managing the time to replace the car parts of an autonomous driving vehicle safely, this reduces loss of life and overall cost.

Yukiko Kenmochi, Lilian Buzer, Akihiro Sugimoto, Ikuko Shimizu, "Discrete plane segmentation and estimation from a point cloud using local geometric patterns," *International Journal of Automation and Computing*, Vol. 5, No. 3, pp.246-256, 2008.

This paper presents a method for segmenting a 3D point cloud into planar surfaces using recently obtained discrete-geometry results. In discrete geometry, a discrete plane is defined as a set of grid points lying between two parallel planes with a small distance, called thickness. In contrast to the continuous case, there exist a finite number of local geometric patterns (LGPs) appearing on discrete planes. Moreover, such an LGP does not possess the unique normal vector but a set of normal vectors. By using those LGP properties, we first reject non-linear points from a point cloud, and then classify non-rejected points whose LGPs have common normal vectors into a planar-surface-point set. From each segmented point set, we also estimate the values of parameters of a discrete plane by minimizing its thickness.

Ning Ye, Yingya Zhang, Ruchuan Wang, Reza Malekian, "Vehicle trajectory prediction based on Hidden Markov Model," *The KSII Transactions on Internet and Information Systems*, Vol. 10, No. 7, 2017.

In Intelligent Transportation Systems (ITS), logistics distribution and mobile e-commerce, the real-time, accurate and reliable vehicle trajectory prediction has significant application value. Vehicle trajectory prediction can not only provide accurate location-based services, but also can monitor and predict traffic situation in advance, and then further recommend the optimal route for users. In this paper, firstly, we mine the double layers of hidden states of vehicle historical trajectories, and then determine the parameters of HMM (hidden Markov model) by historical data. Secondly, we adopt Viterbi algorithm to seek the double layers hidden states sequences corresponding to the just driven trajectory. Finally, we propose a new algorithm (DHMTTP) for vehicle trajectory prediction based on the hidden Markov model of double layers hidden states, and predict the nearest neighbor unit of location information of the next k stages. The experimental results demonstrate that the prediction accuracy of the proposed algorithm is increased by 18.3% compared with TPMP algorithm and increased by 23.1% compared with Naive algorithm in aspect of predicting the next k phases' trajectories, especially when traffic flow is greater, such as this time from weekday morning to evening. Moreover, the time performance of DHMTTP algorithm is also clearly improved compared with TPMP algorithm.

3 EXISTING SYSTEM

k-NN, RF, SVM and Bayes models are existing methods. Although studies have been done in the medical field with an advanced data exploration using machine learning algorithms, orthopedic disease prediction is still a relatively new area and must be explored further for the accurate prevention and cure. It mines the double layers of hidden states of vehicle historical trajectories, and then selects the parameters of Hidden Markov Model (HMM) by the historical data. In addition, it uses a Viterbi algorithm to find the double layers hidden states sequences corresponding to the just driven trajectory. Finally, it proposes a new algorithm for vehicle trajectory prediction based on the hidden Markov model of double layers hidden states, and predicts the nearest neighbor unit of location information of the next k stages.

Drawbacks

1. less efficiency and need more are to explored for prevention

4 PROPOSED WORK AND ALGORITHM

Here we propose "A Driving Decision Strategy (DDS) Based on Machine learning for an autonomous vehicle" which determines the optimal strategy of an autonomous vehicle by analyzing not only the external factors, but also the internal factors of the vehicle (consumable conditions, RPM levels etc.). The DDS learns a genetic algorithm using sensor data from vehicles stored in the cloud and determines the optimal driving strategy of an autonomous vehicle. This paper compared the DDS with MLP and RF neural network models to validate the DDS. In the experiment, the DDS had a loss rate approximately 5% lower than existing vehicle gateways and the DDS determined RPM, speed, steering angle and lane changes 40% faster than the MLP and 22% faster than the RF.

Advantages

1. These improvements system to control the vehicle based on sensor data

5 METHODOLOGIES

MODULES

ABOUT TECHNOLOGY

Below are some facts about Python.

Python is currently the most widely used multi-purpose, high-level programming language.

Python allows programming in Object-Oriented and Procedural paradigms. Python programs generally are smaller than other programming languages like Java.

Programmers have to type relatively less and indentation requirement of the language, makes them readable all the time.

Python language is being used by almost all tech-giant companies like – Google, Amazon, Facebook, Instagram, Dropbox, Uber... etc.

The biggest strength of Python is huge collection of standard library which can be used for the following –

- Machine Learning
- GUI Applications (like Kivy, Tkinter, PyQt etc.)
- Web frameworks like Django (used by YouTube, Instagram, Dropbox)
- Image processing (like OpenCV, Pillow)
- Web scraping (like Scrapy, BeautifulSoup, Selenium)
- Test frameworks
- Multimedia

6 RESULTS AND DISCUSSION

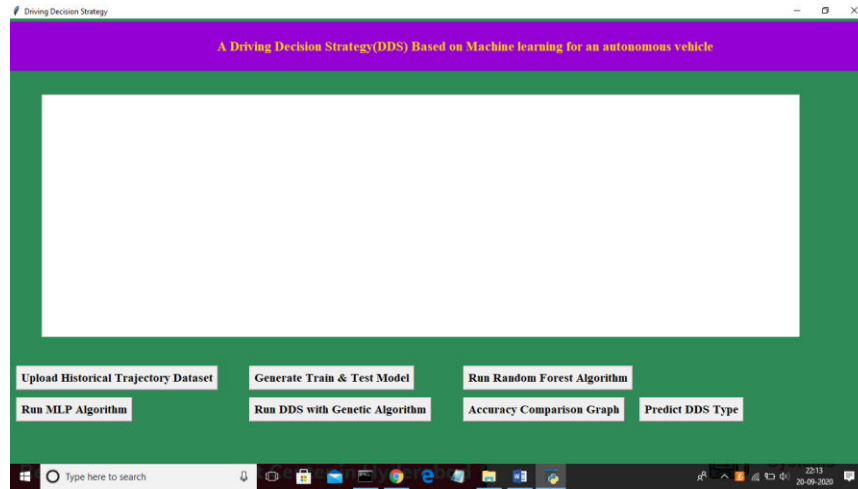


FIG 1: In above screen click on ‘Upload Historical Trajectory Dataset’ button and upload dataset

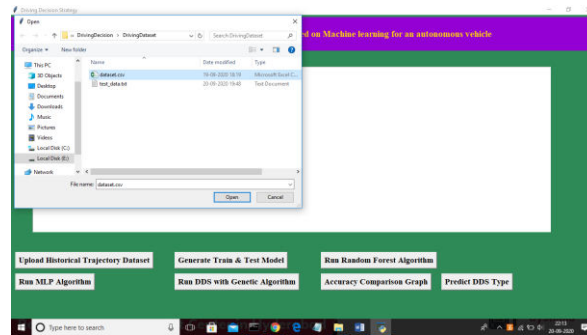


FIG 2: Now select ‘dataset.csv’ file and click on ‘Open’ button to load dataset and to get below screen

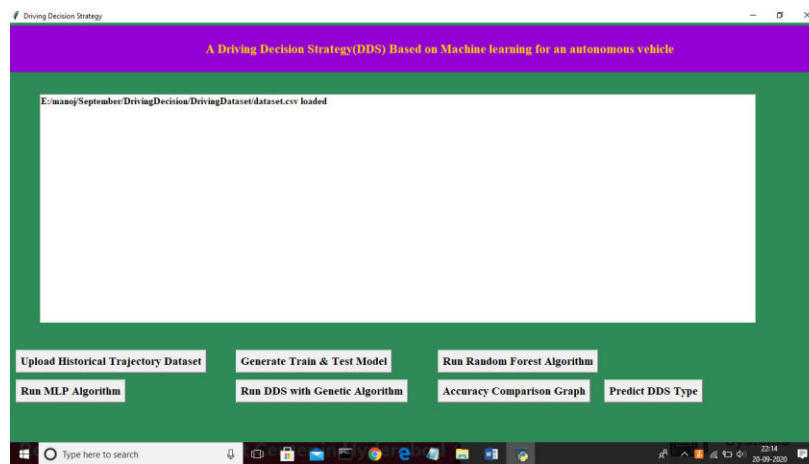


FIG 3 In above screen dataset is loaded and now click on ‘Generate Train & Test Model’ button to read dataset and to split dataset into train and test part to generate machine learning train

model

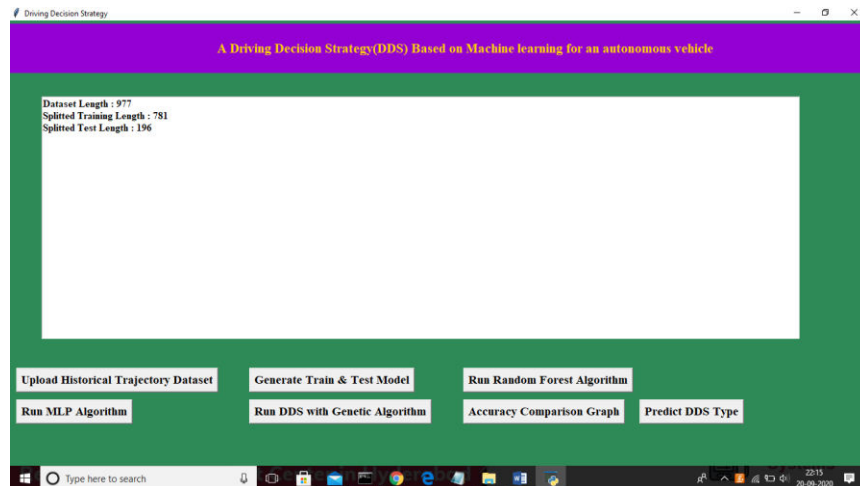


FIG 4 In above screen dataset contains 977 total trajectory records and application using 781 (80% of dataset) records for training and 196 (20% of dataset) for testing. Now both training and testing data is ready and now click on ‘Run Random Forest Algorithm’ button to train random forest classifier and to calculate its prediction accuracy on 20% test data

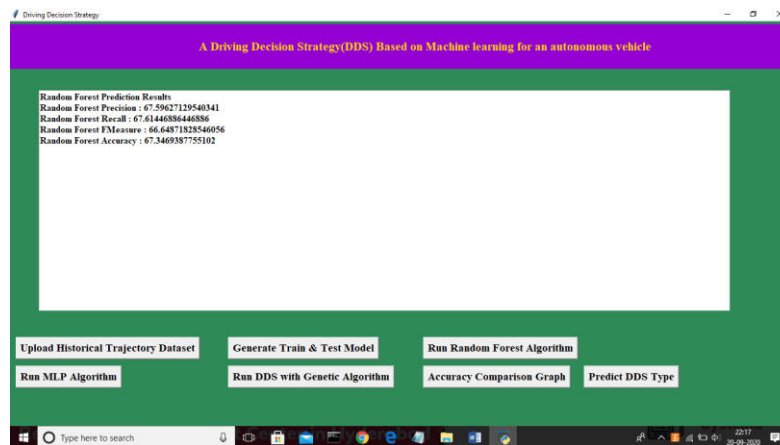


FIG 5 In above screen we calculated random forest accuracy, precision, recall and fmeasure and random forest got 67% prediction accuracy. Now click on ‘Run MLP Algorithm’ button to train MLP model and to calculate its accuracy

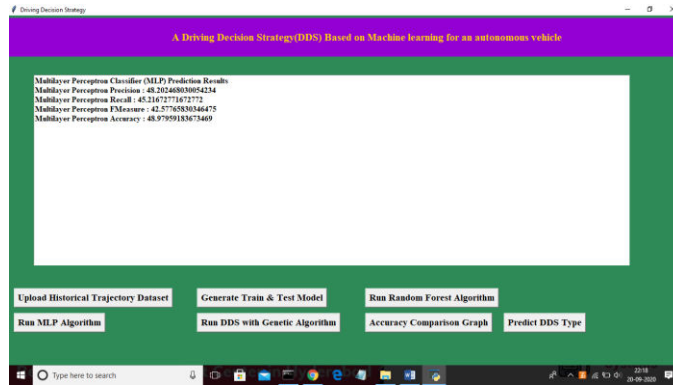


FIG 6 In above screen MLP got 48% prediction accuracy and in below screen we can see genetic algorithm code used for building propose DDS algorithm

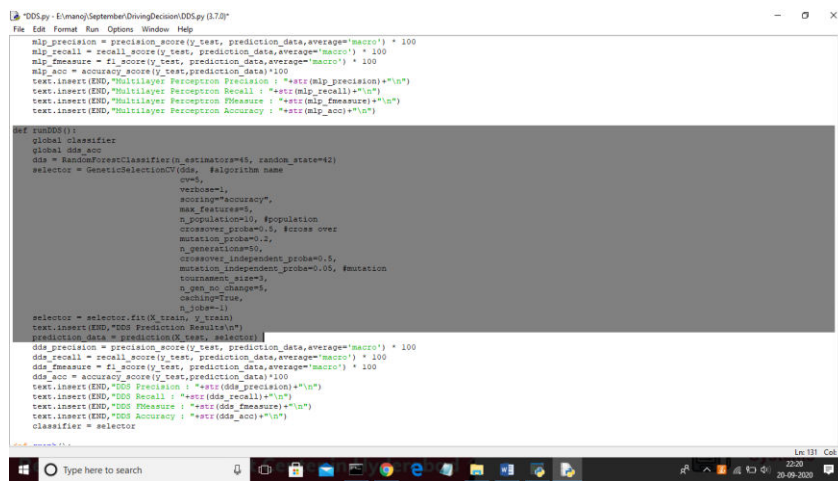


FIG 7 In above screen we can see genetic algorithm code used in DDS algorithm and now click on ‘Run DDS with Genetic Algorithm’ button to train DDS and to calculate its prediction accuracy

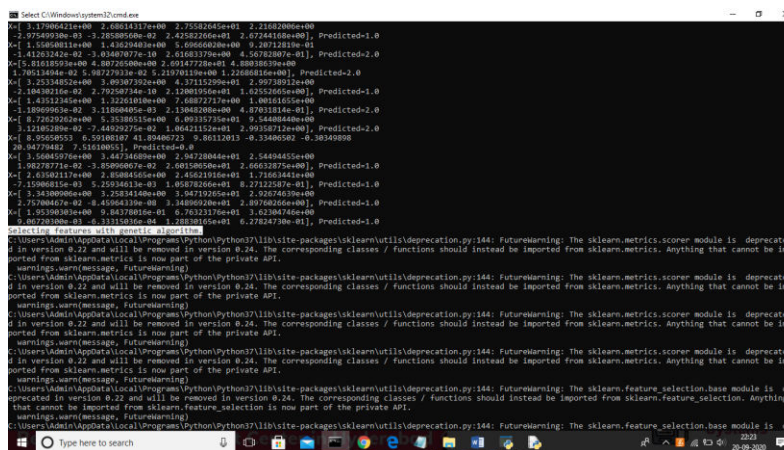


FIG 8 In above black console genetic algorithm starts optimal feature selection

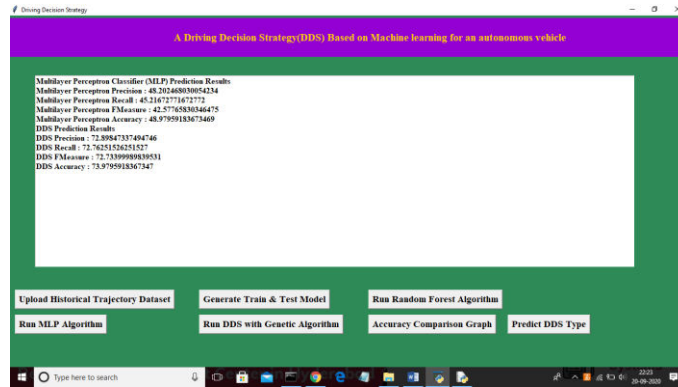


FIG 9: In above screen propose DDS algorithm got 73% prediction accuracy and now click on 'Accuracy Comparison Graph' button to get below graph

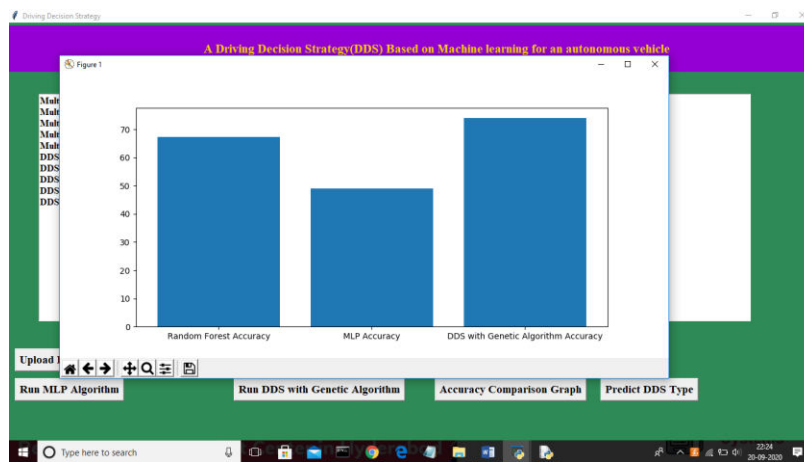


FIG 10 In above graph x-axis represents algorithm name and y-axis represents accuracy of those algorithms and from above graph we can conclude that DDS is performing well compare to other two algorithms. Now click on 'Predict DDS Type' button to predict test data

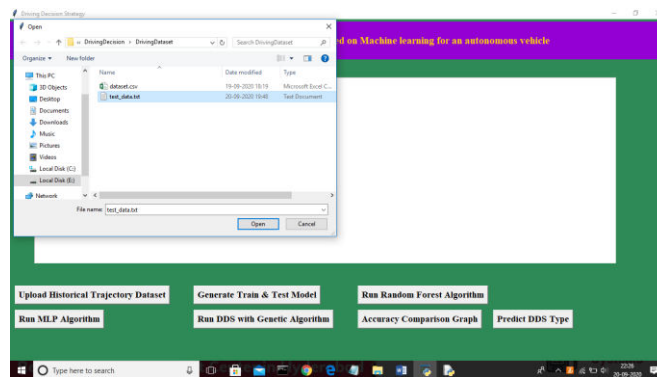


FIG 11 In above screen uploading 'test_data.txt' file and click on 'Open' button to predict driving decision

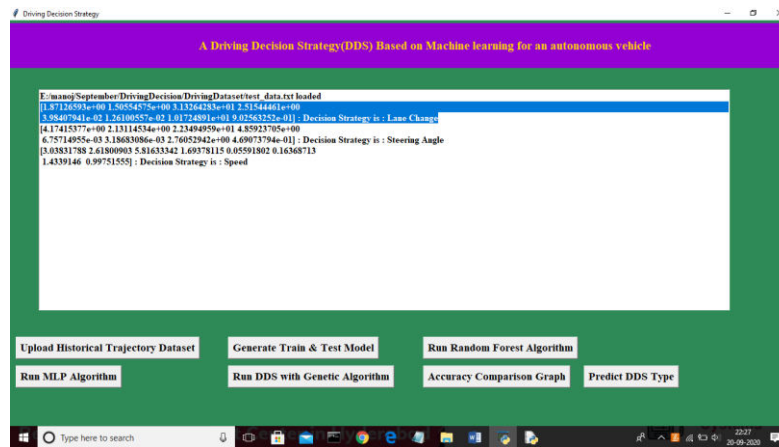


FIG 12 In above screen in selected first record we can see decision is Lane Change and for second record values we got decision as ‘steering angle’ and for third test record we got predicted value as vehicle is in speed mode.

7.CONCLUSION AND FUTURE SCOPE

This paper proposed a Driving Decision Strategy. It executes the genetic algorithm based on accumulated data to determine the vehicle's optimal driving strategy according to the slope and curvature of the road in which the vehicle is driving and visualizes the driving and consumables conditions of an autonomous vehicle to provide drivers. To verify the validity of the DDS, experiments were conducted on the DDS to select an optimal driving strategy by analyzing data from an autonomous vehicle. Though the DDS has a similar accuracy to the MLP, it determines the optimal driving strategy 40% faster than it. And the DDS has a higher accuracy of 22% than RF and determines the optimal driving strategy 20% faster than it. Thus, the DDS is best suited for determining the optimal driving strategy that requires accuracy and real-time. Because the DDS sends only the key data needed to determine the vehicle's optimal driving strategy to the cloud and analyzes the data through the genetic algorithm, it determines its optimal driving strategy at a faster rate than existing methods. However, the experiments of the DDS were conducted in virtual environments using PCs, and there were not enough resources for visualization.

FUTURE SCOPE

Future studies should test the DDS by applying it to actual vehicles, and enhance the completeness of visualization components through professional designers. Enhancing the accuracy and efficiency of the driving decision strategy by using more advanced machine learning techniques and algorithms. Expanding the scope of the driving decision strategy to include more factors, such as traffic conditions, weather conditions, driver preferences, and vehicle health.

8 REFERENCES

- [1] Y.N. Jeong, S.R.Son, E.H. Jeong and B.K. Lee, "An Integrated Self- Diagnosis System for an Autonomous Vehicle Based on an IoT Gateway and Deep Learning," Applied Sciences, vol. 8, no. 7, July 2018.
- [2] Yukiko Kenmochi, Lilian Buzer, Akihiro Sugimoto, Ikuko Shimizu, "Discrete plane segmentation and estimation from a point cloud using local geometric patterns," International Journal of Automation and Computing, Vol. 5, No. 3, pp.246-256,

2008.

[3] Ning Ye, Yingya Zhang, Ruchuan Wang, Reza Malekian, "Vehicle trajectory prediction based on Hidden Markov Model," The KSII Transactions on Internet and Information Systems, Vol. 10, No. 7, 2017.

[4] Li-Jie Zhao, Tian-You Chai, De-Cheng Yuan, "Selective ensemble extreme learning machine modeling of effluent quality in wastewater treatment plants," International Journal of Automation and Computing, Vol.9, No.6, 2012